US Department of the Interior
BUREAU OF RECLAMATION

Great Plains Region
OKLAHOMA-TEXAS AREA OFFICE

Construction Program
SEPTEMBER 1995

FINAL *Supplemental* ENVIRONMENTAL ASSESSMENT

Lake Meredith Salinity Control Project

Texas-New Mexico

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

Preface

This document is made up of three parts. The first part is a "Finding of No Significant Impact" (FONSI). This part details the alternative plan selected, describes the impacts from the project and the reason for finding these impacts insignificant, and lists the environmental commitments.

The second part is a list of comment letters on the July 1995 draft supplemental EA and the U.S. Bureau of Reclamation's responses. Letters were received from the New Mexico Interstate Stream Commission, and the U.S. Fish and Wildlife Service. Reclamation's responses are listed in the right-hand column, directly across from the comment.

The last part of the document is the Final Supplemental Environmental Assessment. It is a revised version of the Draft Supplemental EA, based on updated information and the comments received.

Part 1: FONSI

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
GREAT PLAINS REGION
OKLAHOMA-TEXAS AREA OFFICE
OKLAHOMA CITY, OKLAHOMA

FINDING OF NO SIGNIFICANT IMPACT

Lake Meredith Salinity
Control Project
Texas-New Mexico

FONSI # OT-150-95-08

Prepared: Donald E Moomaw Date: 9/14/95
Environmental Specialist
Oklahoma-Texas Area Office

Approved: Larry T. Todd Date: 9/14/95
Area Manager
Oklahoma-Texas Area Office

PURPOSE

The Bureau of Reclamation (Reclamation) and the Canadian River Municipal Water Authority (CRMWA) are implementing this project to improve the water quality of Lake Meredith. The reservoir is the principal source of water for 11 cities in the Texas panhandle. High total dissolved solids, primarily sodium, chlorides, and sulphates, have caused a deterioration of water quality in Lake Meredith. The purpose of this project is to reduce salt loading of Lake Meredith by limiting the influence of a brine aquifer on ground water inflows of the Canadian River. In October 1992, authorization for construction was provided in Public Law 102-575. Because the plans to control salinity were ten years old, the study partners (CRMWA, the Texas Water Development Board, and Reclamation) decided to review information in the technical report and in the EA/FONSI that accompanied it. This review resulted in modification of the originally selected plan, and Reclamation made a decision to supplement the 1986 EA/FONSI.

THE PREFERRED ALTERNATIVE

The preferred alternative includes a series of wells that would intercept and remove saline groundwater moving into the alluvial aquifer of the Canadian River. The project area is in eastern New Mexico, downstream of Ute Dam and Reservoir. Water removed would be disposed of by injection into wells completed in underlying deep saline aquifers.

Up to 25 production wells would be completed in two phases in this alternative. Phase 1 would include the design and construction of ten production wells and design of an additional 15 wells. These would be completed under a later (Phase 2) contract, if necessary. All wells would be drilled to the top of the Upper Shale unit in the Tecovas Formation, about 90-165 feet below the Canadian River. Collection would be out of the Trujillo Formation.

The anticipated operation pumping rate of the production well field would be 1.6 cfs. Each well would be equipped with a submersible pump, an apparatus for controlling pump discharge, and sensors for monitoring discharge rate and the electrical conductivity (a measure of salinity) of the pumped brine. Each well head would be protected by a small concrete or metal housing.

Two injection wells would dispose of the collected brine. Each would have a injection rate of 1.6 cfs, with one serving as a backup to the other. One injection well would be constructed first and operated for a period of 60 days before construction of the second. The exact lithologic zones the brine would be injected into is unknown at present, but it is anticipated they would be permeable zones in the Permian or Pennsylvanian sediments less than 4,000 feet deep. Data from oil wells surrounding the area show that the most likely places for injection might be in the Glorieta Sandstone (the upper several hundred feet of the San Andres Formation), and in the lower part of the Abo and upper part of the Sangre de Cristo Formations. Chemical analyses would be done to determine compatibility between the water existing in the injection zone and the injected brine.

ENVIRONMENTAL EFFECTS OF THE PREFERRED ALTERNATIVE

Construction and operation of the facilities proposed in the Modified Well Pumping and Deep Well Injection Alternative would have no significant effects on the environment, so an environmental impact statement will not be necessary. An analysis of the environmental effects is contained in the attached Supplemental EA.

The reason for the Finding of No Significant Impacts is as follows:

1. Construction would temporally disturb approximately 68 acres of vegetation, but upon the completion of the project only 10 acres of terrestrial habitat would be lost to project facilities. All areas disturbed during construction and not used for project facilities will be reshaped and left in a condition for revegetation.

2. The project would reduce the flow in the Canadian River by an average of 1.4 cubic feet per second (or 35%). This equates to 12 to 14 percent of the base flow below the confluence of Revuelto Creek.

3. Operation of the project will improve the water quality by removing an estimated 18,300 tons of salt from the river annually.

4. Wildlife would experience temporary disturbance during construction and the permanent lost of about 10 acres of habitat. This loss would be off set by the fencing of the areas around the injection wells, so the over grazed range habitat could be enhanced upland habitat.

5. No federally listed endangered species would be affected by the alternative.

6. Impacts to the social and economic conditions of the Logan area would be minor, with the addition of 10 to 25 workers to the local economy during construction. Impacts of this alternative would not affect lower-income people differently than it would affect other economic classes.

7. The project area has been surveyed for cultural resources and located sites would be flagged so the could be avoided during construction.

8. The preferred alternative will have no effect on Indian Trust Assets.

ENVIRONMENTAL COMMITMENTS

Commitments were developed in consultation the U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, CRMWA, and the State of New Mexico. Reclamation would ensure that fish and wildlife measures and environmental commitments were followed and that implementation would occur before or during construction, unless otherwise specified.

These commitments are:

Reclamation would require the contractor to comply with all State and local rules regarding water and air quality standards, including appropriate erosion control, pollution and noise abatement measures.

The contractor will reshape disturbed areas and leave in a condition for re-vegetation where appropriate after construction.

Injection well facilities would be fenced to provide an area of vegetation protected from livestock grazing.

Construction would be scheduled in the floodplain only during low-flow or low precipitation conditions, and all staging, parking, storage and refueling areas would be constructed above the 100-year floodplain.

All project facilities would be designed to avoid archeological sites determined potentially eligible to be listed as National sites. If the engineering and geologic constraints create a situation where a facility cannot avoid these sites, further testing and/or mitigation would be conducted before/during construction. During construction, archeological sites will be monitored to evaluate any new discoveries. To prevent any adverse effects during the operation and maintenance of the facilities, the CRMWA would be provided with a map of the areas that must be avoided. Since the project will located on private land, NMSHPO and Reclamation would work together to educate the land owner about cultural resources discovered on his land and the value of protecting such resources.

Impacts to fish and wildlife from construction of the project would be minimized where possible. Reclamation and CRMWA would enter into discussions with the Service on a conservation agreement for the proposed Arkansas River shiner *(Notropis girardi)* and the Arkansas River speckled chub.

Part 2: Comments and Responses

NEW MEXICO INTERSTATE STREAM COMMISSION

BATAAN MEMORIAL BUILDING, ROOM 101
STATE CAPITOL
POST OFFICE BOX 25102
SANTA FE, NEW MEXICO 87504-5102
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RECEIVED
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August 16, 1995

Larry L. Todd, Area Manager
Bureau of Reclamation
Great Plains Region
Oklahoma-Texas Area Office
420 West Main Street, Suite 630
Oklahoma City, Oklahoma

Dear Mr. Todd:

By letter dated July 28, 1995, you transmitted for review and comment a draft Supplemental Environmental Assessment for the Lake Meredith Salinity Control Project. The following comments on the draft Environmental Assessment (Assessment) are offered:

The Assessment states that the project would have no significant impacts on the Arkansas River shiner population found in the reach of the Canadian River between Ute Dam and the mouth of Revuelto Creek, which population was proposed to be listed as an endangered species by the U.S. Fish and Wildlife Service on August 3, 1994. The Assessment reaches this conclusion in part because the reduction in stream flows due to project implementation would be 35% of the total flow above the confluence of Revuelto Creek and less than 14% of the total flow below the confluence of Revuelto Creek.

The seepage from Ute Dam plus ground water inflow measured at the streamflow gage Canadian River at Logan, is about 2-4 cubic feet per second and has resulted in a perennial base flow in a portion of the reach of the river between Ute Dam and the New Mexico-Texas state line. The proposed Eastern New Mexico Water Supply Project, which would deliver water from Ute Reservoir, or other similar projects, may be developed in such a manner that would intercept the seepage below the Dam via a pumping plant which

Small reduction in flow was one of the reasons for anticipating minor impacts to the Arkansas River Shiner. However, other reasons were also a part of the analysis. These included: 1) this stretch of river has changed and is not typically considered the preferred habitat of the shiner; 2) the incremental reduction in brine inflow is spread through the entire area of the project so no major reduction will occur in any specific area; 3) the fishery surveys of the area indicated that some years the fish were present and some they were not; and 4) the flows of Revuelto Creek are more of a controller on the Canadian River than the base flow between Ute Dam and the confluence of Revuelto Creek.

The water supply project you pointed out could have an affect on the stream which would accentuate the effects of the project. However, because it is unknown as to when or how this would take place, anticipated effects were not included in the analysis. Reclamation and the U.S. Fish and Wildlife Service both agree that the impact of the project upon the shiner is unclear. We are therefore we are pursuing the initiation of a study to obtain better information of the life history and habitat requirements of the shiner.

would reduce the base flow below that point. If the Eastern New Mexico Water Supply Project is completed in this fashion, the percentage reduction in base flows would be greater than those currently estimated in the Assessment. The Interstate Stream Commission has filed with the New Mexico State Engineer a notice of Intention covering waters in the Canadian River downstream of Ute Dam.

The following specific comments on the Assessment are offered. The project map shows one of the Phase 2 production wells, PW2-1, to be located in the proximity of the Ute Dam spillway discharge into the Canadian River. At the well location indicated the well could be adversely impacted by spillway discharge. It is recommended that final siting of any proposed wells located along the river west of the section line common to Section 15 & 16 be coordinated with this office.

If Phase 2 activities commence, the location of Phase 2 production well PW2-1 will be coordinated with the New Mexico Interstate Steam Commission.

Page 9, last paragraph. Section 804.(c) of Public Law 102-575, which authorized construction of the project, provides that upon completion of construction and testing of the project the Secretary of the Interior will turn over the operation and maintenance of the project to the Canadian River Municipal Water Authority or other bona fide entity agreeable to the states of New Mexico and Texas. It is suggested that this paragraph be corrected to reflect that provision of the statute law. This comment also applies to the first sentence of the final paragraph on page 33.

Text has been edited to read "Section 304, part c, of Public Law 102-575, which authorized the project, provides that, upon completion of construction and testing of the project, the Secretary of the Interior shall transfer the care, operation, and maintenance of the project works to CRMWA or to a bona fide entity mutually agreeable to the States of New Mexico and Texas. Pursuant to this, the salinity control facilities would be owned...".

Page 31, fourth paragraph under the heading "Social and Economic Conditions. It is suggested that this paragraph be revised to reflect that Ute Reservoir has a surface area of 8047 acres at spillway crest elevation, 3787.0 feet, and delete the reference to Ute Reservoir as the next-to- largest lake in New Mexico, which is an incorrect statement.

Text has been edited to read "Ute Lake, with a surface area of 8,047 acres, offers a warm-water fishery and other water sports.".

Based upon our review of the Assessment, it appears that construction of the project would not result in significant environmental consequences, and therefore Reclamation should issue a Finding of No Significant Impact and proceed with construction of the project.

Thank you for the opportunity to comment on the Draft Assessment.

Sincerely,

Thomas C. Turney
Secretary

TCT:rav

cc: John Williams
Canadian River Municipal Water Authority

\rav\canadian\todd.fnl

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New Mexico Ecological Services State Office
2105 Osuna NE
Albuquerque, New Mexico 87113
Phone: (505) 761-4525 Fax: (505) 761-4542

August 14, 1995

Cons. #2-22-95-I-443

Memorandum

To: Area Manager, Bureau of Reclamation, Oklahoma City, Oklahoma

From: State Supervisor, New Mexico Ecological Services State Office, Albuquerque, New Mexico

Subject: Draft Supplemental Environmental Assessment for the Lake Meredith Salinity Control Project, Quay County, New Mexico

Thank you for the opportunity to review the Draft Supplemental Environmental Assessment (EA) for the Lake Meredith Salinity Control Project. The U.S. Fish and Wildlife Service concurs that there are no significant negative impacts to fish and wildlife resources as a result of this project. However, there are some points of minor concern.

Page 11, alternatives also considered in the 1986 EA. We suggest water releases from Ute Reservoir be explored as an alternative.

Page 11, ¶ 4. The statement..."potential environmental impacts,..." should be explained.

Page 18, ¶ 4 should read: Flows in Revuelto Creek are greater than flows... ¶ 5 should read: From this point to Amarillo (148 miles from the dam), average monthly flows in the river...

Page 21, ¶ 1 should read: In addition, two 1,000-ft by 1,000-ft areas around each injection well would be fenced to enhance habitat value to terrestrial wildlife by eliminating livestock grazing from these areas.

Page 23, Table 3. The Arkansas River speckled chub subspecies is found in the Canadian River. There is only one species of largemouth bass, as addressed in Attachment II of the EA.

Page 25, Table 4. Change collard lizard to collared lizard. ¶ 1 should read: The two fenced areas around the injection wells, rested from livestock grazing, would mitigate any potential loss of cover and forage habitat from construction activities.

Page 26. The bald eagle should be listed as a threatened species. This should also be reflected in Table 5. ¶ 6 should read: One species proposed for listing as endangered...

Releases of water from Ute Reservoir were considered early in the process, but were dropped because it was cost prohibitive (approximately $25 per acre-foot). In addition, releases from Ute Reservoir would only diluted the brine flow into the river and not reduce the actual salt loading. Eliminating or reducing the brine flow was deemed the better approach.

