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Upper Rio Grande Basin Water Operations Review and EIS
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Key Words: Abiquiu Reservoir, Abiquiu Dam, water quality, dissolved oxygen

Completed By (Name): Sarah Goldman; SWCA Albuquerque **Date:** 23 June 2004

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Comments/Summary:

DRAFT FINDING OF NO SIGNIFICANT IMPACT

ABIQUIU DAM AND RESERVOIR

SECTION 1135 ABIQUIU DAM OXYGENATOR

An air injection oxygenation system is planned for installation at Abiquiu Dam and Reservoir to provide adequate levels of dissolved oxygen (DO) in the waters of the Chama River downstream of the facility. This action will help maintain a dissolved oxygen level of 6 parts per million (ppm), the State standard for a coldwater (i.e., trout) fishery, the designated use for the Rio Chama below Abiquiu Dam. The Incorporated County of Los Alamos, owners and operators of an electrical generating plant located below the dam, will sponsor the project.

The planned action will consist of installing two positive-displacement rotary-lobe blowers, each driven by a three-phase motor of approximately 40 horsepower. Electric controls for the motors would be activated by DO sensing equipment with a probe mounted in a shaft extending into the river just downstream of the turbines. Each blower would operate to produce airflow of up to approximately 400 cubic feet per minute (cfm) at about 8 to 10 pounds per square inch (psi) above atmospheric pressure. Air produced by the blowers would be injected into the low-pressure outflow from the turbines through an oxygen injection ring installed around the circumference of each turbine's draft tube. One or both blowers would automatically be activated as necessary to keep DO levels in the power plant outflow in the range of approximately 6.4 to 7.1 ppm at flows between 200 and 600 cfs. This approximates the normal release range for the dam during the period when DO levels are a problem. Installation of the oxygen injection system can be accomplished without major modifications to the existing conduit because it was initially designed and built to incorporate an air injection system.

A detailed description of project features and the associated environmental and cultural setting is described in the Environmental Assessment (EA). No potential for adverse environmental effects was identified in the EA.

The planned action would help maintain DO levels at appropriate levels without significant effects on biological, cultural, social, economic, or other environmental values of the project and the surrounding area. The action has been fully coordinated under the National Environmental Policy Act, Endangered Species Act, and other pertinent laws and Executive Orders. The Fish and Wildlife Coordination Act is not applicable, because no water bodies are modified by the project. No federally listed endangered or threatened species would be adversely affected, nor would any cultural resources. Compliance under Sections 404 and 401 of the Clean Water Act is not required by this action.

The evaluation of potential project effects contained in the EA indicates the planned action by the Corps to install an air injection oxygenation system at Abiquiu Dam and Reservoir will not have any significant adverse effects on the environment. Therefore, the preparation of an Environmental Impact Statement will not be necessary for this action.

_____ _____

DATE Raymond G. Midkiff

Lieutenant Colonel, EN

District Engineer

Planning, Programs, and Project
Management Division

County of Los Alamos New Mexico
Utilities Electric Production
2300 Trinity Drive
Los Alamos County, New Mexico 87544

Dear Mr. Biggs,

The U.S. Army Corps of Engineers (Corps), Albuquerque District, has prepared for your review the "Draft" Environmental Assessment (EA) and "Draft" Finding of No Significant Impact (FONSI) entitled SECTION 1135 Abiquiu Dam Oxygenator Project, Abiquiu Dam and Reservoir, Rio Arriba County, New Mexico. The Corps is sending copies of the draft EA and FONSI, and soliciting comments from those who may have a direct interest in the project (the mailing list is attached for your information). Each addressee may distribute copies of the draft EA and draft FONSI as they deem necessary. Please review the draft EA and Draft FONSI and provide written comments directly to:

Mr. Eric Fino
U.S. Army Corps of Engineers
Attn: CESPA-PM-C
4101 Jefferson Plaza, NE
Albuquerque, New Mexico 87109-3435

Written comments should be submitted **no later than February 7, 2001**, so that we may make revisions, if necessary, and complete National Environmental Policy Act compliance. Copies of the draft EA may be requested from Mr. Fino at (505) 342-3480. If you have any questions or need additional information please contact me at (505) 342-3351.

Sincerely,

James A. White,
Chief, Civil Works Program and Project Management Branch

Draft EA and FONSI – Mailing List

Tom Biggs
Utilities Electricity Production
County of Los Alamos New Mexico
2300 Trinity Drive
Los Alamos County, New Mexico 87544

Federal Agencies:

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Fish and Wildlife Service
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Mr. Tod Stevenson, Chief
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Villagra Building
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Santa Fe, New Mexico 87504

Planning, Programs, and Project
Management Division

US Department of Interior
Fish and Wildlife Service
Field Supervisor
2105 Osuna Road, Northeast
Albuquerque, New Mexico 87113

Dear Ms. Nicholopoulos,

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James A. White,
Chief, Civil Works Program and Project Management Branch

Planning, Programs, and Project
Management Division

Conservation Services Division
New Mexico Department of Game and Fish
Villagra Building
P.O. Box 25112
Santa Fe, New Mexico 87504

Dear Mr. Tod Stevenson,

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Sincerely,

James A. White,
Chief, Civil Works Program and Project Management Branch

DRAFT
ENVIRONMENTAL ASSESSMENT
AND
FINDING OF NO SIGNIFICANT IMPACT

SECTION 1135
ABIQUIU DAM OXYGENATOR
FOR
ABIQUIU DAM AND RESERVOIR
RIO ARRIBA COUNTY, NEW MEXICO

PREPARED FOR

U.S. ARMY CORPS OF ENGINEERS
ALBUQUERQUE DISTRICT
AND
LOS ALAMOS COUNTY, NEW MEXICO

SUBMITTED BY

U.S. ARMY CORPS OF ENGINEERS
ALBUQUERQUE DISTRICT
ALBUQUERQUE, NEW MEXICO

January 6, 2001

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1. INTRODUCTION 1. INTRODUCTION

1.1 BACKGROUND 1.1 BACKGROUND

The environmental study and subsequent construction for this proposed restoration project is authorized and funded under Section 1135 of the Water Resources Development Act of 1986, as amended. Section 1135 authorizes the Secretary of the Army, acting through the Chief of Engineers, to modify existing Corps projects to restore the environment or construct new projects to restore areas degraded by Corps projects. The objective of Section 1135 projects is the improvement of degraded ecosystem structure, function, and dynamic processes to a less degraded, more natural condition.