Text has been edited to read "For this reason, and because this alternative does not improve the water quality in the Canadian River, ...".

Text has been edited to read "Flows in Revuelto Creek are greater than..." and "From this point to Amarillo (148 miles from the dam), average monthly flows in the river...".

Text has been edited to read "In addition, two 1,000-ft by 1,000-ft areas around each injection well would be fenced to enhance habitat value to terrestrial wildlife by eliminating livestock grazing from these areas".

Text in the table has been edited to read "Arkansas River speckled chub" and "largemouth bass".

Text has been edited to read "collared lizard" and "The two fenced areas around the injection wells, rested from livestock grazing, would...".

Text has been edited to reflect the bald eagle as being threatened. Text has been edited to read "One species proposed for listing as ..".

Page 31, ¶ 1 should read: Impacts to the brook stickleback and the bigscale logperch are not anticipated, as there is no record of their occurrence in the Canadian River within the study area.

Several of the scientific names of fishes are misspelled or are incorrect in Attachment II. Those corrections have been made on the attached manuscript. Please contact Mr. Craig L. Springer at (505) 761-4525 concerning these comments.

Jennifer Fowler-Propst

Attachment

cc: (w/o attach)
Director, New Mexico Department of Game and Fish, Santa Fe, New Mexico
Chief, New Mexico Environment Department, Surface Water Quality Bureau, Santa Fe, New Mexico
State Supervisor, Oklahoma Ecological Services State Office, Oklahoma City, Oklahoma

Text has been edited to read "Impacts to the brook stickleback and the bigscale logperch are not anticipated, as there is no record of their occurrence in the Canadian River within the study area.".

Attachment II has been edited to incorporate the spelling corrections submitted.

Contents

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Consultation and Coordination

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Introduction

Lake Meredith, an impoundment of the Canadian River about 40 miles northeast of Amarillo (Map 662-525-1103: Canadian River Project, Texas), has experienced a gradual decline in water quality because of high salt concentrations. The primary source is a leaking brine aquifer that contributes 0.5-1.0 cubic-feet-per-second (cfs) into the river just downstream of Ute Dam and Reservoir in New Mexico, about 35 miles west of the Texas-New Mexico state line.

Lake Meredith is part of the U.S. Bureau of Reclamation's (Reclamation) Canadian River Project. Constructed in the 1960's, the project provides municipal and industrial water supplies to about 450,000 residents in 11 cities in northwestern Texas through the Canadian River Municipal Water Authority (CRMWA). CRMWA delivers 72,000-75,000 acft of water yearly through the Main Aqueduct (which extends from the lake through Amarillo, Lubbock, and southwards to Tahoka, O'Donnell, and Lamesa), the East Aqueduct (serving Borger and Pampa), and the Southwest Aqueduct (serving Levelland and Brownfield). Plainview and Slaton are also served by lines from the Main Aqueduct.

Congress authorized Reclamation in 1980 to conduct a feasibility study on salinity control for Lake Meredith. A study plan was approved in 1983, the *Technical Report on the Lake Meredith Salinity Control Project* completed in 1985, and an *Environmental Assessment/Finding of No Significant Impact* (EA/FONSI) was released in 1986. In October 1992, authorization for construction was provided in Public Law 102-575. Because the plans to control salinity were ten years old, the study partners (CRMWA, the Texas Water Development Board, and Reclamation) decided to review information in the technical report and in the EA/FONSI that accompanied it. This review resulted in modification of the originally selected plan, and Reclamation made a decision to supplement the 1986 EA/FONSI.

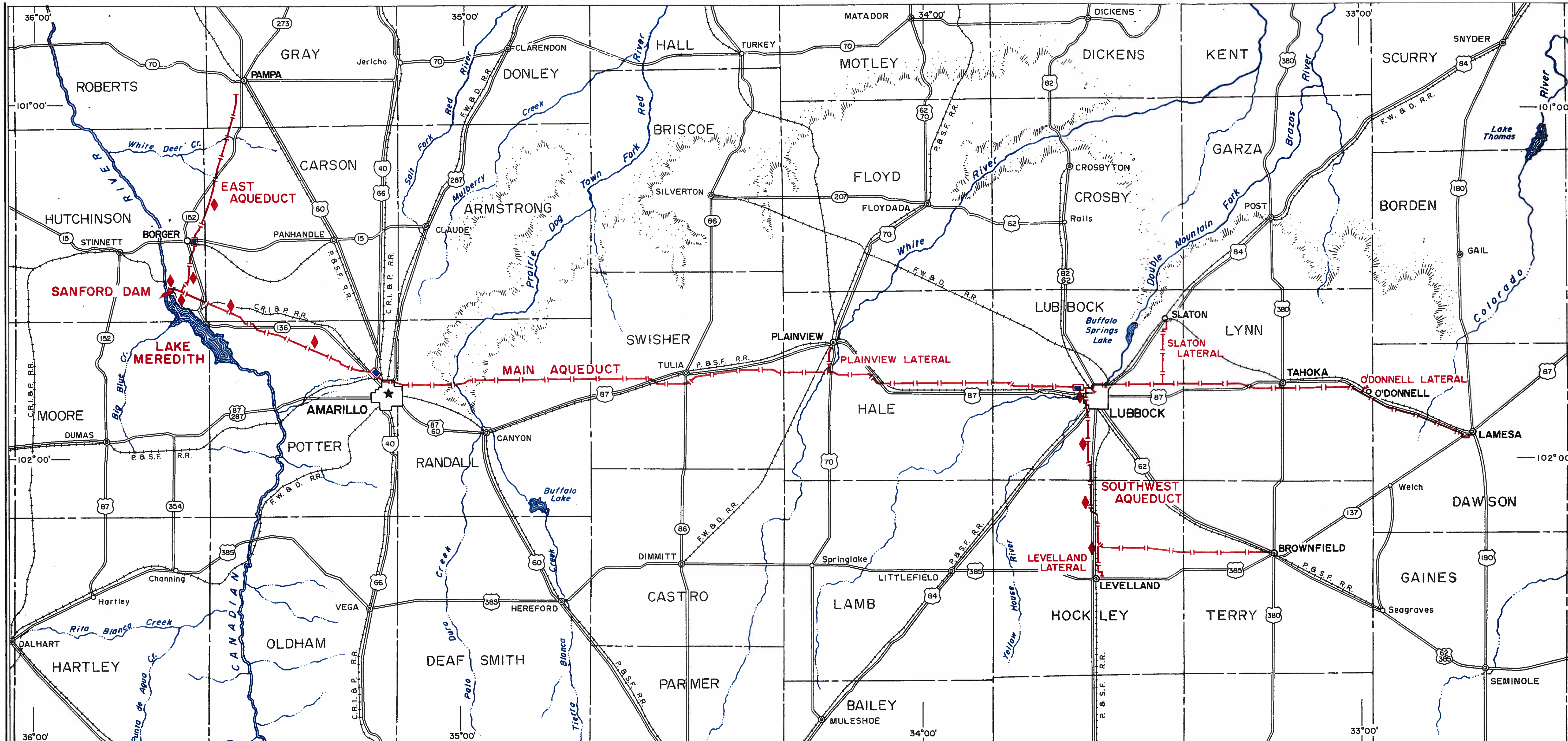
Prepared according to the National Environmental Policy Act, this Supplemental EA addresses the impacts of the modified plan to correct the salinity problems associated with Lake Meredith. This document will lead either to an *Environmental Impact Statement* (EIS) if impacts are determined to be significant, or to a *Finding of No Significant Impact* (FONSI) if impacts are determined to still be insignificant. Reclamation will reach a decision on the EIS or FONSI after the public and other agencies have the opportunity to review and comment on the draft Supplemental EA.

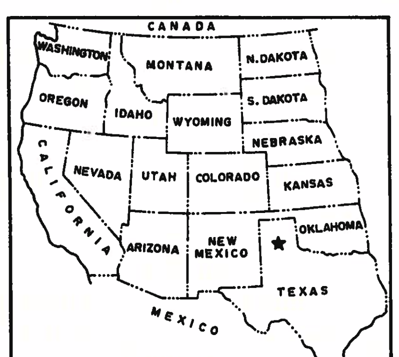
PURPOSE AND NEED

The fundamental purpose and need for the salinity control project has not changed since the Technical Report completed in 1985 (Reclamation). High total dissolved solids (TDS), primarily sodium (Na), chlorides (Cl) and sulfates (SO_4), have caused deterioration of water quality in Lake Meredith (Bureau of Reclamation, 1986). Salinity increases when freshwater inflows are low and lake levels decline, and decreases when freshwater inflows are high and lake levels rise. The purpose of the project is to reduce salt loading into the lake by limiting the influence of the brine aquifer on inflows of the Canadian River.

The Environmental Protection Agency sets ***maximum contaminant levels*** (MCL's) for drinking water for both primary contaminants (that deal with effects of water on human health) and secondary contaminants (that deal with taste, smell, and appearance). MCL's for secondary contaminants are not legally enforceable, but they do act as national drinking water standards. Chlorides in the lake have been recorded as high as 570 milligrams per liter (mg/l), more than twice EPA's MCL of 250 mg/l, and TDS has been recorded at 1,880 mg/l, more than three times the MCL of 500 mg/l.

The effects of poor water quality in the lake vary. When chloride concentrations exceed 250 mg/l, water begins to taste salty and steel and aluminum corrosion increases. Sulfates may cause problems for some industrial users when concentrations exceed 100 mg/l, and when over 250 mg/l the water would begin to taste bitter. The CRMWA and its water users are concerned about the continuing degradation of water quality in Lake Meredith. The reservoir is the principal source of water for the 11 member cities, so it is extremely important.





VICINITY MAP

N

EXPLANATION

- AQUEDUCT SYSTEM
- PUMPING PLANTS
- O PROJECT CITIES
- REGULATING RESERVOIR
- ★ PROJECT HEADQUARTERS

UNITED STATES
DEPARTMENT OF THE INTERIOR
ROGERS C. B. MORTON, SECRETARY
BUREAU OF RECLAMATION
GILBERT G. STAMM, COMMISSIONER

CANADIAN RIVER PROJECT

TEXAS

MAP NO. 662-525-1103

SCALE OF MILES
8 0 8 16 24

JANUARY 1967
REVISED —— APRIL 1974

☆ GPO—781-08

Alternatives

Two alternatives are described in this chapter: the 1995 Preferred Alternative and a No Action Alternative. The 1995 Preferred Alternative is a modified version of the Well Pumping and Deep Well Injection Alternative, the preferred plan in the 1986 EA. Modifications made to the 1986 plan include the number and capacity of collection and injection wells, injection rate, acres of habitat disturbed, and reduction in base flows of the Canadian River. Additional data gained from a groundwater model showed that these modifications allowed quicker reductions in salinity with less overall impacts. A summary of the differences between the original 1986 Preferred Alternative and the modified 1995 Preferred Alternative are shown in Table 1 below.

Table 1: Primary Differences Between the 1986 and 1995 Preferred Alternatives

Difference	1986 Preferred Alternative	1995 Preferred Alternative
Collection wells	3 wells in the Tecovas Formation	Phase I: 10 wells in the Trujillo Formation Phase II: an additional 15 wells in the Trujillo Formation
Injection wells	3 wells in the Abo Formation (about 5,000 feet deep)	2 wells into the Sangre de Cristo Formation (about 4,000 feet deep)
Injection Rate	3 cfs total	1.6 cfs total
Surface Disturbance Area	Temporary: 45 acres Permanent: 15 (all under easement)	Temporary: 68 acres Permanent: 10 acres (all under easement)
Anticipated Percent Reduction in Base River Flows		
From Ute Dam to Revuelto Creek	75% (1.5 cfs)	35% (1.4 cfs)
Below Revuelto Creek	19% (1.5 cfs)	12-14% (1.4 cfs)

NOTE: Percentages are based on base median flow conditions which have changed since 1986 due to the raising of Ute Dam.

This supplemental EA discusses the impacts of the 1995 Preferred Alternative. A general layout is shown in Drawing 1253-600-36.

The second alternative analyzed in this supplemental EA is the No Action Alternative, in which nothing would be done to reduce salt loading in Lake Meredith. No Action serves as a basis of comparison for the Preferred Alternative, as required by the National Environmental Policy Act. There were other alternatives analyzed in the 1986 EA. These are briefly discussed later on in this chapter.

THE 1995 PREFERRED ALTERNATIVE

This alternative would use a series of wells to intercept and remove saline groundwater moving into the alluvial aquifer of the Canadian River. The project area is in eastern New Mexico, downstream of Ute Dam and Reservoir. Water removed would be disposed of by injection into wells completed in underlying deep saline aquifers.

Facilities

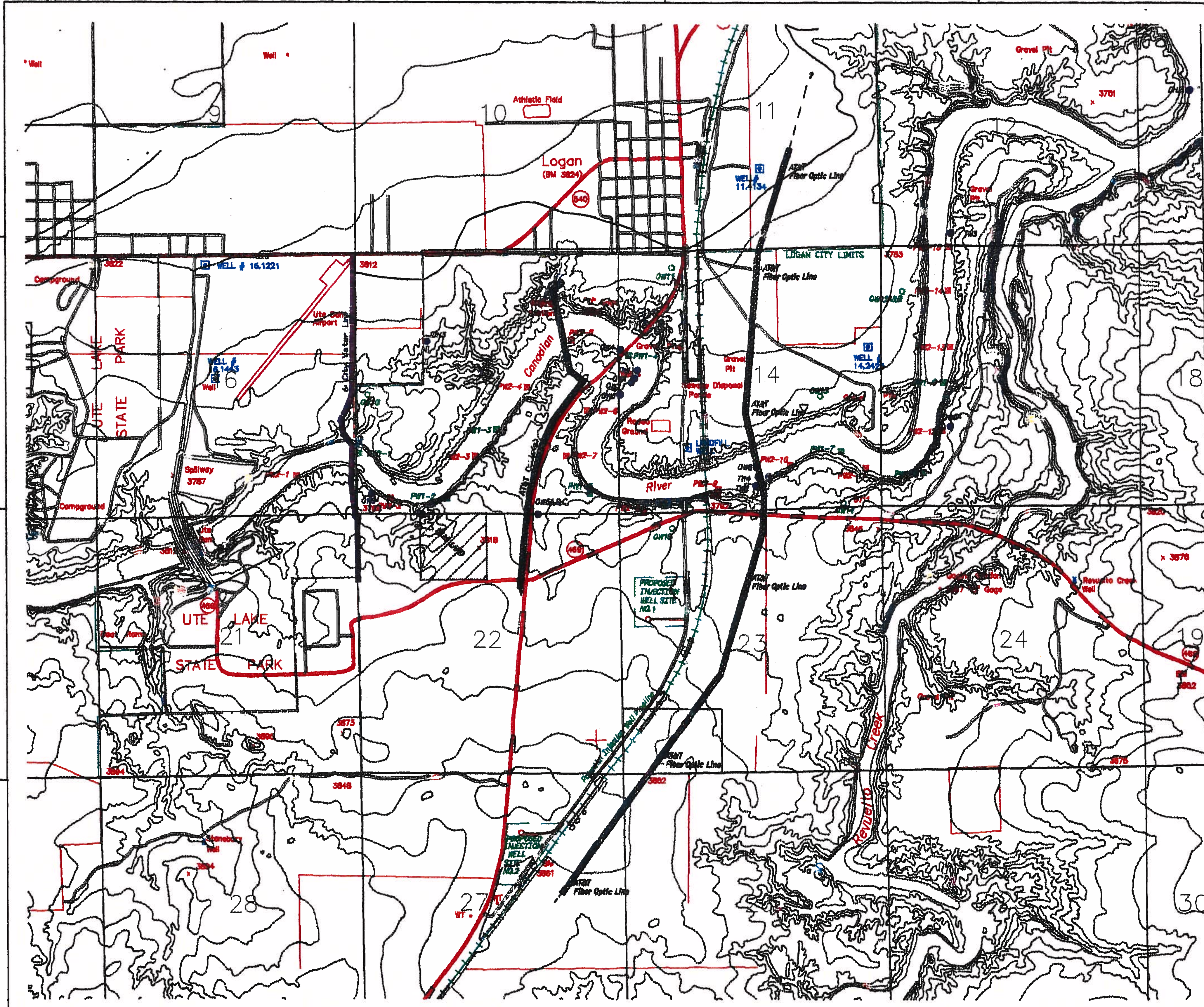
Up to 25 production wells would be completed in two phases in this alternative. Phase 1 would include the design and construction of ten production wells. Phase 1 would also include design of an additional 15 wells. These wells would be completed under a later (Phase 2) contract, if necessary. All wells would be drilled to the top of the Upper Shale unit in the Tecovas Formation, about 90-165 feet below the Canadian River. Collection would be out of the Trujillo Formation (Figure 2).

The anticipated operation pumping rate of the production well field would be 1.6 cfs. Each well would be equipped with a submersible pump, apparatus for controlling pump discharge, and sensors for monitoring discharge rate and the electrical conductivity (a measure of salinity) of the pumped brine. The well head would be protected by a small concrete or metal housing.

Two injection wells would dispose of the collected brine. Each would have a injection rate of 1.6 cfs, with one serving as a backup to the other. One injection well would be constructed first and operated for a period of 60 days before construction of the second. The exact lithologic zones the brine would be injected into is unknown at present, but it is anticipated they would be permeable zones in the Permian or Pennsylvanian sediments less than 4,000 feet deep. Data from oil wells surrounding the area show that the most likely places for injection might be in the Glorieta Sandstone (the upper several hundred feet of the San Andres Formation), and in the lower part of the Abo and upper part of the Sangre de Cristo Formations. Chemical analyses would be done to determine compatibility between the water existing in the injection zone and the injected brine.

The location of each injection well is shown on the Lake Meredith Salinity Control Project map (1253-600-36). At each injection site, a metal building would house the well head, injection pump, and monitoring and control equipment. One building would include a maintenance area for injection equipment and a restroom with a septic tank and leach system. A 2-inch diameter domestic water line would supply water from the City of Logan to this injection well site. The immediate area around each building would be protected by a chain-link security fence. Next to each building, there might also be a small brine holding tank or sediment settling pond. A 1,000-ft by 1,000-ft 5-strand barbed wire fence would be built around each injection well site to keep livestock out.

1253-600-36



REVISION DATE 02-06-95

SCALE 1"=1000'

EXPLANATION

- = Existing 6" Logan City Waterline
- = Existing Water Wells
- = Completed Test or Observation Wells
- = Proposed Phase 1 Observation Wells
- = Proposed Phase 1 Production Wells
- = Proposed Phase 2 Production Wells
- = Primary Roads
- = Secondary Roads
- = Railroad
- = Fence

ALWAYS THINK SAFETY

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LAKE MEREDITH SALINITY CONTROL PROJECT
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LAKE MEREDITH SALINITY CONTROL PROJECT

MAP

1253-600-36

A buried pipeline would be built to collect the brine from the production wells and convey it to the injection wells. It is estimated that roughly 23,500 feet of pipeline would be needed to convey brine from the production wells to the first injection well, and another 5,500 feet to the second injection well. Pressure transducers or another monitoring system would also be installed in the pipeline to detect breakage and to cause an automatic shut-off of the production wells in that eventuality. Electrical power to the injection facilities would be provided by overhead transmission lines. Power distribution to individual production wells would be by buried cable or overhead transmission line.

All weather permanent roads would be built to provide access to the injection wells for construction and operation and maintenance. Temporary roads and/or ground clearing might be needed for construction of the production wells, but it is anticipated that access for operation and maintenance would be gained via trails and off-road or all-terrain vehicles.

Both flow and conductivity measurements will be made as part of this alternative. In addition to an existing U.S. Geological Survey stream flow gauging station at the Highway 54 bridge, and a second station would be added just upstream from the confluence of Revuelto Creek. These gauging stations would be used to monitor river discharge and any flow changes created by production wells. Water quality impacts of the project would be monitored by regularly measuring electrical conductivity at several locations. Several sensors would be installed at selected locations in the river to directly monitor surface water salinity levels. Seven additional observation wells would be constructed mainly to monitor impacts to the Trujillo aquifer from operation of the production wells. Five of the wells would be located north of the river and 2 wells to the south. Six would be completed in the lower Trujillo formation and the seventh in the Tecovas formation.

Facilities in Phase 1 would be tested before any of the wells in Phase 2 are developed. Testing could last for up to 2 years. Monitoring of salinity in the river would be used to adjust pumping rates from individual wells. If enough brine were removed from the river by the wells in Phase 1, plans for Phase 2 would not be implemented.

Costs

The estimated total project cost is approximately $9,400,000, and would be shared by Reclamation (31%) and CRMWA and the Texas Water Development Board (69%). Reclamation's share will include design and other non-construction costs. These costs are estimates and could differ significantly from final designs developed by the contractor.

Operations and Maintenance

Section 304, part c, of Public Law 102-575, which authorized the project, provides that, upon completion of construction and testing of the project, the Secretary of the Interior shall transfer the care, operation, and maintenance of the project works to CRMWA or to a bona fide entity mutually agreeable to the States of New Mexico and Texas. Pursuant to this, the salinity control facilities would be owned by the Federal government and operated and maintained by CRMWA under contract with the United States. No private land would be acquired as all facilities would be built on permanent easements.

It is anticipated that operation and maintenance at the injection well facility would be performed daily with at least one operator at one of the injection wells for part of each day. Daily operation would involve monitoring injection rates and production well discharges and making adjustments as necessary. The range of adjustments would include controlling brine production from wells, adjusting injection well pressures, and adjusting flows to each injection well. It is estimated that weekly (or more frequent) visual inspections of each production well would be needed. Remote transmission capabilities would be built into the system to transmit monitoring data to the CRMWA office at Sanford Dam.

Fish and Wildlife Measures

Impacts to fish and wildlife from construction of the project would be minimized where possible. Production and injection well facilities would be fenced to provide an area of vegetation protected from livestock grazing. Construction would be scheduled in the floodplain only during low-flow or low precipitation conditions, and all staging, parking, storage and refueling areas would be constructed above the 100-year floodplain. Reclamation would require the contractor to comply with State water quality standards, including appropriate erosion control measures. Finally, Reclamation and CRMWA would enter into discussions with the Service on a conservation agreement for the proposed Arkansas River shiner *(Notropis girardi)*, as discussed in the next chapter.

NO ACTION ALTERNATIVE

This alternative would mean no action would be taken to reduce salt loading in Lake Meredith. If no action were taken, water quality in the lake would continue to deteriorate. The EPA's ***maximum contaminant level*** (which serve as national water standards) of 250-mg/l for chloride and 500-mg/l for total dissolved solids would continue to be exceeded. Water to the CRMWA member cities would taste salty and increasingly cause metal fixtures to corrode.

The quality of water at present in Lake Meredith exceeds Texas standards for potable water. For this reason, the CRMWA is making plans to purchase from 30,000-45,000 acft/yr of groundwater drawn from the already depleted Ogallala Aquifer to mix with Lake Meredith water (CRMWA, 1995). Withdrawals could total 60,000 acft in a drought year. This project is expected to cost $75 million, which CRMWA would likely have to pass on to the water customer. Groundwater depletion and the cost would increase as the population grows. Member cities may also have to buy additional groundwater or surface water on their own.

ALTERNATIVES ALSO CONSIDERED IN THE 1986 EA

Blending Groundwater with Lake Meredith Water

The CRMWA and some member cities could blend groundwater with Lake Meredith water to raise the quality to federal and state standards, as mentioned above. Based on projections done for Reclamation's 1986 EA/FONSI, 32,300 acft/year of water (in addition to Lake Meredith's current firm annual yield of 76,000 acft/year) would be required in the year 2000 to meet CRMWA needs. Additional water requirements would grow to 53,300 acft/year in 2010, 77,600 in 2020, 94,300 in 2030, and 110,700 acft/year in 2040. Much of this extra water would be drawn from the Ogallala Aquifer.

Improvement of water quality in Lake Meredith would lessen dependency on the aquifer, and would increase the flexibility of CRMWA member cities in development, delivery systems, and delivery points of their municipal systems. Since this alternative would not improve Lake Meredith water, it was not selected as the 1986 Preferred Alternative.

Desalination of Lake Meredith

A reverse-osmosis desalination plant at the division of the Main and East Aqueducts near Pumping Plant No.2 at Lake Meredith was also analyzed. Maximum capacity of the plant would be 50 million gallons/day of water with TDS ranging from 800-900 mg/l. The desalting plant would produce 6,100 acft/year of brine effluent, which would be stored in a holding pond. About 2,200 acres of private land would have to be acquired for the pond.

Construction costs for this alternative would be approximately $125,350,000 in 1986 dollars, and operation and maintenance costs $27,300,000 (Bureau of Reclamation, 1988). Both of these costs are much more than the Preferred Alternative. For this reason, and because this alternative does not improve the water quality in the Canadian River, desalination of Lake Meredith was not selected.

Alluvial Pumping

An infiltration gallery pumping system (an excavated infiltration trench with perforated pipe as the collection element, a water collection sump, and a sump pumping plant) was also considered. The perforated pipe would be laid in the alluvium to intercept rising brine as it entered the river channel. The brine would flow into the sump and be pumped to an evaporation pond or injected into a deep well.

This alternative was discarded for several reasons. First, water pumped from the alluvium could contain a high total suspended solids content, requiring a filtering plant to prevent clogging of the injection well. This would increase the cost of pumping substantially. Second, this pumping program would probably dry the streambed for several miles. The associated legal problems with disrupting existing water rights and impacts on wildlife and fishery resources were considered unacceptable.

Hydrostatic Control Pool

Construction of a 660-acre hydrostatic control pool on the Canadian River just downstream of the confluence of Revuelto Creek was also considered. About 3.5 miles of the river, extending from Ute Dam downstream to a new retention structure, would be converted to a lake-type environment.

The backwater effects would adversely affect Ute Dam during normal operations and at flood (during spills) stage. In addition, the suppressed brine could eventually seep out in other areas. The cost of this alternative was also of concern. For these reasons, it was not selected.

Well Pumping and Brine Disposal Pond

This alternative would differ from the Preferred Alternative primarily in the method of disposal of the brine effluent. Discharge from the production wells would be piped to a playa lake for surface storage and evaporation. A 230-acre area lined with 20-mil polyvinyl-chloride membrane liner and enclosed with a dike would serve as the disposal pond. This pond would contain about 100 years of salt and sediment deposits.

The pond area would be totally lost to wildlife and other uses. Construction would also cost about four times as much as the Preferred Alternative, so this alternative was not selected.

Affected Environment and Environmental Consequences

The High Plains region of the southern Great Plains occurs predominantly in the Panhandles of Texas and Oklahoma and adjacent portions of New Mexico, Kansas and Colorado (Nelson, 1983). The Canadian River cuts deeply into this plateau as it flows from New Mexico into Oklahoma, effectively separating the High Plains into two distinct parts; the Northern High Plains of the Texas Panhandle, Oklahoma, Kansas and Colorado, and the Southern High Plains (also called the Llano Estacado, or Staked Plains) of Texas and New Mexico. In between lies the Canadian River valley with its associated breaks and canyons (Figure 3).