Abiquiu Dam and Reservoir are located on the Rio Chama about 32 river miles upstream from its confluence with the Rio Grande, near the city of Española, New Mexico. It is located approximately seven miles northwest of the village of Abiquiu, 30 miles northwest of Española, 60 miles northwest of Santa Fe, and 110 miles north of Albuquerque. Abiquiu Dam and Reservoir are in Rio Arriba County and can be reached via U.S. Highway 84. New Mexico State Highway 96 leads to the project and crosses the dam (Figure 1).

Abiquiu Dam and Reservoir function for flood control, sediment retention, water supply, and recreation. Abiquiu Reservoir is one element of a comprehensive system of flood control features providing flood protection for the Rio Grande and its tributaries in New Mexico. It is also one of the facilities that collectively manage the water resources of New Mexico for irrigation, municipal water supply, recreation, and fish and wildlife conservation. Abiquiu Dam was authorized for construction by the Flood Control Act of 1948, approved June 30, 1948 (Public Law No. 858, 80th Congress, Chapter 771, 2nd Session) and the Flood Control Act of 1950, approved May 17, 1950 (Public Law No. 516, 81st Congress, Chapter 188, 2nd Session). Abiquiu Dam and Reservoir is specifically authorized for flood control and sediment retention. The establishment of a conservation pool of about 200,000 acre-foot (af) in 1983 created a 4,100 surface-acre lake, incidentally expanding and improving the lake fishery and recreational opportunities.

Construction of Abiquiu Dam was initiated in 1956 and the project was completed and placed into operation in 1963 by the U.S. Army Corps of Engineers at a total cost of $21,275,000 (1963 prices). The dam is a rolled earth-fill structure with a crest length of 1,800 feet, a crest width of 30 feet, and a bottom width of 2,000 feet. The top of the dam is at elevation 6,381 feet and approximately 341 feet above the streambed. The outlet works are located at the base of the embankment, within the left (north) abutment. The outlet works consist of an intake structure, 12-foot diameter tunnel (conduit) upstream of the bifurcated gate chamber, two service gates, and a terminal flip bucket. The 2,260-foot-long conduit (at invert elevation of 6060 feet) has a maximum release capacity of 8,200 cubic feet per second (cfs) at maximum pool level. The uncontrolled spillway is located about 4,000 feet north of the dam's left abutment. It is about 2,600 feet long, 68 feet wide at the bottom, and has a maximum depth of about 42 feet. Spillway crest elevation is 6,350 feet. The maximum reservoir pool is at elevation 6,374.7 feet, with the top of the flood control pool at 6283.5 feet (USACE 1995).

The Incorporated County of Los Alamos, New Mexico owns and operates a hydroelectric power facility below Abiquiu Dam. The plant consists of an outlet steel liner, closure gate, penstock, powerhouse, tailrace, switchyard, and transmission line. The powerhouse structure contains two turbine-generators and related equipment. Each generator is rated at 6.3 megawatts and will pass up to 610 cfs. In addition, two 54-inch fixed cone bypass valves and one 14-inch jet flow bypass valve are located in the powerhouse with total bypass capacity of 2,500 cfs. During normal operation all water released from Abiquiu Dam passes through the hydropower plant. The County has no authority for dam releases specifically for power generation and, therefore, is a run-of-the-river facility. The construction

of the facilities occurred from 1987 to 1990.