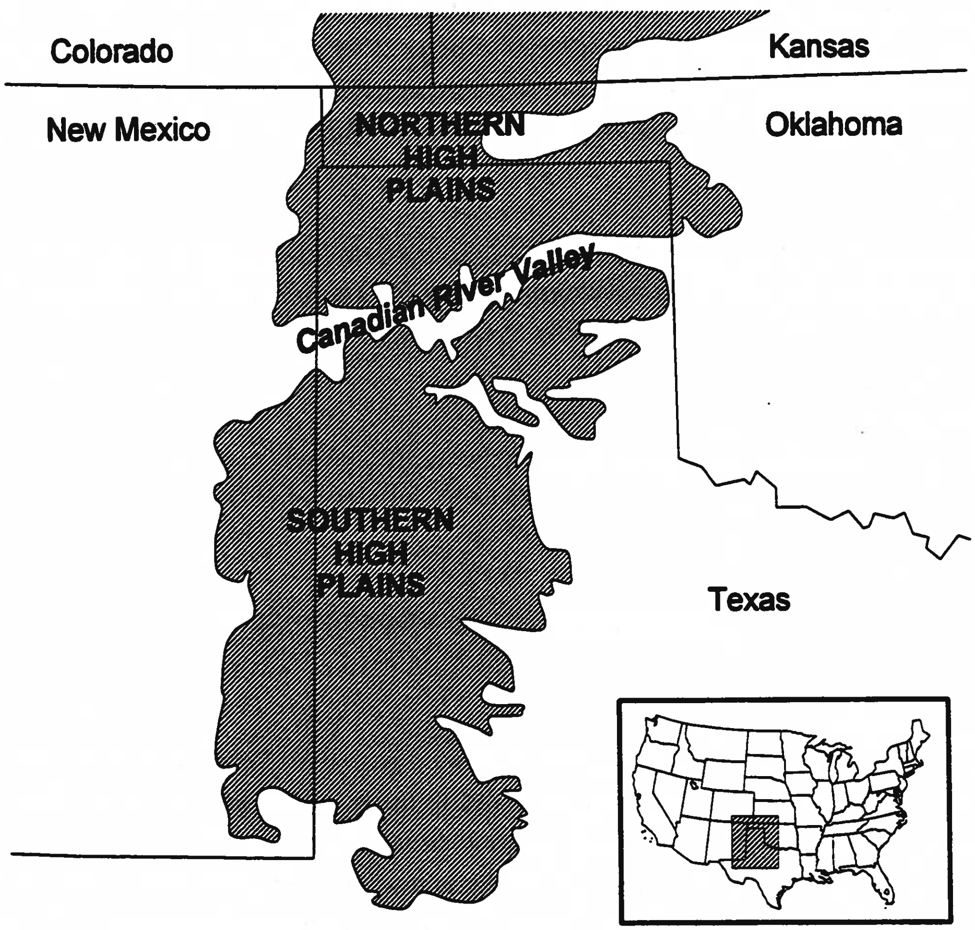


Figure 3: The Southern Great Plains of North America. Adapted from Choate (1991) and Nelson (1983).

SOILS

Affected Environment

The floor of the Canadian River channel is covered in fine sand, silty sand, and silt (Bureau of Reclamation, 1979). Uplands above the channel, particularly on the north side of the river, are blanketed by gravelly and sandy terrace and windblown deposits. Depending upon the rate of flow, the river frequently carries large volumes of suspended red sediments, resulting in a reddish appearance. Ute Dam has served as a sediment trap for the river since its construction in 1962.

Impacts of the Preferred Alternative

Surface disturbance would include site excavation and leveling, construction of all-weather roads to the two injection wells, and installation of pipelines. Pipelines could be one large diameter pipe or a bundle of smaller pipes buried to a depth of 3-4 feet. Power lines or buried cable would be extended to the sites from the nearest source of electricity.

Blading, trenching, and vehicle movement would affect soils in construction rights-of-way (ROW) easements, which parallel existing roads to minimize impacts. The ROW for the production wells would total 12 acres, the ROW for the injection wells 4 acres, the pipeline 50 acres, and miscellaneous facilities 2 acres, for a total of 68 acres. About 10 of theses acres would be affected permanently, the rest temporarily.

Soils in the area could be contaminated by accidental spills of brine during the drilling of wells or operation of the project. Impacts would be minimized by the safeguards required of the contractor.

No Action Impacts

There would be no impacts to the soils in the area from this alternative.

GROUNDWATER RESOURCES

Affected Environment

Sedimentary rocks in northeastern portion of New Mexico range from Upper Pennsylvanian to Holocene in age. Only rocks younger than the Permian crop out in the area. The Sangre de Cristo Formation overlies the Precambrian basement complex (granite) beneath the area (Figure 4). Permian sediments overlying the Sangre de Cristo include, in ascending order, the Abo, Yeso, San Andres, and Artesia (Bernal) Formations. The Abo and Sangre de Cristo Formations contain shales and sandstones. The other Permian sediments contain shales, siltstones, sandstones, dolomites, and anhydrite beds. Salt beds are common in the Yeso, San Andres, and Artesia Formations, but many units have been removed by dissolutioning beneath and north of the Canadian River in sediments younger than the Yeso. The Abo and Sangre de Cristo Formations are continental deposits that were laid down next to a topographic high. The remaining Permian sediments were deposited under a marine environment.

Three Triassic units are exposed in the area. The oldest is the Tecovas Formation, composed of mostly fine-grained sandstone with some conglomerate and shale. The Upper Shale unit of the Tecovas acts as a limited barrier that retards water movement into the overlying Trujillo. Thickness of the Tecovas in the study area ranges from about 100-225 feet. The Trujillo Formation conformably overlies the Tecovas. This formation varies from about 160-290 feet in thickness and forms the massive cliffs along the Canadian River. It consists of cross-bedded sandstones and conglomerates with lesser amounts of discontinuous shales. The youngest Triassic Formation rocks exposed in the area are shale, siltstone, and sandstone of the Chinle. The irregular, discontinuous, and lenticular bedding in the Triassic sediments indicate deposition in fluvial environments.

Quaternary sediments are extensive along the river. The oldest units include terrace sand and gravel deposits, occurring at three different levels along the walls of the trench. Terrace debris can be up to 60 feet thick. Alluvium partly fills the river trench, varying from sand and gravel to fine, uniform sand. Maximum thickness of this debris is also up to 60 feet. The terrace and alluvial deposits are locally mantled by colluvium and eolian deposits.

Contributing Brine Aquifer

Natural sodium chloride dissolution occurs in the Permian strata several miles southwest of the Logan area. Salt brine enters the Canadian River along a reach of the river from Ute Dam to Revuelto Creek (about 5.5 miles). The brine moves upward into the Tecovas Formation in an east-northeasterly direction. Drilling records indicate that this sandstone formation is located in the bottom of the Triassic strata at a depth of 350-500 feet below land surface some area to the southwest (Figure 4). The Tecovas Formation is probably connected to the Upper Permian strata (encountered at approximately 500 feet) by fractures or dissolution channels. Brine seeps upward from the Upper Permian strata into the Tecovas. Near the Canadian River, the brine enters the Trujillo aquifer at an estimated rate of 0.6 cfs.

As the brine moves northward and upward, it passes through up to 60 feet of silt, sand, and gravel deposited at the bottom of the Canadian River valley. Here it mixes with freshwater moving southward from the upper portions of the Triassic strata in a zone that roughly follows the river. The river trench thus acts as a general division line for fresh and saline groundwater, with the saline water found generally to the south. The resulting solution, further diluted by surface water within the alluvium as it moves downstream, emerges at many points along the river. These points may be directly associated with brine pools which occur along the river from Ute Dam to 10 miles downstream.

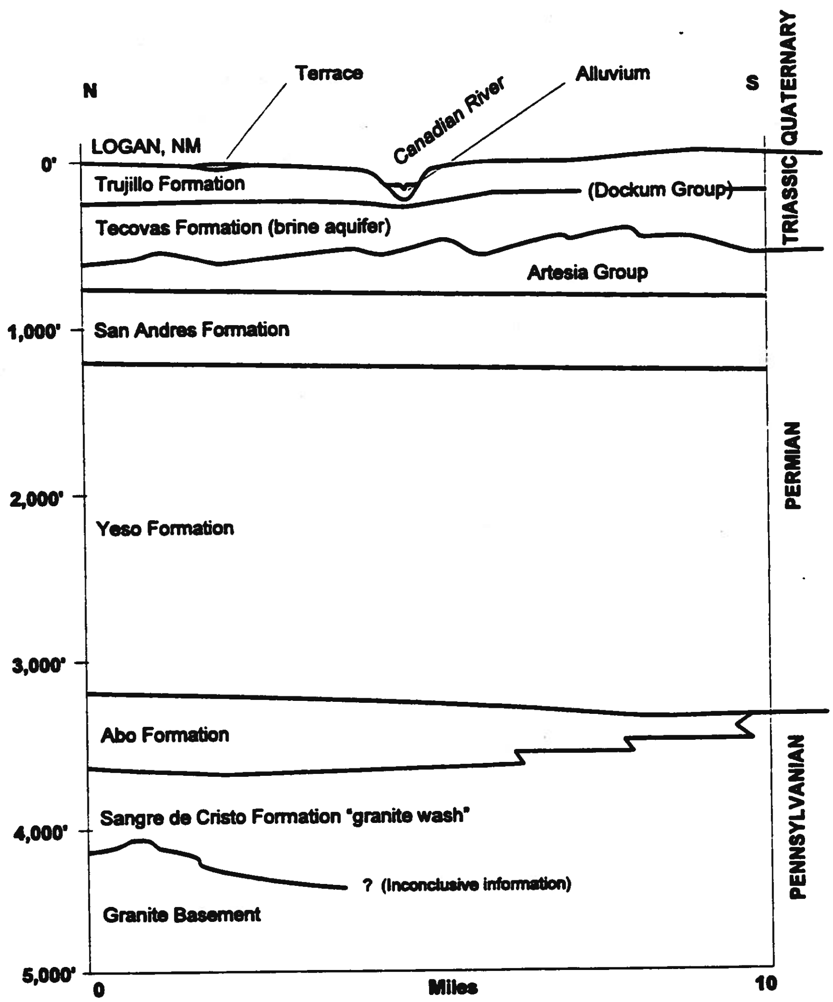


Figure 4: Conceptual Cross-Section Showing the Correlation of Strata that Underlie the Logan, New Mexico, Vicinity.

Flow modeling and aquifer tests suggest hydraulic conductivity for the Tecovas aquifer varies from 5-36 feet per day. Except near the Canadian River where jointing occurs, the Tecovas aquifer in the area is confined due to the Upper Shale unit in the formation acting as an "*aquitard*" (or water barrier). Hydraulic conductivities for the Trujillo are estimated to be 9.0 feet per day. It is expected that the Trujillo aquifer is generally unconfined throughout most of the area. However, an aquifer test performed on that formation in the study area indicates that locally there are confining conditions.

Samples of water from observation wells into the Tecovas Formation south of the river have TDS concentrations up to 63,400 mg/l and chloride concentrations up to 35,600 mg/l. Groundwater flow modeling using variable fluid density suggests that a wedge of brine could be occurring in the Tecovas Formation for about 1,400 feet to the north of the river. The wedge would explain why there are some elevated brine levels measured in one observation well (DH-3) completed in the Tecovas just to the north of the river. However, there have been no indications of brine in the Trujillo to the north of the river.

Injection Zone

The geologic zone targeted for injection of collected brine is the Sangre de Cristo Formation just below the Permian strata in the Pennsylvanian strata (Figure 4), although zones in the Abo and Sangre de Cristo will be evaluated. The intended injection depth is 3,500 to 4,000 feet. The quality of the water in the potential injection zone is unknown at present. It is probable the water is saline, perhaps as saline as the brine. There are no known users of water from the targeted zones in the area.

Impacts of the Preferred Alternative

Contributing Brine Aquifer

Generalized impacts to the shallow brine aquifer and its discharge to the river were evaluated using a 3-dimensional groundwater flow and solute transport mode. Simulations were run with a production well field in the lower Trujillo aquifer with a combined total pumping rate of 1.6 cfs, the target pumping rate for the project. After 10 years of continuous well pumping, the discharge rate from the ground-water aquifer to the river from Ute Dam to the Revuelto Creek confluence was reduced by 1.4 cfs. With the average aquifer accrual to the river assumed to be 3 cfs, the 1.4 cfs reduction would result in a groundwater flow reduction of about 47 percent. The model did not simulate reductions to surface flows in the stream.

Injection Zone

Depending on the water quality in the injection zone, the addition of brine from the production wells might cause salinity levels to increase. Also, chemical and physical differences between the injectate and receiving waters would probably result in the introduction of sediments or the formation of precipitates that, with time, would reduce the porosity of the receiving aquifer near the injection well.

Injection pressures would not be allowed to exceed fracture limits. The targeted injection zones are at a sufficient depth so that brine should not work its way up along the fractures to the Trujillo Aquifer, which is used as a domestic and municipal supply. Hydro-fracturing might cause some small seismic events, but these would not be detected at the surface by area residents.

No Action Impacts

The No Action alterative would have no impacts to either the contributing brine aquifer or the injection zone. Brine seepage would continue to enter the Canadian River from the Trujillo Formation.

SURFACE WATER RESOURCES

Affected Environment

Bounded on the downstream end by Sanford Dam (completed in 1965) and on the upstream end by Ute Dam (completed in 1962), the Canadian River stretches 150 miles through the study area. Its broad, flat, shifting-sand bottom meanders back and forth and is frequently braided. River depths are generally uniform with maximum depths of less than 2 feet. The river frequently carries large amounts of sediments, causing the water to appear thick and red.

The frequency of flows used in this document were determined from measurements made at the U.S. Geological Survey's (USGS) Logan gauging station, located 2 miles downstream from Ute Dam. Discharge at the gauge mostly reflects seepage from the dam, along with brine groundwater accruals to the river in this reach. Two time periods, 1965-1993 and 1986-1993, were used demonstrate any changes in the flow regime due to the raising of Ute Dam. The first period reflects flows after Ute Dam was first closed, while the second shows flows after Ute Dam was raised to allow for more storage. This data indicates that flows in the river have been continuous due to seepage past the dam and have increased with the increased storage ability of Ute Reservoir.

It is estimated that the river reach from Ute Dam to the confluence of Revuelto Creek has a total base flow of 4 cfs. Of that base flow, 1 to 2 cfs is due to seepage past Ute Dam. The remainder is made up of groundwater accruals.

Revuelto Creek, the first major tributary below Ute Dam, is located about 6 miles downstream from the dam. USGS data indicates that Revuelto Creek contributes about half of the historic combined flows below its confluence with the Canadian River (1984). Flows in the creek are largely sustained by irrigation return flows from the Tucumcari Project. Average monthly flows are 45 cfs, and median flows are 8 cfs. Flows in Revuelto Creek are greater than flows in the Canadian River at Logan. Combined average flows are 75 cfs, and median flows are 10 cfs. Periods of no flow, especially during the non-irrigation season, are also common in the creek.

Between Revuelto Creek and the New Mexico-Texas State line (35 miles from Ute Dam), there is an additional freshwater inflow, primarily from Triassic Formation groundwater seepage. From this point to Amarillo (148 miles from the dam), average monthly flows in the river increase to 190 cfs, and median flows to 50 cfs.

Water Quality

TDS and Cl concentrations in the Canadian River depend on location and surface water runoffs. Measurements in 1983-1984 ranged from 1,175 to 30,400 mg/l TDS, and 340 to 16,900 mg/l Cl (Hydro Geo Chem, Inc., 1984). Cl concentrations, based on 325 analyses, averaged 218 mg/l at Revuelto Creek, 1,728 mg/l at the state line, 530 mg/l at the gauging station at Tascosa, Texas, and 320 mg/l at the Amarillo gauge just upstream from Lake Meredith.

During low river flows, upward brine movement and evaporation concentrates salts at or near the channel surface. During high flows, these surface salt deposits are flushed downstream and into Lake Meredith. Based on an assumed flow from the brine aquifer of 0.6 cfs, it is estimated that the contribution of Na, Cl, and SO_4 averages about 26,900 ton/year.

TDS and Cl concentrations in Lake Meredith measured from 1964-1982 appear to be inversely related to surface water inflows (Hydro Geo Chem, Inc., 1984). Although high flows flush deposited salts from the river channel, the volume of water is far in excess of the volume of salts. During periods of low flows, evaporation losses concentrates salts within the lake, which could be in excess of 64,000 acft/year at full conservation pool. Lake Meredith has never overflowed, so the only significant salt-removal mechanism is water withdrawal by the CRMWA. The full firm annual yield of Lake Meredith was estimated to be 103,000 acft/year in 1960 (Reclamation), but limited water inflows have restricted withdrawal to about 72,000 to 76,000 acft/year.

Impacts of the Preferred Alternative

This alternative would reduce the assumed base flow of 4 cfs between Ute Dam and Revuelto Creek by an average of 1.4 cfs (or 35 percent). The reduction would equate to 12-14 percent of the base flow below the confluence. The alternative would lower the artesian head of the brine aquifer below the river elevation. Upward movement of the brine and later evaporation would no longer concentrate salts near the surface of the river channel. As a result, average concentrations of Na, Cl, and SO_4 flowing into Lake Meredith should be reduced. At the end of the 10 year simulation, chloride loading to the river was simulated to be reduced from 21,800 tons per year to 3,500 tons, or a reduction of 84 percent. Groundwater levels in the upper Trujillo aquifer were simulated to decline approximately 1 to 1.5 feet in the immediate vicinity of Logan, and about 10 feet along the Canadian River.

No Action Impacts

Without any action there would be no impacts to the water quality of the river or lake. Flows would remain the same and Cl and SO_4 levels in Lake Meredith would continue to increase. As salinity level in the lake increased, mixing would become more expensive and more taxing on groundwater resources.

VEGETATION AND WETLANDS

Affected Environment

The project area lies within the Canadian Breaks subregion of the Rolling Plains vegetation zone of Texas, and is bordered on the north and south by the caprock of the High Plains zone (Smeins, 1978, and Fish and Wildlife Service, 1986). It is similar to the Escarpment Breaks along the east caprock, which serves as a transition zone between the High Plains grasslands and the mesquite savanna of the Rolling Plains, but also includes the floodplain and sandhills of the Canadian River in the northern Texas Panhandle. It is generally a mixed grass prairie with some low shrubs grading from succulents and dwarf shrubs in the east to a savanna of scattered clusters of woody species in the west (Smeins, 1978).

McMahan and others have described in detail the Canadian River drainage area according to dominant vegetation associations (1984). The western portion (New Mexico) of the study area is dominated by *mesquite shrub/grassland* and *mesquite brush* associations. A *sandsage-harvard shin oak brush* assemblage occurs in sandy soils of this area in both New Mexico and Texas. Eastwards, toward and around Lake Meredith, a *mesquite-juniper brush* association is prevalent. The principal drainages of the Canadian River basin are largely comprised of *cottonwood-hackberry-saltcedar brush* and *woods* associations. Cottonwoods are common on the wide, open canyon floors beside permanent water courses, while hackberry, elm, willow, and plum increase in size and height as the narrowing canyon gives greater protection from drying winds, and as water from the soil becomes more abundant (Tharp, 1936).

The whole breaks area is bounded by the Northern and Southern High Plains, which are almost completely dominated by cultivated cover crops and row crops. Some areas of blue grama-buffalograss grassland occur, especially in the northwestern portions of the High Plains. Although buffalograss and grama grasses typically dominate climax sites, overgrazing and fire suppression have allowed species such as yucca, snakeweed, cholla, and annual broomweed to become established (Fish and Wildlife Service, 1986). Commonly associated plants for each major vegetation type are listed in Table 2.

Riparian and Other Wetland Areas

The predominant wetland type in the project area is riparian wetlands associated with the Canadian River and its tributaries. These assemblages are generally far removed from the streamflow and appear to be primarily dependent upon alluvial flows (Fish and Wildlife Service, 1986). These areas include a diversity of forested, scrub-shrub, and emergent vegetation types. Plains cottonwood is the dominant cover plant and is concentrated in moist areas along streambeds (Sikes, 1975), though saltcedars, black willow, redcedar, netleaf hackberry, lambsquarters, baccharus, and goldenrod are also prevalent.

Riparian ecosystems in the breaks are especially valuable to wildlife as habitat and food sources because of their vegetative and structural diversity, their high productivity (Johnson, 1977), being unique to the mostly open, semi-arid high plains. Within the greater project area, the Service estimated that there are about 7,000 acres of riparian woodland, of which approximately 6,100 acres are in Texas and 900 acres in New Mexico (Fish and Wildlife Service, 1978).

The Service stated that other small wetlands are scattered along the Canadian River and its tributaries throughout the study area and that obligate hydrophytes, such as Johnson grass, cattails, rushes and sedges, are found rooted in saturated soils below or immediately above the water surface (Fish and Wildlife Service, 1986). The largest single wetland of this type in the project area is located in a depression at the toe of Ute Dam, fed by seepage from the reservoir. Tailwater and spillway flows have scoured a narrow, deep channel through this wetland.

Table 2: Plant Species Occurring in the Study Area

Major Vegetation Type	Commonly Associated Plant Species
Mesquite shrub/grassland and mesquite brush	Narrow-leaf yucca, tasajillo, juniper, grassland pricklypear, cholla, several grama and three-awn species, buffalograss, little bluestem, wheatgrass, Indiangrass, switch-grass, James rushpea, scurfpea, sandlily, plains beebalm, scarlet gaura, yellow evening primrose, sandsage, wild buckwheat
Mesquite-juniper brush	Lotebush, shin oak, sumac, Texas pricklypear, tasajillo, kidneywood, agarito, redbud, yucca, Lindheimer silktassel, sotol, catclaw, Mexican persimmon, grama, three-awn, curly mesquite, buffalograss, tridens
Sandsage-harvard shin oak brush	Sumac, Chickasaw plum, Indiangrass, switchgrass, sand bluestem, little bluestem, sand lovegrass, big sandreed, grama, sand dropseed, sand paspalum, lead plant, scurfpea, scarletpea, slickseed bean, wild blue indigo, wild buckwheat, beach morningglory
Cottonwood-hackberry-saltcedar brush and woods	Lindheimer's black willow, buttonbush, grounsel-tree, rough-leaf dogwood, elm, plum, Panhandle grape, heartleaf ampelopsis, false climbing buckwheat, cattail, switchgrass, prairie cordgrass, salt grass, alkali sacaton, spikesedge, horsetail, bulrush, coarse sumpweed, Maximilian sunflower
Blue grama-buffalograss grassland	Sideoats grama, hairy grama, sand dropseed, cholla, grassland pricklypear, narrowleaf yucca, western ragweed, broom snakeweed, zinnia, rushpea, scurfpea, catclaw sensitive briar, wild buckwheat, woollywhite, yucca, snakeweed, cholla, annual broomweed

Compiled from Fish and Wildlife Service (1986) and McMahan et.al. (1984).

Impacts of the Preferred Alternative

The Preferred Alternative would impact about 68 acres of mesquite shrub/grassland in the Logan area, all of which would be under ROW easements. Direct impacts would include removal and/or destruction of vegetation within these ROW, as well as any temporary staging or storage areas. These impacts would be temporary, except for about 10 acres that would be lost to facility construction. ROW would parallel existing roadways as much as possible. All areas temporarily disturbed would be reshaped and left in a condition for re-vegetation. Impact minimizing measures would be employed during construction so no unnecessary ground disturbance would occur. In addition, two 1,000-ft by 1,000-ft areas around each injection well would be fenced to enhance habitat value to terrestrial wildlife by eliminating livestock grazing from these areas.

Riparian and Other Wetland Areas

No impacts are anticipated to wetlands in the Logan area. The wetland located in the depression at the base of Ute Dam would continue to be maintained by seepage. The small emergent wetlands located along the banks of the Canadian River would not be affected. Downstream, minor improvements in water quality may have some influence on the composition of the riparian community along the Canadian River. A succession of less salt-tolerant species would be considered beneficial, for example, if dense thickets of saltcedar were displaced by stands of cottonwood and willow (Fish and Wildlife Service, 1986). More obvious effects would likely occur only where high salinity has directly influenced plant species composition and distribution.

No Action Impacts

Without any action, there would be no impacts to upland vegetation in the project area. There would also not be any impacts to wetland resources, riparian or emergent, other than natural community shifts over time due to increasing saline conditions.

FISHERY RESOURCES

Affected Environment

Because water depths in the Canadian River are generally shallow and intermittent, deep undercut banks, rocks or other forms of cover habitat are almost non-existent. Ute and Sanford Dams have effectively isolated the project area reach from any future migrations of native fish species. Fluctuations in salinity are common, especially in isolated pools during low or no flow conditions.

In 1983 and 1984, Reclamation participated in three fishery surveys of the river from Ute Dam to Lake Meredith. The first was conducted in August 1983 along the Texas portion of the river with biologists from the Service and the Texas Parks and Wildlife Department. At that time, flows from the New Mexico portion of the river were lost to evaporation and seepage into the alluvial deposits shortly after flowing across the state line. Water from the state line to Lake Meredith was restricted to isolated pools. Due to the broad, flat, sandy bottom and intermittent flows, the entire length of the river channel in Texas was driven and pools periodically sampled.

The second and third surveys were conducted in November 1983 and August 1984 along the river from the state line to Revuelto Creek and from Revuelto Creek to Ute Dam, respectively. These were done in conjunction with biologists from the Service and the New Mexico Department of Game and Fish.

A total of 20 species were collected during the 1983-84 surveys and by Sublette (1975). The Service lists 35 species of fish as occurring in the Canadian River, although many of the listed species are more typical of lake-type environment (1986). Fish species composition in Lake Meredith is similar to that of a Texas open water fishery, with many species being stocked for recreational fishing (Kraai, 1994). The species identified in the surveys and those commonly found in Lake Meredith are listed below in Table 3.

Impacts of the Preferred Alternative

The Preferred Alternative would primarily impact the habitat of fishery resources in the project area by lowering salinity concentrations and reducing flow volumes downstream of Logan, New Mexico, to Lake Meredith.

Table 3: Fish Species Occurring in the Study Area

Location	Common Fish Species
Canadian River, from Ute Dam, New Mexico to Lake Meredith, Texas	Red shiner, Arkansas River shiner, plains minnow, Arkansas River speckled chub, bullhead minnow, mosquito fish, gizzard shad, central plains killfish, green sunfish, channel catfish, river carpsucker, carp, bluegill, white crappie, sand shiner, flathead minnow, black bullhead, largemouth bass, walleye, and silvery minnow
Lake Meredith, Texas	Rainbow and brown trout, channel and flathead catfish, gizzard shad, smallmouth bass, largemouth bass, white bass, bluegill sunfish, white and black crappie, yellow perch, and walleye

Compiled from Fish and Wildlife Service (1986) and Kraai (1994).

Many species apparently tolerate a wide range of salinities, and it is difficult to predict which species would benefit from reduced salinity and at what threshold (Fish and Wildlife Service, 1986). None of the species collected appear to be dependent upon high salinities and would therefore not be adversely affected by a possible decrease in salinity. The Service stated there is no correlation between conductivity and the population parameters of overall abundance, number of species, and species diversity (Fish and Wildlife Service, 1986). However, two species exhibit an apparent preference, or adaptive advantage, which does correlate with conductivity. The Arkansas River shiner *(Notropis girardi)* exhibits an apparent preference for lower conductivities, while the sand shiner *(N. stramineus)* appears to favor higher values (Fish and Wildlife Service, 1986). Reduced salinity in the river and Lake Meredith could improve conditions for a number of other aquatic fish and invertebrate species whose diversity has been found to increase with lower salt concentrations (Clemens and Finnell, 1955).

Impacts from reduced flows on aquatic habitat in the river would be primarily experienced between Ute Dam and the confluence of Revuelto Creek. Withdrawal of 1.4 cfs from the estimated 4 cfs base flow in this reach would represent a potential 35 percent reduction. Prolonged drought or extreme heat could aggravate impacts by eliminating surface flows completely within a short distance of Ute Dam. However, periods of zero flow were a common occurrence before completion of Ute Dam, and native aquatic biota are undoubtedly adapted to the rigors of this environment.