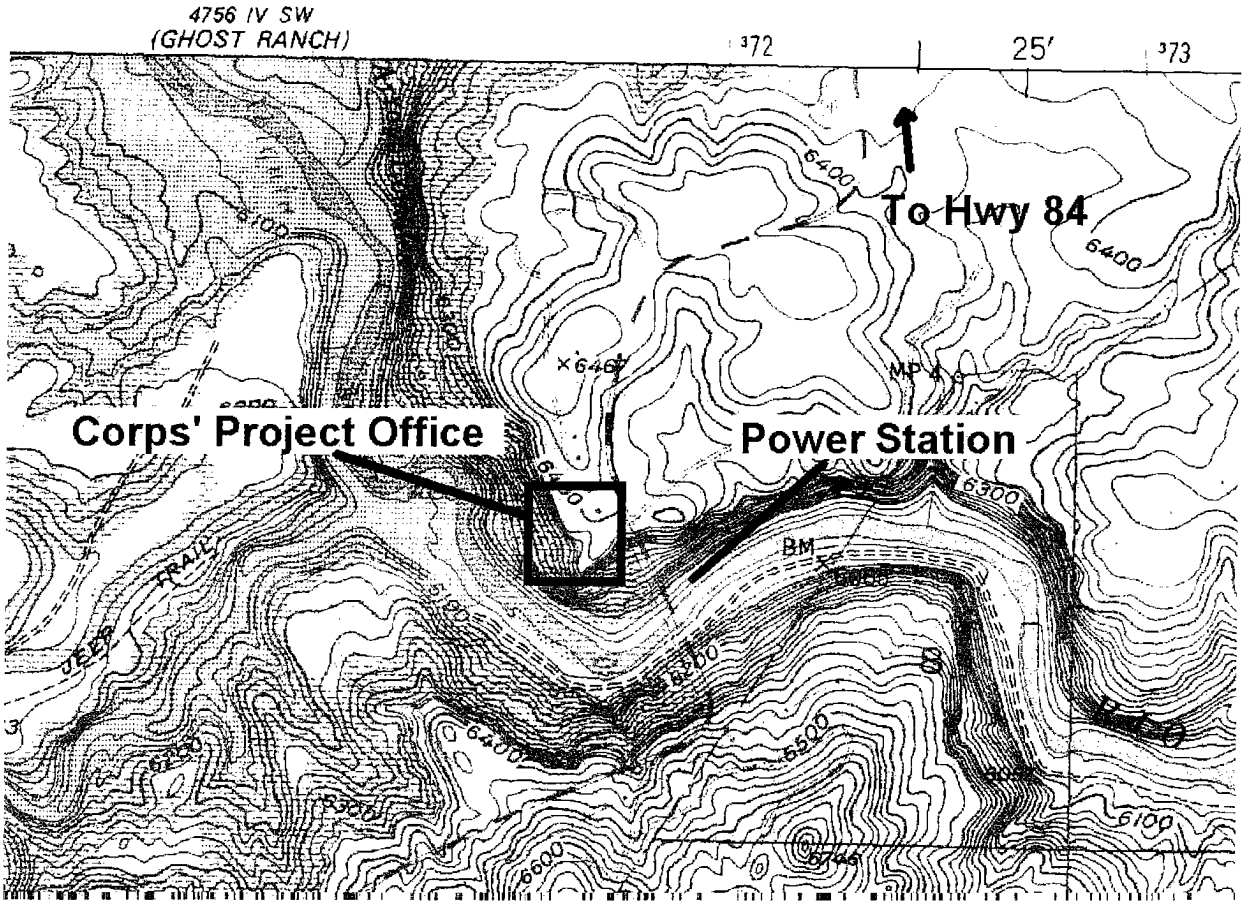

Figure 1: Cañones, NM USGS 7.5' Quad Showing Project Location

1.2 PURPOSE AND NEED 1.2 PURPOSE AND NEED

A dissolved oxygen (DO) level of 6 parts per million (ppm) is the State standard for a coldwater (i.e., trout) fishery, which is a designated use for the Rio Chama below Abiquiu Dam. During the summer and early fall (roughly from late July through early October), Abiquiu Reservoir, which is impounded by the dam, normally is stratified. At times DO levels below the thermocline, where the conduit intake is located, do not exceed 3 ppm. The chief cause of these problems is depletion of oxygen in the hypolimnion of Abiquiu Reservoir during these months. This is a widespread and well-known phenomenon, which comes about due to the death of phytoplankton and other small organisms that settle in the hypolimnion and, through bacterial decomposition, cause oxygen depletion. Very low readings (2-4 ppm) have been noted to occur in periods following thunderstorms and high runoff, so it is suspected that organic input resulting in high Biological Oxygen Demand (BOD) may be a significant causal factor. More frequently, DO levels in the reservoir's hypolimnion and downstream of the dam fall to the 4-6 ppm range, with the lowest readings typically occurring in August and September. As the air temperature drops and the lake turns over, DO levels in the lower depths rise and soon attain the standard of 6 ppm.

Low DO levels in lake waters are little changed by transit through the dam and powerhouse, so that standards in the Rio Chama are typically not attained during periods when DO levels are low in the

reservoir. It is not known at what downstream location a low DO level in released water reaches 6 ppm through aeration due to diffusion and turbulence, i.e., normal river processes. Determination of the length of affected stream due to a specific oxygen deficit at the discharge point (i.e., the dam) would best be determined empirically by downstream measurements. However, such data are not available.

The Streeter-Phelps steady-state model for stream aeration is useful for computing natural aeration rates if the aeration coefficient, k_2, is known. Since an effective model for predicting the value of k_2 for a certain reach requires values for hydraulic parameters that are not available or easily obtained, a typical range of k_2, as empirically determined for rivers in the eastern U.S., was used. An "average" August-September water temperature of 15.5 degrees Celsius (C) and a barometric pressure of 605 millimeters (mm) of mercury were used to compute the time in which water released from Abiquiu Dam containing 4 ppm of DO would naturally aerate to 6 ppm. Since the transit time from the dam to the mouth of the Rio Chama for various discharges is known, aeration times were converted to distances. For k_2 = 1, 2 and 3, the respective distances were 9.0, 4.5 and 3.0 stream miles below Abiquiu Dam. Therefore, it is likely that at least 3.0 miles of stream is adversely affected by a release under the specified, typical, conditions.

The higher water temperatures that exist during summer and early fall compound adverse effects of the low DO levels on aquatic organisms downstream of the dam. The lake normally exhibits a temperature difference of only 7-8 degrees C across the thermocline, so that outflow is typically 14 to 17 degrees C, which is in the upper range for a coldwater fishery. Low oxygen levels also adversely affect the productivity of aquatic invertebrates such as mayflies and stoneflies, and consequently affect fish and other organisms that feed on them. Levels of DO in the neighborhood of 2-4 ppm, while not nearly as frequent as those in higher deficiency ranges, are likely to have longer-lasting and more severe effects on ecosystem function, even though fish kills are not apparent.

1.3 REGULATORY COMPLIANCE 1.3 REGULATORY COMPLIANCE

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

American Indian Religious Freedom Act of 1978 (42 U.S.C. 1996)
Archaeological Resources Protection Act of 1979 (16 U.S.C. 470)
Clean Air Act of 1972, as amended (42 U.S.C. 7401 *et seq*)
Clean Water Act of 1972, as amended (33 U.S.C. 1251 *et seq*)
Endangered Species Act of 1973, as amended (16 U.S.C. 1531)
National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321 *et seq*)
National Historic Preservation Act of 1966, as amended (16 U.S.C. 470)
Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. 3001 *et seq*)

This EA also reflects compliance with all applicable State of New Mexico and local regulations, statutes, policies, and standards for conserving the environment such as water and air quality, endangered plants and animals, and cultural resources.

2. PROPOSED ACTION AND ALTERNATIVES 2. PROPOSED ACTION AND ALTERNATIVES

All Federal agencies assisting in projects that utilize public funding are mandated by the National Environmental Policy Act to evaluate alternative courses of action so that decisions are made in the best

interests of the public. In considering the proposed project modification, reasonable alternatives should consider a balanced approach to safe and efficient project implementation; the social, economic, and environmental impacts of the proposed construction; and Federal, State, and local environmental resource protection goals.

The construction of features that mimic natural aeration (i.e., an aerating weir), mechanical (i.e., air injection) and non-mechanical alterations (e.g., forebay selective withdrawal structures) to the outlet structure of Abiquiu Dam were considered as project alternatives.

2.1 ALTERNATIVES CONSIDERED 2.1 ALTERNATIVES CONSIDERED

2.1.1 Alternative No. 12.1.1 Alternative No. 1: No Action. The no action alternative would provide for no work and for no Federal assistance for design or construction beyond this study. Therefore, dissolved oxygen levels would continue to be below the standards set by the state of New Mexico. Prolonged exposure to low dissolved oxygen levels may not directly kill an organism, but will increase its susceptibility to other environmental stresses. Growth is inhibited by prolonged exposure to DO levels less than 5.0 g/liter and exposure to saturation levels less than 30% (~ 2.0 g/liter in the current problem) for one to four days may kill most biota in a system.

2.1.2 Alternative No. 22.1.2 Alternative No. 2: Aerating Weir. Aeration occurs naturally as river flows cascade through shallow rapids or over waterfalls. A system mimicking this natural action involve the placement of an aerating weir from the outlet for a distance downstream producing sufficient turbulence to aerate flows to the desired DO range of 6.4 to 7.1 ppm. The installation of an aerating weir at Abiquiu would entail several significant drawbacks. An aerating weir is only effective when lake D.O. levels are greater than 4.35 S/L (Hibbs and Gulliver, 1995). Measurements taken below Abiquiu Dam have indicated occasional minimum D.O. levels of 3.0 S/L. An aerating weir would not provide sufficient oxygenation and therefore be ineffective at these minimum levels. Although low maintenance, aerating weirs may be expensive to construct. Weirs typically are designed to extend downstream a distance six times channel width (Hibbs and Gulliver, 1995). The channel width below Abiquiu Dam is between 50 and 100 meters wide. The weir length required for efficient operation would therefore be approximately 300-600 meters. The cost of weir construction has been generically estimated at $2,500 per meter of weir length. Resulting aerating weir construction costs alone may be estimated between $750,000 and $1.5 million.

Construction of an aerating weir would also result in significant environmental impacts. Facility construction would require dewatering of the Chama in the construction zone and pumping of water to maintain flows downstream of the project area for a construction period of between 3 to 6 months. Cost estimates for dewatering are in excess of $1.5 million. In addition, habitat destruction in the project area resulting from dewatering and facility installation would require significant mitigation measures.

2.1.3 Alternative No. 32.1.3 Alternative No. 3: Non-mechanical modifications to outlet suffer the same drawbacks as described above for an aerating weir. Based on opinion provided by the Waterways Experiment Station (WES) of the Corps of Engineers, construction costs associated with 'retrofitting' Abiquiu Dam would be well in excess of $1 million. Non-mechanical modifications would entail similar dewatering issues (high cost and significant environmental impact) previously discussed.

2.2 RECOMMENDED PLAN, Alternative No. 42.2 RECOMMENDED PLAN, Alternative No. 4:

Alternatives 1-3, discussed above, are unsatisfactory because of their relative ineffectiveness at extremely low D.O. levels or their high cost.

Restoration would consist of installing aeration equipment in the Los Alamos Power powerhouse

below Abiquiu Dam. This equipment would consist of two positive-displacement rotary-lobe blowers, each driven by a three-phase motor of approximately 40 horsepower. Electric controls for the motors would be activated by DO sensing equipment with a probe mounted in a shaft extending into the river just downstream of the turbines. Each blower would operate to produce airflow of up to approximately 400 cubic feet per minute (cfm) at about 8 to 10 pounds per square inch (psi) above atmospheric pressure. Air produced by the blowers would be injected into the low-pressure outflow from the turbines, possibly through an oxygen injection ring installed around the circumference of each turbine's draft tube. One or both blowers would automatically be activated as necessary to keep DO levels in the power plant outflow in the range of approximately 6.4 to 7.1 ppm at flows between 200 and 600 cfs. This approximates the normal release range for the dam during the period when DO levels are a problem.

At releases of 200 to 600 cfs, all of the released water is routed through the turbines, except for the rare occasion when it would be necessary to take the power plant off line for maintenance or modifications. The system would insure, to the maximum extent feasible, that DO levels in the Rio Chama downstream of Abiquiu Dam would meet State water quality standards during the period of concern.

All construction would take place on Corps fee lands that are part of the Abiquiu Dam and Reservoir Project. Project life, which is essentially the life of the electrical and mechanical equipment that would be installed, is estimated to be 20 years.

The proposed project would restore an important component of aquatic habitat quality throughout at least 3.0 miles of the Rio Chama below Abiquiu Dam by eliminating chronic and occasionally severe problems with dissolved oxygen levels. There are no other known deficiencies in water quality in this or lower reaches of the Rio Chama.

In numerical terms, the project would restore adequate levels of dissolved oxygen to 3 to 9 miles of the Rio Chama below Abiquiu Dam. Using the mid-point of the expected range for the aeration coefficient (k_2=2, as discussed above), the first 4.5 stream miles below Abiquiu Dam would be restored. Due to a relatively rocky substrate and effects of the Abiquiu Project in reducing water temperatures, this reach is primarily coldwater fish habitat. Brown trout are well established there and are highly valued by anglers and promoted as a valuable resource by the New Mexico Department of Game and Fish and the New Mexico State Field Office of the U.S. Fish and Wildlife Service. The longnose dace, a native species that has a preference for the type of habitat in this reach, would also likely benefit significantly from improved DO levels. Benefits would likely accrue by the direct effects of increased DO levels on fish health, growth and reproduction and indirectly by positive effects on their invertebrate food base.

3. EXISTING ENVIRONMENT AND FORESEEABLE EFFECTS3. EXISTING ENVIRONMENT AND FORESEEABLE EFFECTS

3.1 PHYSICAL RESOURCES 3.1 PHYSICAL RESOURCES

3.1.1 Physiography, Geology and Soils3.1.1 Physiography, Geology and Soils

Diverse land forms and features characterize the general Abiquiu area: steep, narrow canyons; rocky foothills; broad valleys; vertical cliffs; gently sloping mesas; river; agriculturally dominated floodplain; and riparian cottonwood forest. Piñon-juniper woodland characterizes the upland with areas of grassland and sagebrush on flat to gently sloping plains. The Rio Chama is sharply constricted just above the dam by a deep and narrow canyon, which extends about three miles below the dam. From this point, the canyon opens into a wide floodplain dominated by agriculture, for the remaining 29 miles before meeting the Rio Grande. Relief varies from about 6,000 to near 10,000 feet.

The Abiquiu Dam site is located in a canyon that is approximately 350 feet deep, varying in width from 300 feet at streambed level to 1,500 feet at the mesa. The site is about one mile downstream from the head of the canyon. Upstream from the head of the canyon, the reservoir area is a wide valley eroded in soft shales and mudstones of Middle Triassic age. At the dam site, the abutment slopes range from nearly vertical sandstone ledges and cliffs, to moderately sloping talus or overburden slopes. The deep canyon is eroded through hard, resistant Poleo sandstone of Lower Triassic age and Abo sandstones and mudstones of Permian age. In the streambed area, bedrock is covered by an average 20-foot thickness of streambed alluvium (silty sand and gravel). Overburden on the abutments consists of slope wash, slump material, and talus, averaging about 50 feet in thickness. Bedrock in the upper slopes of the abutments is massive sandstone; the lower slopes and streambed area are interbedded sandstone and mudstone. The outlet works in the left abutment are in the Abo mudstone; the access shaft penetrates the full abutment section. The unlined spillway is excavated in the Poleo sandstone. The abutment and streambed mudstones are dense, well consolidated, and relatively impervious. The sandstones are a source of leakage due to open fractures, cracks, joints, and bedding planes.

3.1.2 Climate3.1.2 Climate

The climate of the area, not including higher mountain regions, is semi-arid continental. The summers are warm and sunny; the winters are cold. The average annual precipitation is 11 inches of moisture. The majority of the annual precipitation comes from brief but intense afternoon thunderstorms some of which can be severe. These storms usually occur during late summer and early fall. Humidity is generally low and snowfall is common, averaging 15 to 40 inches per year. The average annual temperature is 48.5 degrees Fahrenheit (°F) with maximum-recorded temperatures of 99°F for a high and a low of 23°F. The average frost-free season is about 120 days. None of the project alternatives would affect the local climate.