Accumulated impacts from this alternative on both water quantity and quality in the river should diminish below its confluence with Revuelto Creek, where the anticipated 1.4 cfs reduction represents less than 14 percent of the base flow. These reductions are not expected to affect a significant amount of aquatic habitat, with the influence becoming much less apparent downstream.

No Action Impacts

Fishery resources would not be impacted from this alternative other than possible gradual community shifts resulting from the salinity preferences of individual species.

WILDLIFE RESOURCES

Affected Environment

The project area is located in the Kansan Biotic Province of Dice (1943) and Blair (1950), which represents a transitional assemblage between a western and an eastern vertebrate fauna. On a whole, the faunal composition of the area also closely resembles that of the Chihuahuan Province. The Canadian River valley and its narrower tributary canyons provide a corridor where wildlife adapted to wetter environments are found to intermingle with species typical of the drier High Plains.

The Canadian River sometimes runs completely dry through the project area, with only isolated pockets of water in it or its tributaries during that time. This greatly influences the activity and distribution of wildlife dependent upon wet or moist environments. Understandably, amphibian distribution in the area is somewhat limited (Scudday, 1975).

Reptiles, however, are numerous and live among exposed beds of sandstone and other rocks. Lizards and snakes common above and below the caprock may be found together in the area, and water snakes may even be present during wet years. Turtles are less abundant, probably being limited in their distribution, like amphibians, by the ephemeral nature of the river (Scudday, 1975), and are usually found on the river or around earthen livestock tanks.

One of the most significant biological functions of the breaks is to provide a bird sanctuary within a region largely devoid of a diversity of habitats for birds. This habitat includes large cottonwood trees along the drainages and dense mats of cottonwoods in the valley of the river itself; dense stands of cedars sometimes found along some of the drainage slopes; open grasslands and mesquite-hackberry thickets, especially around semi-permanent stock ponds. These habitats provide nesting and roosting opportunities for birds not normally found on the Great Plains. In addition, the breaks provide areas to rest and replenish energy reserves for numerous species of warblers, vireos, and other passeriform birds during the spring migration. Many species of waterfowl and shorebirds may also be found in the study area during the fall when the Canadian River and its tributaries contain water.

Mammalian fauna in the area is also quite diverse. Smaller mammals include mice, squirrels and rabbits. Bats are infrequent residents of the project area, usually found around ponds. Representative larger mammals include coyotes, foxes, bobcats, raccoons, opossums, and deer. A summary of wildlife species occurring in the area by major cover types is presented in Table 4.

Table 4: Wildlife Species Occurring in the Study Area

Major Cover Type	Commonly Associated Faunal Species
Cropland	American kestrel, horned lark, ring-necked pheasant, deer mouse, coyote, desert cottontail, and opossum
Shortgrass prairie	Great plains toad, collared lizard, rattlesnakes, bullsnake, ornate box turtle, yellow musk turtle, pond slider, Cassin's sparrow, lark sparrow, horned lark, upland sandpiper, burrowing owl, black-tailed prairie dog, chestnut-faced pocket gopher, blacktailed jackrabbit, and badger
Canyon breaks	Collard lizard, checkered whiptail, great plains skink, side-blotched lizard, rattlesnakes, western coachwhip, kingsnake, ash-throated flycatcher, kestrel, ladder-backed woodpecker, mourning dove, mockingbird, field sparrow, yellow-billed cuckoo, scaled quail, rufous-crowned sparrow, Swainson's hawk, greater roadrunner, bobcat, thirteen-lined ground squirrel, and canyon bat
Floodplain prairie	Mockingbird, red-winged blackbird, ash-throated flycatcher, ladder-backed woodpecker, mourning dove, curve-billed thrasher, black-throated sparrow, marsh hawk, grasshopper sparrow, ring-necked pheasant, white-footed mouse, deer mouse, hispid pocket mouse, Ord's kangaroo rat, bobcat, desert cottontail, and black-tailed jackrabbit
Riparian	Southern prairie lizard, ornate box turtle, Bullock's oriole, western kingbird, Mississippi kite, red-tailed hawk, red-bellied woodpecker, red-shafted flicker, scissor-tailed flycatcher, yellow-billed cuckoo, wild turkey, fox squirrel, pallid cave bat, hoary bat, raccoon, coyote, swift fox, mule deer, and pronghorn
Streambed	Blanchard's cricket frog, barred tiger salamander, plains leopard frog, Rocky Mountain toad, spadefoot, checkered whiptail, killdeer, cliff swallow, belted kingfisher, raccoon, beaver, and badger

Compiled from Fish and Wildlife Service (1986) and Scudday (1975).

Impacts of the Preferred Alternative

Direct impacts to wildlife habitat from construction would be limited to the vicinity of Logan. Production wells, pipelines, power lines, booster pumping plant facilities, and injection wells would be constructed on uplands vegetated with woody shrubs and cacti, such as juniper, mesquite, sandsage, yucca, cholla, prickly pear, and a herbaceous compost consisting of annual arid perennial grasses and fobs. The two fenced areas around the injection wells, rested from livestock grazing, would mitigate any potential loss of cover and forage habitat from construction activities.

There would be little indirect impact on terrestrial wildlife along the Canadian River or around Lake Meredith. The Service has observed that reductions in salinity would probably not cause significant impacts to terrestrial wildlife, though water-dependant wildlife, such as waterfowl, shorebirds, furbearers, amphibians, and certain reptiles could benefit indirectly from improved water quality (Fish and Wildlife Service, 1986).

No Action Impacts

Without any action, wildlife resources would only be indirectly impacted by shifts in vegetation cover and forage areas due to changing salinity regimes.

THREATENED OR ENDANGERED SPECIES

Affected Environment

Through informal consultation and coordination with the Service, the State of Texas and the State of New Mexico, the following threatened and endangered species have been identified as ranging within the study area. These species and their listing status are presented in Table 5.

Federally Listed Species: Threatened and Endangered

The project area lies within the range of three Federally listed species: the endangered southwestern willow flycatcher *(Empiodonax traillii extimus)*, endangered American peregrine falcon *(Falco peregrinus anatum)* and the threatened bald eagle *(Haliaeetus leucocephalus)*. Federally listed species are protected by law through the Endangered Species Act.

The southwestern willow flycatcher was listed as endangered in February 1995. The breeding range of this bird includes southern California, southern Nevada, southern Utah, Arizona, New Mexico, western Texas, southwestern Colorado, and extreme northwestern Mexico. Within this region, the species is restricted to dense riparian associations of willow, cottonwood, buttonbush, and other deciduous shrubs and trees. It forages within and above the canopy, taking insects on the wing or gleaning them from foliage. Habitats not selected for either nesting or singing are narrower riparian zones with greater distances between willow patches and individual willow plants. The listing data records only the extreme southwest corner of Quay County in New Mexico as falling within the range of the species.

The American peregrine falcon, listed in 1970, ranges from Canada to Alaska south to Baja California and central and northwestern Mexico, including New Mexico. It prefers high, massive cliffs near water where avian prey densities are high. For nesting, the falcon favors ledges and high cliffs near water, rarely using old tree nests or cavities (Ehrlich et. al., 1988).

The bald eagle frequents all major river systems in New Mexico from November through March, including the Canadian River. The favored prey of bald eagles are fish, waterfowl and small mammals. They prefer to roost in large trees in close proximity to water.

Federally Proposed Species: Category 1

One species proposed for listing as endangered has been identified as occurring in the project area: the Arkansas River shiner *(Notropis girardi)*. Proposed species have no legal status under the Act, and are included in this document for planning purposes.

Table 5: Federal and State Threatened and Endangered Species with Ranges in the Study Area

LISTED SPECIES		STATUS					
Common Name	Scientific Name	Federal				State	
		End	Threat	Prop	Cand	End	Threat
Plains minnow	*Hybognathus placitus*				X		
Arkansas River speckled chub	*Macrhybopsis aestivalis tetranesus*				X		NM
Flathead chub	*Platygobio gracilis*				X		
Arkansas River shiner	*Notropis girardi*			X		NM	
Brook stickleback	*Culaea inconstans*						NM
Bigscale logperch	*Percina macrolepida*						NM
Texas horned lizard	*Phrynosoma cornutum*				X		TX
Least bittern	*Ixobrychus exilis exilis*				X		
White-faced ibis	*Plegadis chihi*				X		TX
Bald eagle	*Haliaeetus leucocephalus alascanus*		X			TX	NM
Loggerhead shrike	*Lanius ludovicianus*				X		
Ferruginous hawk	*Buteo regalis*				X		
American peregrine falcon	*Falco peregrinus anatum*	X				TX, NM	
Mountain plover	*Charadrius montanus*				X		
Western snowy plover	*Charadrius alexandrinus nivosus*				X		
Black tern	*Chlidonias niger surinamensis*				X		
Burrowing owl	*Speotyto cunicularia hypugaea*				X		
Southwestern willow flycatcher	*Epidonax traillii extimus*	X					NM
Gray vireo	*Vireo vicinior*						NM
Baird's sparrow	*Ammodramus bairdii*				X		NM
Least shrew	*Cryptotis parva parva*						NM
Swift fox	*Vulpes velox*				X		

This shiner is found in the Arkansas River drainage of Arkansas, Kansas, Oklahoma, and Texas. In New Mexico, the natural distribution is restricted to the larger creeks and main channels of the Canadian River (Koster, 1957), although there is an introduced population in the Pecos River. Sublette (1975) collected Arkansas River shiners only from the Canadian River downstream from Ute Dam, and from Revuelto Creek near its confluence with the river. This species was the most abundant collected, with 42 shiners found just below the dam, 65 in Revuelto Creek, 72 about 9 miles below the dam, and 68 shiners 18.5 miles below the dam. During the 1983-84 collections by Reclamation, the Arkansas River shiner was the second-most abundant species collected in Texas (786 fish) and was the third-most abundant species collected in New Mexico (959 fish). Although they were collected throughout the entire reach of the river in a wide range of salinities (conductivity), the Service has noted that it exhibits an apparent preference for lower conductivities (1986).

Cross and Collins described Arkansas River shiner habitat in Kansas as being broad, sandy channels of the major streams of the Arkansas River where it inhabits the "lee" side of sand ridges formed by steady, shallow waterflow (1975). Although absent below Ute Dam to the confluence of Revuelto Creek, this type of habitat does occur in the Canadian River below this point. The shiner is described as spawning from June to August when streams approach flood stage. Eggs drift near the surface in the swift currents of the open channel, and hatch within 3 to 4 days after being deposited. After hatching, the fry swim to sheltered areas.

Federal Candidate Species: Category 2

There are several Category 2 candidate species that have been identified as potentially occurring in the study area. These include the plains minnow, Arkansas River speckled chub, flathead chub, Texas horned lizard, least bittern, white-faced ibis, loggerhead shrike, ferruginous hawk, mountain plover, western snowy plover, black tern, burrowing owl, Baird's sparrow, and swift fox. Category 2 candidate species are those for which the Service has information indicating that proposing to list is possibly appropriate, but for which substantial data on biological vulnerability or threats are not currently available to support the preparation of such rules. Like Proposed species, Candidate species have no legal status under the Endangered Species Act and are included in this document for planning purposes only. Some of these Candidate species are also listed by the States of Texas or New Mexico and are addressed below.

Texas State Listed Species

There are four State listed species that have been identified as occurring in the Texas portion of the study area: the threatened white-faced ibis, endangered bald eagle, endangered American peregrine falcon and threatened Texas horned lizard. Of these, the bald eagle and American peregrine falcon have already been addressed.

Oberholser and others (1974) lists the white-faced ibis as preferring to nest in inaccessible areas in freshwater marshes and sloughs and irrigated rice fields. The bird wades and probes in mud for crayfish or walks through wet meadows to take insects and frogs. Although it once bred inland Texas, it is now confined to near-coast rookeries. The Texas horned lizard ranges from Kansas and northwest Louisiana to southeast Arizona and northern Mexico. It is an inhabitant of arid and semi-arid open terrain with sparse plant cover, and feeds on spiders, sowbugs and insects, especially ants.

New Mexico State Listed Species

There are ten State listed species that have been identified as occurring in the New Mexico portion of the study area: the threatened Arkansas River speckled chub, endangered Arkansas River shiner, threatened brook stickleback, threatened bigscale logperch, threatened bald eagle, endangered American peregrine falcon, threatened southwestern willow flycatcher, threatened gray vireo, threatened Baird's sparrow, and threatened least shrew. Four of these species (the Arkansas River shiner, bald eagle, American peregrine falcon, and southwestern willow flycatcher) have been addressed in the Federally listed section.

The grey vireo prefers arid thorn scrub, chaparral, pinon-juniper and oak-juniper woodlands in the southwest United States and eastern Mexico. Its diet consists of almost solely of insects which it gleans from the ground and scrub canopy (Ehrlich et. al., 1988). The least shrew inhabits grassy or weedy fields of the eastern United States below the Great Lakes and occasionally uses marshy areas or wet woods (Whitaker, 1980). It is primarily nocturnal and feeds it highly demanding metabolism with insects. The Baird's sparrow is native to upland short-grass prairies and nests in natural or scratched depressions, often concealed by overhead vegetation. Its diet consists of spiders and grass and forb seeds.

The Arkansas River speckled chub is moderately common in the main rivers and canals east of the Continental Divide, including the Canadian River drainage. The speckled chub's habitat has been identified as shallow channels of large, permanently flowing, sandy-bottomed streams (Cross and Collins 1975), where it spawns in the summer. It prefers currents over a substrate of clean, fine sand and avoids areas of calm water and silted stream bottoms. With the exception of permanent flows, this describes the Canadian River below Revuelto Creek. During the 1983-84 collections, a total of 128 speckled chub were collected in Texas (the sixth-most abundant species collected) a total of 22 in New Mexico.