3.1.3 Water Resources 3.1.3 Water Resources

Section 404 of the Clean Water Act of 1972 (CWA; 33 U.S.C. 1251 *et seq.*), as amended, provides for the protection of waters of the United States, including wetlands, through regulation of the discharge of dredged or fill material. The Corps' Regulatory Program (33 CFR Parts 320-330) requires that a Section 404 determination be conducted for all proposed construction that may affect waters of the United States. Since no work would be required in the Rio Chama or any other water body or wetland, a Section 404 Permit under the Clean Water Act and State certification under Section 401 of the Act would not be required.

Section 402 of the CWA, as amended, regulates point source discharges of pollutants into waters of the United States and specifies that storm-water discharges associated with construction activity be conducted under National Pollutant Discharge Elimination System guidance (NPDES). Since no ground would be disturbed by this project, a Storm Water Pollution Prevention Plan and permit authority to discharge under the National Pollutant Discharge Elimination System would not be required.

3.1.4 Air Quality and Noise 3.1.5 Air Quality, Noise, and Visual Quality

Abiquiu Reservoir is located in the state of New Mexico and U.S. Environmental Protection Agency Air Quality Control Regions 3 and 157, respectively (NMAQ 1994). Existing air quality is good. Although no specific air quality data are known for the immediate vicinity of the project, there are no manufacturing interests or heavy traffic patterns in the area that would degrade air quality or cause significant noise. Some blowing dust is characteristic of the area, especially in spring, when moderately strong winds blow through the Chama Canyon from the west. However, this situation is not unique to Abiquiu Reservoir, but is characteristic of the Southwest in general. Project land, which has been temporarily inundated in the past, generally establishes a vegetative cover of annuals during the next growing season, which (although composed substantially of such nuisance species as cocklebur and

dodder) decreases wind erosion and blowing dust. The general area is in conformance with State and Federal Ambient Air Quality Standards. Rio Arriba County has not been designated as a non-attainment area and is not included in the State of New Mexico's Implementation Plan for the Attainment of the National Ambient Air Quality Standards (NMAAQS 1994).

The use of electrically powered motors for the oxygenator pumping system will increase ambient noise levels immediately around the dam. Mechanical noise from the motors is estimated in the range of 65 to 75 decibels (equivalent of a loud conversation at 2 - 4 feet). However, the structure enclosing the motors will reduce these levels.

Increased ambient noise levels will not be a significant effect on either human or wildlife use of the area. Little recreational use of the reservoir occurs during the winter months. Site-seeing visitors using the scenic overlook near the dam will be able to hear the motors, but noise levels will be reduced due to the distance from the noise source. The late fall and early winter is a popular time for trout fishing in the Rio Chama. However, only anglers very near the dam could possibly hear the noise and the level should not be a nuisance. No impact to wildlife is anticipated. The noise could be a nuisance to Corps personnel working in and around the project office, but this should be minor and of relatively short duration.

Air quality should be maintained during and after project implementation. Oxygenator installation would require only a limited number of vehicles and equipment and therefore produce only minute amounts of hydrocarbon emissions.

3.2 BIOLOGICAL RESOURCES 3.2 BIOLOGICAL RESOURCES

3.2.1 Vegetation Communities3.2.1 Vegetation Communities. Abiquiu Dam and Reservoir lies within the Great Basin Desert Scrub biotic community as described by Brown and Lowe (1980). Higher elevation terrain surrounding the reservoir is characteristic of the Great Basin Conifer Woodland biotic community. The vegetation on lands in the vicinity of Abiquiu Reservoir varies from bunch grass prairie to piñon-juniper woodland, depending primarily upon elevation, slope exposure, and soils. The one-seed juniper is prominent on the steeper slopes of dissected terraces or plateaus. The juniper and piñon pine are both prominent on the shallow, sandy soils of the Santa Fe formation outcroppings and the foothills of Cerro Pedernal. Ground cover in these areas is sparse, probably due to soil and moisture relationships. Considerable areas of woodland have been cleared in the general area during past years to improve grazing.

Grasslands near the project typically occur on flat to gently sloping plains with fine sand loam surface soils and clay loam. Cattle forage production is dominated by galleta, blue grama, and bottlebrush-squirreltail. Broom snakeweed and other forbs and shrubs are also present. Rangelands within the boundaries of the project, which are accessible to cattle, are generally overgrazed.

The canyon walls and slopes downstream of the embankment are sparsely vegetated with scrub one-seed juniper and piñon pine, snakeweed, four-wing saltbush, locoweed, wolfberry, rabbitbush, cholla, Mormon tea, and mixed grasses such as Indian ricegrass, galleta, threeawn, dropseeds, and sideoats and blue grama. The Corps and USFWS have planted several cottonwoods on this right downstream terrace. This terrace serves as a parking and picnic area.

3.2.2 Wildlife3.2.2 Wildlife

Terrestrial Fauna. The overall reservoir area and adjacent lands are of generally moderate value, at best, as wildlife habitat. Upland areas have been heavily grazed, and flooding and sedimentation have affected habitat at lower elevations. Wildlife, which now utilize the area in modest numbers, include

mule deer, cottontail rabbit, various small mammals, coyote, eastern fence lizard, plateau whiptail lizard, western terrestrial garter snake, mourning dove, nighthawk, rock wren, golden eagle, sharp-shinned hawk, red-tailed hawk, merlin, and swallows.

Most of the rocky slopes and gravelly banks on the project are too unstable to harbor much wildlife. Cliff swallows and white-throated swifts nest on the higher rock faces, along with canyon and rock wrens. Turkey vultures, red tailed hawks and ravens nest in the ledges of the high rock faces below the dam. Woodrats use these high cliffs, as well as the piñon-juniper areas. Rock squirrels, least chipmunks, and rock wrens use some of the more stable gravelly slopes. The piñon-juniper areas on project lands support mice, brown towhees, house finches, rufous crowned sparrows, and western flycatchers. Great horned owls, American kestrels, prairie falcons, meadowlarks, and horned larks are also found in the vicinity. Bobcat and other large mammals occur infrequently in the project area due to disturbance by man. Faunal use of the area that would be disturbed by the project is extremely limited by a combination of human and mechanical disturbances and the direct absence of suitable habitat.

Waterfowl utilizing the reservoir and downstream reach include mallards, common mergansers, Canada geese, common goldeneyes, common loons, hooded mergansers, Western grebes, American wigeon, and redheads. The project is not on a major migration route and has no significant feeding areas, so the reservoir does not attract large numbers of shorebirds and waterfowl.