The brook stickleback inhabits streams, ponds and lakes with clear, cold water and abundant aquatic vegetation which the male uses to construct small nests during spawning. It rarely enters brackish water (Boschung et. al. 1983), and natively occurs in the northern United States and Canada, though it has been introduced in Connecticut, Alabama, and New Mexico. The bigscale logperch prefers riffles and pools of moderate to large streams over sand, gravel, or rocks in the eastern United States and Canada. It also occurs in similar habitats in southern Oklahoma, Texas, and eastern New Mexico. It feeds on aquatic insects, frequently flipping stones in search of prey.

Impacts of the Preferred Alternative

Federally Listed Species: Threatened and Endangered

There are no anticipated impacts to Federally listed species in the project area. The necessary dense riparian habitat for the southwestern willow flycatcher is lacking and the Service has no recorded sitings of the species in Quay County (Service, 1995). Regarding the American peregrine falcon, although some cliffs are present along the Canadian River, high prey densities or habitat which support them are not. Finally, potential roosting sites in the construction area for the bald eagle are absent, and any sites downstream are not expected to be affected by the minor changes in flow and salinity.

Federally Proposed Species: Category 1

There are no significant impacts expected on Federally proposed species from the project. Impacts to the Arkansas River shiner may occur in the 4-mile reach of the Canadian River between Ute Dam and Revuelto Creek. In this reach, flows could be reduced by an estimated 35%, and less than 14% below the confluence. The river, however, traditionally experiences periods of low and/or no flow, which has not prohibited survival of the species. In addition, salinity does not appear to be limiting to the distribution nor abundance of the species, and reductions in conductivity may even benefit the shiner if it indeed prefers lower conductivities.

To verify impacts on the proposed shiner, Reclamation and CRMWA would enter discussions with the Service which could result in a conservation agreement. If the Service agrees that sufficient benefits would result, the agreement could provide for a two-year study, funded by Reclamation and CRMWA, that focuses on the Arkansas River shiner and the Arkansas River speckled chub. This agreement could also provide for Reclamation and CRMWA to recognize and consider these two species in the future operation of project facilities within the affected reach of the river. The studies could also assist in the development of appropriate operating criteria.

Federal Candidate Species: Category 2

Neither construction activities nor the anticipated reductions in flow and salinity are expected to have any impacts on these Candidate species.

Texas State Listed Species

Impacts on the white-faced ibis and Texas horned lizard would be confined to the Texas portion directly along the corridor of the Canadian River. Because impacts from reduced flows and salinities would be greatly diluted at this point and are not expected to be significant, no impacts to Texas State listed species are anticipated.

New Mexico State Listed Species

There are no anticipated impacts to New Mexico State listed species. Habitat for neither the gray vireo nor the least shrew exists in the proposed construction area. Habitat preferred by Baird's sparrow may be present in the construction area, but only an isolated area (68 acres temporarily and 10 acres permanently) will be affected, which is not expected to affect the species' regional distribution or abundance. There has been no designation of critical habitat for Baird's sparrow in Quay County (Service, 1995).

The Service states that the Arkansas River speckled chub does not exhibit an apparent adaptive or competitive advantage based on conductivity (1986). Any potential adverse impacts to the speckled chub would be offset by measures in the conservation agreement between Reclamation, CRMWA and the

Service, similar to the Arkansas River shiner. Impacts to the brook stickleback and the bigscale logperch are not anticipated, as there is no record of their occurrence in the Canadian River within the study area.

No Action Impacts

The No Action Alternative would not affect any Federal or State threatened or endangered species.

SOCIAL AND ECONOMIC CONDITIONS

Affected Environment

Areas of consideration for social and economic conditions include not only the immediate area of the project, Logan, New Mexico, but also the Lake Meredith region of Texas. Information on Logan was provided by the Logan-Ute Lake Chamber of Commerce and the U.S. Bureau of the Census. Information on Lake Meredith was provided by the U.S. National Park Service and CRMWA.

Logan is in the northeastern corner of New Mexico in Quay County, about 24 miles northeast of Tucumcari and Interstate 40. Population of the county in 1990 was 10,823 people (Bureau of the Census, 1990). The county's economy centers on agriculture, primarily irrigated crops and cattle feeding operations.

Logan is reached by U.S. Highway 54 from Tucumcari, and New Mexico Highways 39 and 18. Population is 915 (Logan-Ute Lake Chamber of Commerce, 1995). The town is governed by a mayor with assistance of a Village Administrator and city personnel. Logan has police and fire departments, ambulance service, and a school system with grades K-12. Tucumcari has the nearest hospital. Of the 296 homes in the town, 57 are rentals (Bureau of the Census, 1990). There are also six mobile home parks.

About 90 businesses are located in the town, including grocery stores, service stations, motels, restaurants, grocers, bait and tackle shops, and a sand-and-gravel operation, among others (Logan-Ute Lake Chamber of Commerce, 1995). Many of the businesses serve visitors attracted to the area by Ute Lake and the state park that surrounds it. Ute Lake, with a surface area of 8,047 acres, offers a warm-water fishery and other water sports. Hunting for big game, waterfowl, and game birds is popular around the lake. The state park offers picnicking, camping, hiking, and off-road vehicle (ORV) areas. Fishing just downstream of Ute Dam, where seepage and spills have scoured deeper pools, is also popular.

Lake Meredith, with more than 10,000 acres of water surface (at elevation 2900.0 feet), attracts visitors from New Mexico and Oklahoma, as well as from Texas. Noted for its warm-water fishery and other water sports, the National Recreation Area surrounding the lake also offers camping, picnicking, hiking, and ORV areas, and touring in the Alibates Flint Quarries National Monument. During the season, the recreation area provides the only public hunting in the region. Hunting for big game, waterfowl, and game birds is popular.

The area immediately surrounding Lake Meredith is a National Recreation Area, managed by the U.S. National Park Service (NPS). The area offers visitors camping, fishing, boating, and water sports. There is also an aquatic and wildlife museum in the nearby town of Fritch, jointly managed by the town and NPS.

Impacts of the Preferred Alternative

Short-term impacts of the Preferred Alternative on social and economic conditions in Logan would be slight. A work force of about 10 to 25 people would temporarily move into the area during the anticipated 18-month construction period of Phase I activities. These people might live in Logan or commute from nearby towns like Tucumcari. The influx of workers and their families would be so slight that there would be a limited effect on schools, housing, medical care, etc., regardless of where they chose to live.

The addition to the local work force would have some beneficial effects on the local economy, however slight, during construction. The hauling of equipment and supplies for this alternative might increase traffic slightly on highways in the Logan area. The long-term impact would be the addition of 1 to 2 people to operate and maintain the facilities. Long-term impacts would mainly accrue to the cities of the CRMWA, who would avoid having to purchase water from other sources for a M&I water supply.

Impacts of this alternative would not affect lower-income people differently than it would affect other economic classes.

No Action Impacts

The CRMWA would have to buy water from other sources if nothing were done to correct the salinity in Lake Meredith. The CRMWA is presently negotiating to purchase groundwater to mix with Lake Meredith water. Lake Meredith water with projected chlorides of 455 mg/l would have to be mixed to get water that meets the state standard of 300 mg/l. This would require 30,000-40,000 acft of water (and up to 60,000 acft in drought years) annually at a price of $0.90 per 1,000 gals per year(CRMWA, 1995). Total cost would range between $9.3 and $12.4 million. The CRMWA would likely have to pass this cost on to customers, resulting in higher water costs.

CULTURAL RESOURCES

Affected Environment

In 1965, Laurens Hammack began his description of the survey of Ute Reservoir by stating *"the northeastern corner of New Mexico is a large but archeological unimposing area. The antiquity of this region is totally unknown archaeologically, and except for a few scattered sites, this area has been generally neglected by professional archeologists"*. This statement now needs to be modified for the vicinity of Logan, New Mexico due to new archeological data provided by the surveys of Ute Reservoir, road construction and repairs, power lines, fiber optic cables, and other Federal projects. The results of these surveys has revealed a long history of human occupation from early Prehistoric to Historic periods. The area along the Canadian River and secondary creeks have been a preferred area for habitation, as well as areas were springs and/or seeps are located.

In 1995, Reclamation conducted a Class III survey of the project area covering 2,800 acres of river bottom and terraces, bluff face and edge, and upland (Figure 5). A draft of the survey results will be available in August 1995. Preliminary consultation with the New Mexico State Historic Preservation Officer (NMSHPO) would begin as soon as a survey map is completed in late July. The current and previous cultural resource surveys within the project area and in the vicinity have revealed many prehistoric and historic archeological sites along the river. The current survey is being conducted by a private contractor for Reclamation and may provide valuable data to compare with the Ute Reservoir survey and other smaller surveys in the vicinity.

Impacts of the Preferred Alternative:

All archeological sites within the project area would be evaluated for eligibility to the National Register of Historic Places (NHRP). Sites that are evaluated as potentially eligible or eligible to the NRHP, and after consultation and concurrence with the NMSHPO, would be delineated on the map of the project and the map provided to the design contractor. All the project facilities (brine production wells, pipelines, power lines, injection wells, and access roads) would be designed to avoid these sites. If the engineering and geologic constraints create a situation where a facility cannot avoid these sites, further testing and/or mitigation would be necessary before construction. The facilities needed for the project have not been located on the ground, and their location is flexible to allow for routing around sites, thus avoidance of sites would be the preferred compliance method.

Once the facilities are in operation, the CRMWA would have management responsibilities over the project. To prevent any adverse effects during the operation and maintenance of the facilities, the CRMWA would be provided with a map of the areas that must be avoided. Some sites may be fenced to prevent access. The project area would be under Federal (Reclamation) jurisdiction due to the easements that have been obtained, but land ownership would remain private. The NMSHPO and Reclamation would work together to educate the land owner about cultural resources discovered on his land and the value of protecting such resources.

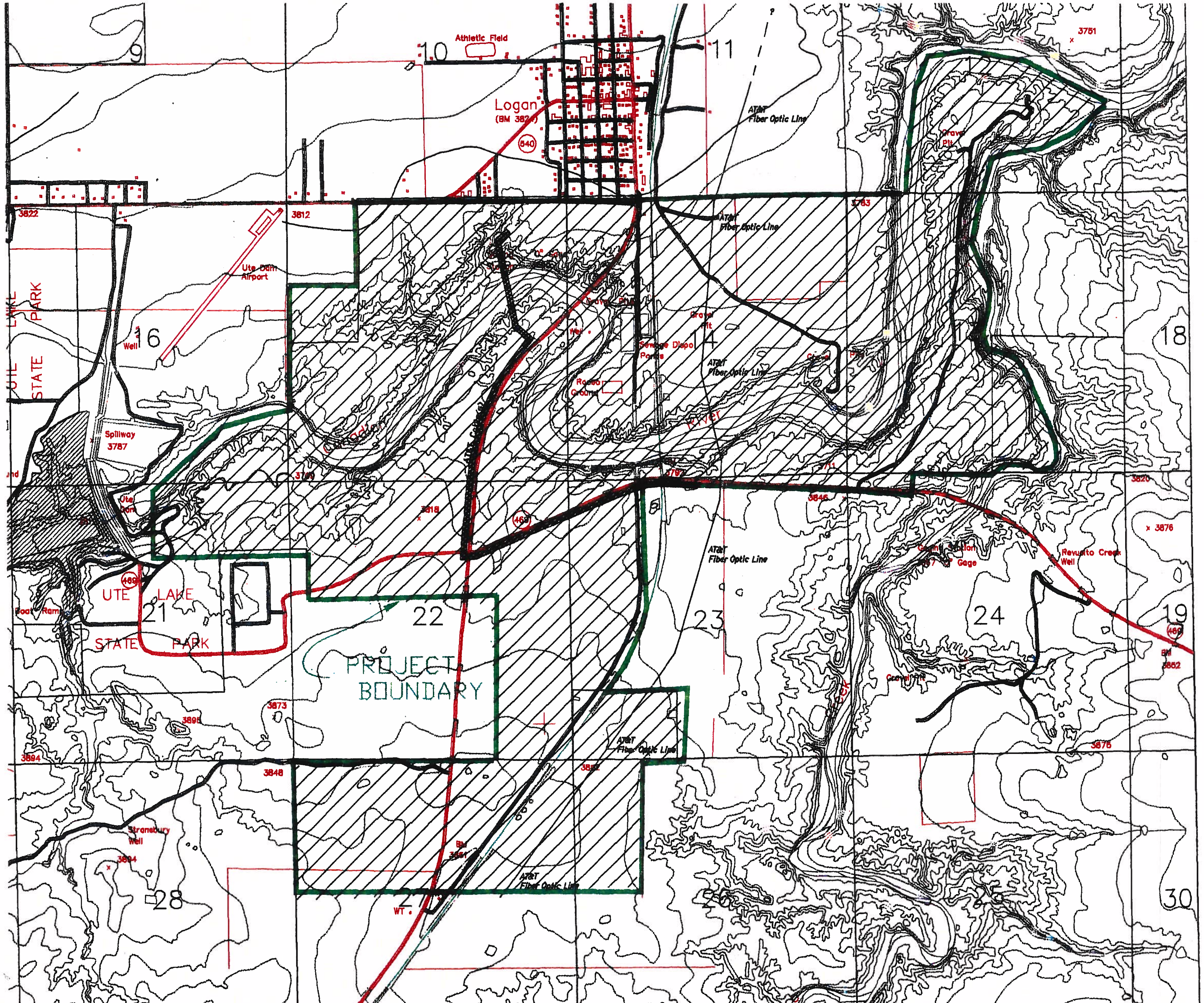
No Action Impacts:
The No Action alternative would prevent all survey, testing and/or mitigation, and management of the resources. Data gathered during the current survey would be available for research.

INDIAN TRUST ASSETS

Affected Environment
The Bureau of Indian Affairs, Albuquerque Office, was contacted for information on Native American Indian Trust Assets. A determination was made that no Indian Trust Assets exist within the project area.

Impacts of the Preferred Alternative
The Preferred Alternative will have no effect on Indian Trust Assets.

No Action Impacts
The No Action Alternative would not have any impacts on Indian Trust Assets.