Aquatic Fauna. *Reservoir fishes.* Abiquiu Reservoir is known to support naturally reproducing and stocked populations of rainbow trout and brown trout, bluegill, white crappie, largemouth bass and smallmouth bass, channel catfish, longnose dace, Rio Grande chub, river carpsucker, fathead minnow, flathead chub, Rio Grande sucker and white sucker. The New Mexico Department of Game and Fish (NMDGF) currently manages Abiquiu Reservoir for recreational fishing for a variety of species. The NMWQCC (1995) designates Abiquiu Reservoir as both a coldwater and warm-water fishery. The NMDGF has also introduced walleye, yellow perch, Kamloops rainbow trout, and lake trout. The recent increase in water storage concurrent with management of the fishery has resulted in a pronounced improvement. The fishing is currently very good. Crappie and smallmouth bass are the most frequently caught species.

Rio Chama fishes. The presence of Abiquiu Dam and the recent long-term storage of about 200,000 af of water have combined to support a viable cold-water fishery downstream of the dam. The release of colder water from the bottom of the reservoir and a reduction of sediment in the water has enhanced physical habitat parameters that favor nonnative trout. Recent studies by the NMDGF, USFWS, and the Corps have demonstrated a reproducing and self-sustaining brown trout population (Hanson 1992). The NMDGF stocks rainbow and brown trout and channel catfish in this reach, and these are the primary game fish caught. The seven-mile reach of the Rio Chama below Abiquiu Dam to the bridge at Abiquiu was classified as "Special Trout Waters" by the NMDGF on April 1, 1991. This classification limits the number of trout caught to two per angler.

3.2.3 Special Status Species 3.2.3 Special Status Species

Included in this section are those species potentially found in the Abiquiu Dam area and the Rio Chama downstream that are presently listed as endangered or threatened at the Federal level, are under review for Federal listing (species of concern), and are presently listed at the State level. Requests for lists of protected species were made to the USFWS and the state agencies responsible for protecting state threatened and endangered species (Appendix B). The following species were considered based on the agencies' responses and additional research from the BISON database (NMDGF 1995).

a. Federally Endangered Species. Pursuant to Section 7 of the Endangered Species Act of 1973, as amended, the Corps must consult with the USFWS for any threatened or endangered species that

could be in the project area and could possibly be affected by the planned action.

Southwestern Willow Flycatcher (*Empidonax trailii extimus*). The southwestern willow flycatcher was recently listed as federally endangered in 1995 and is also state threatened in New Mexico. The bird is a small-bodied neotropical migrant, that occurs in riparian areas of the southwestern United States during the late spring to early summer breeding period. Critical habitat designation has been proposed to include the riparian zone along the Rio Grande from Albuquerque's Alameda Bridge to the bridge of Interstate Highway 25 at Isleta. The species is found in riparian areas with dense stands of understory willows (*Salix* sp.), arrowweed (*Pluchea* sp.), baccharis (*Baccharis* sp.), salt cedar (*Tamarix* sp.), and Russian olive trees (*Eleagnus angustifolia*) usually under an overstory of scattered taller shrubs or cottonwoods (*Populus* sp.). The subspecies nests in shrub thickets between 13 and 23 feet tall with a high canopy closure and high-density foliage within 13 feet of the ground. The shrub thickets are usually homogenous, even-aged, dense and near standing or slow-moving surface water. The loss of these riparian habitats throughout the Southwestern U.S. has been cited as a primary reason for the species decline and for its formal protection.

According to Hubbard (1987), the southwestern subspecies of willow flycatchers occurred in New Mexico throughout the Rio Grande Valley, the San Juan and Sangre de Cristo Mountains, and the upper Rio Chama. The subspecies has been confirmed from surveys in 1993 and 1994 to occur along the Rio Grande within a few miles of the confluence of the Rio Chama. In 1994, the Corps funded extensive surveys to determine the presence of southwestern willow flycatchers, the quantity of potential habitat, and the presence of breeding pairs along the 32 miles of the Rio Chama below Abiquiu Dam (Eagle Ecological Services 1994). The surveys determined that only 10 areas totaling about 30 acres of potential, high-quality habitat occurred. Two separate surveys for presence of the birds were conducted following standardized protocols for a total of nine mornings. No southwestern willow flycatchers were positively identified. One *Empidonax* was seen but did not sing and could not be identified to species. However, one individual was positively recorded from near Chili, New Mexico, (about 19 air-miles downstream from Abiquiu Dam along the Rio Chama) in 1994 by a USFWS biologist (Eagle Ecological Services 1994).

Based on these recent studies, southwestern willow flycatcher would appear to be extremely rare in the project area, and relatively small quantities of suitable habitat available. The Rio Chama Valley has been developed for agriculture resulting in a probable loss of much of the specific qualities of riparian vegetation on which the species depends. Another threat to the species is due to parasitism by brown-headed cowbirds. This species was reported to be widespread throughout the Rio Chama below Abiquiu Dam from the survey results (Eagle Ecological Services 1994).

Rio Grande Silvery Minnow (*Hybognathus amarus*). The Rio Grande silvery minnow was listed as federally endangered in 1994 due to a significant reduction in range. The species is state listed as threatened in New Mexico. Once extending throughout much of the Rio Grande mainstem and large tributaries, the species now only exists in the reach of river between Cochiti Dam and Elephant Butte Reservoir (Bestgen and Platania 1991). The proposed critical habitat designation includes the mainstem Rio Grande from below Cochiti Dam to San Marcial. The species has not been collected on the Rio Chama in recent surveys and is presumed extirpated from any portion of the Rio Grande or Rio Chama drainages upstream of Cochiti Dam (Bestgen and Platania 1991; Hanson 1992; Platania 1996). The nearest occurrence is from the Rio Grande below Cochiti Dam (Bestgen and Platania 1988, 1991).

The species is a small-bodied cyprinid that travels in schools and lays pelagic eggs during spring runoff. The species continues to be threatened due to habitat degradation that has occurred in the remaining range from water management activities.

American Peregrine Falcon (*Falco peregrinus anatum*). The American peregrine falcon is currently listed as federally endangered and state endangered in New Mexico. The project area is not considered to be optimal peregrine falcon foraging or nesting habitat. Peregrine use of the study area historically has been light (irregular), and there have been no recent confirmed sightings. Although some of the cliffs along the Rio Chama may be suitable for nesting, there has been no known nesting activity. The closest reported active nest site is over 25 miles away. The species has been proposed to be removed from the list of threatened and endangered species.

Interior Least Tern (*Sterna antillarum athalassos*). The Interior Least Tern is a shorebird that occurs in wetland, marsh areas as migrants along the Rio Grande. The species is protected as an endangered species by the state of New Mexico. Interior Least Tern is a colonial-nesting water bird, and its critical habitat component is unvegetated sand or gravel substrate for nesting. The only breeding population of Interior Least Tern known to occur in New Mexico is located in Bitter Lake National Wildlife Refuge, in Chavez County, along the Pecos River. The bird over-winters south of the Mexican Pacific coast. The species is known only as a vagrant at Bosque del Apache National Wildlife Refuge.

Whooping Crane (*Grus americana*). Whooping Crane is federally listed as endangered. The species is protected by the state as endangered, Group II. The species exists in only three wild populations and five captive populations. The species has been reintroduced to the Middle Rio Grande through the experimental populations at Grays Lake National Wildlife Refuge in Idaho. Researchers there are attempting to cross-foster Whooping Cranes with Sandhill Cranes. If successful, Whooping Cranes could migrate to the Middle Rio Grande of New Mexico for over-wintering. During the winter, Whooping Cranes at the Bosque del Apache National Wildlife Refuge use sand bars in the Rio Grande for night roosting. The whooping crane is not known to occur within the Rio Chama Valley.

b. Federally Threatened Species. Bald Eagle (*Haliaeetus leucocephalus*). The status of bald eagle populations in the lower 48 states was recently changed from *Endangered* to *Threatened* as a result of increasing numbers and range of the populations. In New Mexico, where the species is protected by the state as threatened, Group II, bald eagles over-winter in areas abundant with fish or waterfowl for prey. Only two pairs are known to nest in the state in Sierra and Colfax Counties. Two of the key winter habitat areas in New Mexico are Cochiti Lake, particularly the upstream delta area, and the Bosque del Apache National Wildlife Refuge. These sites have large numbers of waterfowl from November to March that provide the prey base to support foraging eagles. Other areas providing habitat include Navajo Lake, the Chama Valley (Rio Arriba County), the northeastern lakes (Raton to Las Vegas), the lower Canadian Valley, Sumner Lake, Elephant Butte Lake, Caballo Lake, and the Upper Gila Basin. Winter and migrant populations seem to have increased in New Mexico apparently as the result of reservoir construction and the expansion of fish and waterfowl populations. In New Mexico and adjacent areas, optimal habitats center on riparian and lacustrine environments where food, shelter, and potential nest sites are in the greatest supply. The major food items of bald eagles in New Mexico appear to be waterfowl, fish, and carrion. Dry land eagles also take mammals, such as jackrabbits (*Lepus* sp.). The birds typically night-roost in groups in trees usually in protected sites such as canyons. The few nests reported from New Mexico have been in trees and on cliffs that are typical sites elsewhere as well.

Bald eagles at Abiquiu Reservoir are intensively monitored and the importance of this reservoir to wintering bald eagles appears to have increased significantly during recent years. Dodd (1979) reported Abiquiu Reservoir as frozen over during the winter of 1979 and saw no bald eagles there. Bald eagles were only sporadically seen on Abiquiu Reservoir during fixed wing counts until recently (1978 through 1986) (Hubbard 1986). The increased use of Abiquiu Reservoir by bald eagles has directly coincided with the continual storage of the San Juan-Chama water, starting in 1983. Eight helicopter counts between December 1984 and March 1985 showed continuous use of the lake by bald eagles, with a

midwinter population of 9 to 11 eagles (Stahlecker 1986a). The Rio Chama, from its confluence with the Rio Grande to El Vado Dam, has been intensively monitored by the Corps from 1986 to the present, both by aerial surveys and ground studies. During the winter of 1985 to 1986, a maximum population of 17 was estimated for the Abiquiu Area (confluence to about the Monastery of Christ in the Desert: Stahlecker 1986b). Separate counts on the Rio Chama below the dam showed use by 1 to 6 eagles. No bald eagle use has been observed in the immediate dam area and on the Rio Chama for about two miles below the dam, except for some high flights over the dam. Highway traffic over the dam, activity associated with project operation and maintenance, and recreational use likely deter bald eagle use of the dam area.

Aerial count data from 1984 through 1987 indicated that high flows (greater than 1,000 cfs) discourage bald eagles use on the Rio Chama below Abiquiu Dam (Stahlecker 1987). In 1988 flows in this section of the river were approximately 50 cfs due to construction activities for the hydropower plant at the dam. These low flows resulted in shallower water that made fish more vulnerable and made the lower Rio Chama especially attractive to bald eagles. Prior to 1988 the highest count of bald eagles was 7 on 15 February 1985, when flows were 146 cfs. All helicopter counts in 1988 exceeded this previous high. These data suggest that flows below 100 cfs may be beneficial to wintering bald eagles (Stahlecker 1988). Bald eagle use may be inversely proportional to discharge, given some minimum at which prey is no longer present in sufficient numbers to attract bald eagles. Other factors affecting these results include weather conditions, amount of ice on the river or the reservoir, and the abundance of waterfowl on the river or the reservoir. The mean number of eagles sighted from 1990 to 1996 was 36. The largest number of bald eagles sighted was 62 in 1994. The past two years' surveys resulted in exactly the same number of sightings: 37.

The Corps is of the opinion that the short duration of construction activities, their occurrence inside an existing structure and the lack of impacts to eagle habitat will have no effect on bald eagles in the area.

c. Other Species of Concern. Species federally listed as Species of Concern have no legal protection under the Endangered Species Act but are included for consideration as species that may need special protection. Additional species of federal or state concern were omitted from consideration because: 1) their preferred habitats are typically associated with upland areas away from the river and 2) they are extremely unlikely to be affected by the limited construction activities of installation of the oxygen inserters at Abiquiu Dam.

White-faced Ibis (*Plegadis chihi*). Category 2. The white-faced ibis is federally listed as a Species of Concern. It occurs occasionally throughout much of the state of New Mexico. It is a shorebird associated with marshes and wetlands bordering open waters and nests in dense shrubs or reeds. The species may occur at or near Abiquiu Reservoir, likely during the summer breeding season.

Flathead Chub (*Platygobio gracilis*). Flathead chub is federally listed as a Species of Concern. The species occurs in New Mexico in the Rio Grande, Pecos, and Canadian drainages. It is widespread throughout much of west central North America in the lower Mississippi River drainage (Sublette et al. 1990). The species is present, but uncommon in the Rio Chama downstream of Abiquiu Dam. Platania (1991) collected 36 specimens (?4 % of the total catch) during his surveys. The recent study on the Rio Chama has shown that the species remains present in the reach with increasing abundance downstream from the dam (Platania 1996).

New Mexican Jumping Mouse (*Zapus hudsonius luteus*). The New Mexican jumping mouse is federally listed as a Species of Concern and state threatened, Group 2. The species range is fairly widespread in western North America. It may be limited in the arid southwest from limitations in

quality habitat availability. The species is most often associated with riparian or other moist-soiled habitats with dense vegetation.

Spotted Bat (*Euderma maculatum*). The spotted bat is also federally listed as a Species of Concern and state threatened, Group 2. The species is widespread in western North America. It occurs in New Mexico from the Rio Grande Valley westward, through the Jemez, San Mateo and Mogollon Mountains, and has been recorded from Ghost Ranch, north of Abiquiu Reservoir. The species inhabits cliffs over perennial water, but has been found associated with a wide variety of vegetation types.

d. Foreseeable Effects of the Planned Action. The following determination of effects is pursuant to the requirements of the Endangered Species Act of 1973, as amended.

Southwestern Willow Flycatcher. The planned construction is scheduled completely during the winter when southwestern willow flycatcher would not be present. No impacts to the potential habitat of the species are foreseeable as a result of the short-term flow regulation. Therefore, the planned action will have no affect on the southwestern willow flycatcher or its proposed critical habitat.

Rio Grande Silvery Minnow. The Rio Grande silvery minnow no longer occurs within the Rio Chama or the Rio Grande upstream of Cochiti Dam. The proposed critical habitat of Rio Grande silvery minnow occurs below Cochiti Dam. Therefore, no direct effects to the species or its habitat will occur.

Other Threatened, Endangered or species of concern. The Corps has determined that the proposed action will have no affect on any other threatened, endangered or species of concern.

3.3 CULTURAL RESOURCES 3.3 CULTURAL RESOURCES

The construction of the preferred alternative would not involve ground disturbance. No properties entered in, or determined eligible for inclusion on, the National Register of Historic Places would be affected. The State Historic Preservation Officer has concurred with a determination that this undertaking would not affect cultural resources since all construction activities would be confined to previously disturbed land areas (Appendix A). Therefore the Corps is of the opinion that a determination of no historic or cultural properties affected is appropriate for this undertaking.

3.4 LAND USE AND SOCIOECONOMIC CONSIDERATIONS

The socioeconomic study area, which encompasses the eastern portion of Rio Arriba County, had a 1992 population of 34,891 persons; up 17.4% from the 24,228 in 1980 (Boatmen's Sunwest 1994). The population is predominantly of Hispanic origin. Family size and unemployment are high, while personal income and the general status of housing are low. The unemployment rate in the County is consistently among New Mexico's highest. In 1993, the county's unemployment rate was 12.8%, compared with 7.5% for the state of New Mexico. Employment by broad industry sector shows that government, services, and trade comprised about 80 percent of the wage and salary employment in 1979. Agriculture comprised only about three percent. Inhabitants of the Abiquiu general area reside in small, predominantly Hispanic rural villages. The predominant use of lands surrounding the reservoir is low-density cattle grazing. Farming is the predominant use of the floodplain below the dam.

The economy, and social structure, and activities of the Rio Chama, Española, and middle Rio Grande valleys would not be affected as a result of the proposed project.

3.5 CUMULATIVE IMPACTS 3.5 CUMULATIVE IMPACTS

No cumulative effects are foreseen. Based on the determination of no direct effects and no indirect effects that can be reasonably predicted at this time, the planned action will not affect the Rio Grande silvery minnow or its proposed critical habitat.

4. CONCLUSION 4. CONCLUSIONS

The installation of a forced air injection system would insure the maintenance of adequate levels of dissolved oxygen for a significant distance below the dam. Concurrent installation of D.O monitors would allow the system to efficiently operate during periods of low oxygen concentrations (July-October). Installation of a forced a system at Abiquiu has benefit of most consistently enhancing degraded habit below the dam, while entailing no adverse environmental, cultural, or other impacts through its implementation (Table 1).

Table 1. Summary of foreseeable effects of the proposed alternatives.

PROJECT ALTERNATIVES

1) No action, that is, nothing would be done to alter the existing DO levels.
2) Construction of facilities to mimic natural aeration.
3) Non-mechanical modifications to outlet.
4) The Recommended Plan: Installation of aeration equipment in the Los Alamos Power powerhouse below Abiquiu Dam. Blowers would automatically be activated as necessary to keep DO levels in the power plant outflow in the range of approximately 6.4 to 7.1 ppm at flows between 200 and 600 cfs. This approximates the normal release range for the dam during the period when DO levels are a problem.

Table 1 (cont'd).

	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Physical resources	0	0	0	0
Riparian habitat	0	0	0	0
Wetlands	0	0	0	0
Hydrology	0	-	-	0
Flood plain	0	-	-	0
Water quality	=	++	-	++
Air quality	0	-	-	0
Noise level	0	-	-	0
Aesthetic values	0	-	-	0
Vegetation and Wildlife	=	0	0	0
Protected species	0	0	0	0
Cultural resources	0	0	0	0
Existing land uses	0	0	-	0
Recreational resources	0	0	0	0
Prime and unique farmlands	0	0	0	0
Socioeconomics	0	0	0	0

LEGEND

0 No Impact
- Minor or Temporary Negative Impact
= Severe or Significant Negative Impact
+ Minor Beneficial Impact
++ Major Beneficial Impact

5. CONSULTATION AND COORDINATION

This EA was prepared by the U.S. Army Corps of Engineers, Albuquerque District, 4101 Jefferson Plaza, NE, Albuquerque, NM 87109-3435.

Agencies and concerned entities consulted formally or informally in preparation of this EA include:

U.S. Department of Interior
Fish and Wildlife Service
New Mexico Ecological Services State Office

State of New Mexico
State Historic Preservation Bureau
Department of Game and Fish

Los Alamos County

Information on the proposed project including project background, purpose and need, proposed project description, proposed alternatives, and project area map were mailed to all entities contacted in the above list.

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7. APPENDICES 7. APPENDICES

APPENDIX A

Cultural Resources and Traditional Cultural Properties of the Construction Area

APPENDIX B

Comments to the Draft EA

APPENDIX C

Glossary

Abutment: Portion of dam in contact with the natural slopes adjacent to the watercourse it blocks.
Hypolimnion: The layer of water below the thermocline in a fresh water lake.
Invert: The lowest point in a water conveyance channel, i.e., river or lakebed.
Lacustrine: Of or related to lakes or living and growing in lakes.
Phytoplankton: Microscopic floating aquatic plants.
Service Gate: Gate structure on a dam's outlet that controls the rate at which water is released.
Terminal Flip Bucket: The downstream portion of the concrete structure housing a dam's gates designed to dissipate the energy of water as it flows through the gates.
Thermocline: The region in a thermally stratified body of water (i.e., lake) in which the temperature decrease with depth is greater than that of the water above or below it.
Turbine Draft Tube: Conduit that conveys water from a turbine to a downstream watercourse.