▨ = SURVEYED AREA

ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CANADIAN RIVER PROJECT, TEXAS

LAKE MEREDITH SALINITY CONTROL PROJECT
CULTURE RESOURCES SURVEY AREA

DESIGNED ______ TECH. APPROVAL ______
DRAWN ______ SUBMITTED ______
CHECKED ______ APPROVED ______
REGIONAL ENGINEER

CADD SYSTEM CADSYS	CADD FILENAME LUSCAREA	DATE AND TIME PLOTTED PLDATE
OKLAHOMA CITY, OK SHEET 1 OF 1	MARCH, 1998	1253-514-100

Consultation and Coordination

PUBLIC INVOLVEMENT

A public meeting was held in Logan, New Mexico, on March 11, 1995, to explain the proposed modifications to the project and to receive public input. The meeting was hosted by Reclamation and was attended by representatives from CRMWA, city officials and interested local citizens. City officials were primarily concerned with water and power needs of the project so as to insure the necessary infrastructure could meet them. Citizen comments were mainly focused on potential impacts to the water quality of wells in the area.

OTHER AGENCIES AND ORGANIZATIONS

In preparation of this document, Reclamation coordinated with several entities, including the US Fish and Wildlife Service, US Army Corps of Engineers, Bureau of Indian Affairs, Texas Parks and Wildlife Department, New Mexico Department of Game and Fish, State of New Mexico Environmental Department, New Mexico State Engineer's Office, New Mexico Interstate Stream Commission, and the State of New Mexico Commission of Public Lands.

NECESSARY PERMITS

Requirements of Section 404 of the Clean Water Act would be complied with, as would requirements of Executive Orders 11988 and 11990, which deal with flood plains and wetlands, respectively. The Corps of Engineers maintains regulatory oversight on federally proposed projects that would place fill in existing wetlands. The project would also require an injection well permit from the State of New Mexico.

LETTERS RECEIVED ON THE 1986 EA

Letters were received from the following agencies on the 1986 EA. Comments from these letters were considered during development of this Supplemental EA.

U.S. Geological Survey
Environmental Protection Agency
Texas Office of the Governor
Texas Parks and Wildlife Department
Panhandle Regional Planning Commission
U.S. Fish and Wildlife Service
New Mexico Interstate Stream Commission
New Mexico Department of Game and Fish
New Mexico Office of Cultural Affairs, Historic Preservation Division
El Llano Estacado Resource Conservation and Development Area

The first five agencies wrote to say they concurred with the findings of the 1986 EA. The U.S. Fish and Wildlife Service corrected the status of a threatened and endangered species. The New Mexico Interstate Stream Commission corrected several mistakes and omissions in the 1986 EA, including irrigable acres in the study area, an existing stream gauge that would be affected by various alternatives, and increasing the mean discharge of the Canadian River at Logan listed in the report to agree with USGS data.

The New Mexico Department of Game and Fish was concerned that flows below Ute Dam not be reduced below 2 cfs (Reclamation assured them that based on streamflow data this wasn't likely), that monitoring of the plan was not sufficiently delineated (monitoring was made clear), that the EA should make provision to re-evaluate the Preferred Alternative if monitoring showed it wasn't working (elements of the monitoring plan should assure this), and that some of the scientific names of species were wrong (corrected). The New Mexico Office of Cultural Affairs wanted to correct wording in the EA to show that an intensive cultural resources survey of the area would be done (corrected).

The El Llano Estacado Resource Conservation and Development Area were concerned about problems of deep well injection and the possibility of increasing seepage from Ute Dam. Reclamation assured them that the injection system would be designed and constructed to minimize operational problems and that, while there was no evidence that seepage from Ute Dam would be increased, monitoring would reveal this condition and appropriate measures would be taken to correct it in such an eventuality.

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Attachments

ATTACHMENT I:

ENVIRONMENTAL COMMITMENTS

Commitments were developed in consultation the U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, CRMWA, and the State of New Mexico. Reclamation would ensure that fish and wildlife measures and environmental commitments were followed and that implementation would occur before or during construction, unless otherwise specified.

These commitments are:

Reclamation would require the contractor to comply with all State and local rules regarding water and air quality standards, including appropriate erosion control, pollution and noise abatement measures.

The contractor will reshape disturbed areas and leave in a condition for re-vegetation where appropriate after construction.

Injection well facilities would be fenced to provide an area of vegetation protected from livestock grazing.

Construction would be scheduled in the floodplain only during low-flow or low precipitation conditions, and all staging, parking, storage and refueling areas would be constructed above the 100-year floodplain.

All project facilities would be designed to avoid archeological sites determined potentially eligible to be listed as National sites. If the engineering and geologic constraints create a situation where a facility cannot avoid these sites, further testing and/or mitigation would be conducted before/during construction. During construction, archeological sites will be monitored to evaluate any new discoveries. To prevent any adverse effects during the operation and maintenance of the facilities, the CRMWA would be provided with a map of the areas that must be avoided. Since the project will located on private land, NMSHPO and Reclamation would work together to educate the land owner about cultural resources discovered on his land and the value of protecting such resources.

Impacts to fish and wildlife from construction of the project would be minimized where possible. Reclamation and CRMWA would enter into discussions with the Service on a conservation agreement for the proposed Arkansas River shiner *(Notropis girardi)* and the Arkansas River speckled chub.

ATTACHMENT II:

SCIENTIFIC NAMES OF MENTIONED FLORA AND FAUNA

A

agarito	*Berberis trifoliolata*
ampelopsis, heartleaf	*Ampelopsis cordata*

B

baccharus	*Baccharis* spp.
badger	*Taxidea taxus*
bass, white	*Morone chrysops*
, largemouth	*Micropterus salmoides*
, smallmouth	*Micropterus dolomieui*
bat, pallid cave	*Antrozous pallidus*
, hoary	*Lasiurus cinereus*
, canyon	*Pipestrellus hesperus*
bean, slickseed	*Strophostyles leiosperma*
beaver	*Castor canadensis*
beebalm, plains	*Monarda pectinata*
bittern, least	*Ixobrychus exilis exilis*
blackbird, red-winged	*Agelaius phoeniceus*
bluegill	*Lepomis macrochirus*
bluestem, sand	*Andropogon hallii*
, little	*Schizachyrium scoparium* var. *frequens*
bobcat	*Lynx rufus*
broomweed, annual	*Xanthocephalus* spp.
buckwheat, false climbing	*Polygonum cristatum*
, wild	*Eriogonum* spp.
buffalograss	*Buchloe dactyloides*
bullhead, black	*Ictalunus melas*
bullsnake	*Pituophis melanoleucus sayi*
bulrush	*Scirpus* spp.
buttonbush	*Cephalanthus occidentalis*

C

carp	*Cyprinus carpio*
carpsucker, river	*Carpiodes carpio*
catclaw	*Acacia greggii*

catfish, channel	*Ictalurus puctatus*
, flathead	*Pylodictus olivaris*
cattail	*Typha* spp.
cedar	*Juniperus* spp.
cholla	*Opuntia imbricata* var. *imbricata*
chub, speckled	*Hybopsis aestivalis*
, Arkansas River speckled	*Macrhybopsis aestivalis tetranemus*
, flathead	*Platygobio gracilis*
coachwhip, western	*Masticophis flagellum*
cordgrass, prairie	*Spartina pectinata*
cottontail, (desert)	*Syvilagus auduboni*
cottonwood	*Populus deltoides*
coyote	*Canis latrans*
crappie, black	*Pomoxis nigromaculatus*
, white	*Pomoxis annularis*
cuckoo, yellow-billed	*Coccyzus americanus*

D

deer, mule	*Odocoileus hemionus*
dogwood, rough-leaf	*Cornus drummondii*
dove, mouring	*Zenaida macrorura*
dropseed, sand	*Sporobolus cryptandrus*

E

eagle, bald	*Haliaeetus leucocephalus*
elm	*Ulmus* spp.
evening primrose, yellow	*Calylophus serrulatus*

F

falcon, American peregrine	*Falco peregrinus anatum*
flicker, red-shafted	*Colaptes auratus cafer*
flycatcher, ash-throated	*Myiarchus cinerascens*
, scissor-tailed	*Muscivora forficata*
, southwestern willow	*Epidonax traillii extimus*
fox, swift	*Vulpes velox*
frog, Blanchard's cricket	*Acris creptans*
, plains leopard	*Rana blairi*

G

gaura, scarlet	*Gaura coccinea*
gopher, chestnut-faced pocket	*Pappogeomys castanops*

goldenrod	*Solidago* spp.
grama	*Bouteloua* spp.
, blue	*Bouteloua gracilis*
, hairy	*Bouteloua hirsuta*
, sideoats	*Bouteloua curtipendula*
grape, Panhandle	*Vitis acerifolia*
grounsel-tree	*Baccharis salicina*

H

hackberry	*Celtis* spp.
, netleaf	*Celtis reticulata*
hawk, ferruginous	*Buteo regalis*
, marsh (Harris)	*Circus cyaneus hudsonius*
, red-tailed	*Buteo jamaicensis*
, Swainson's	*Buteo swainsoni*
horsetail	*Equisetum kansanum*

I

ibis, white-faced	*Plegadis chihi*
Indiangrass	*Sorghastrum avenaceum*
indigo, wild blue	*Baptisia australis*

J

jackrabbit, black-tailed	*Lepus californicus*
Johnsongrass	*Sorghum halepense*
juniper	*Juniperus* spp.

K

kestrel, (American)	*Falco sparverius*
kidneywood	*Eysenhardtia texana*
killdeer	*Charadrius vociferus*
killfish, central plains	*Fundulus zebrinus kansae*
kingbirds, western	*Tyrannus verticalis*
kingsnake	*Lampropeltis* spp.
kingfisher	*Ceryle* spp.
kite, Mississippi	*Ictinia misisippiensis*

L

lambsquarters	*Chenopodium album*
lark, horned	*Eremophila alpestris*
lead plant	*Amorpha canescens*

lizard, side-blotched	*Uta stansburiana*
, Texas horned	*Phrynosoma cornutum*
, southern prairie	*Sceloporus undulatus*
, collard	*Crotaphytus collaris*
logperch, bigscale	*Percina macrolepida*
lotebush	*Ziziphus obtusifolia*
lovegrass, sand	*Eragrostis trichodes*

M

mesquite	*Prosopis glandulosa*
, curly	*Hilaria belangeri*
minnow, bullhead	*Pimephales vigilax*
, flathead	*Pimephales promelas*
, plains	*Hybognathus placitus*
, silvery	*Hybognathus* ....
mockingbird	*Mimus polyglottos*
morningglory, beach	*Ipomoea stolonifera*
mosquitofish	*Gambusia affinis*
mouse, deer	*Peromyscus maniculatus*
, hispid pocket	*Perognathus hispidus*
, white-footed	*Peromyscus leucopus*

O

oak, shin	*Quercus sinuata* var. *breviloba*
, harvard shin	*Quercus harvardii*
opossum	*Didelphis marsupialis*
oriole, Bullock's	*Icterus galbula bullockii*
owl, burrowing	*Athene cunicularia*

P

paspalum, sand	*Paspalum setaceum*
perch, yellow	*Perca flavescens*
persimmon, Mexican	*Diospyros texana*
pheasant, ring-necked	*Phasianus colchicus*
plover, mountain	*Charadrius montanus*
, western snowy	*Charadrius alexandrinus nivosus*
plum	*Prunus* spp.
, Chickasaw	*Prunus angustifolia*
prairie dog, black-tailed	*Cynomus ludovicianus*
pricklypear, grassland	*Opuntia macrorhiza*
, Texas	*Opuntia lindheimeri*

pronghorn	*Antilocapra americanus*

Q

quail, scaled	*Callipepla squamata*

R

raccoon	*Procyon lotor*
ragweed, western	*Ambrosia psilostachya*
rat, Ord's kangaroo	*Dipodomys ordi*
rattlesnake	*Crotalus* spp.
redbud	*Cercis canadensis*
redcedar	*Juniperus* spp.
roadrunner, greater	*Geococcyx californianus*
rush	*Juncus* spp.
rushpea	*Hoffmanseggia* spp.
, James	*Caesalpinia jamesii*

S

sacaton, alkali	*Sporobolus airoides*
salamander, barred tiger	*Ambystoma tigrinum marvortium*
salt grass	*Distichlis spicata* var. *stricta*
saltcedar	*Tamarix* spp.
sandlily	*Mentzelia nuda*
sandpiper, upland	*Bartramia longicauda*
sandreed, big	*Calamovilfa gigantea*
sandsage	*Artemisia filifolia*
scarletpea	*Indigofera miniata*
scurfpea	*Psoralea* spp.
sedge	*Carex* spp.
sensitive briar, catclaw	*Schrankia uncinata*
shad, gizzard	*Dorosoma cepedianum*
shiner, Arkansas River	*Notropis girardi*
, red	*Notropis lutrensis*
, sand	*Notropis stramineus*
shrew, least	*Cryptotis parva parva*
shrike, loggerhead	*Lanius ludovicianus*
silktassel, Lindheimer	*Garrya lindheimeri*
skink, great plains	*Eumeces obsoletus*
slider, pond	*Pseudemys scripta*
snakeweed, broom	*Xanthocephalum* spp.
sotol	*Dasylirion* spp.

spadefoot	*Scaphiopus* spp.
sparrow, lark	*Chondestes grammacus*
, Baird's	*Ammondramus bairdii*
, black-throated	*Amphispiza bilineata*
, Cassin's	*Aimophila cassinii*
, grasshopper	*Ammodramus savannarum*
, field	*Spizella pusilla*
, rufous-crowned	*Aimophila ruficeps*
spikesedge	*Eleocharis macrostachya*
squirrel, fox	*Sciurus* spp.
, thirteen-lined ground	*Spermophillus tridecemlineatus*
stickleback, brook	*Culaea inconstans*
sumac	*Rhus* spp.
sumpweed, coarse	*Iva xanthifolia*
sunfish, green	*Lepomis cyanellus*
, bluegill	*Lepomis macrochirus*
sunflower, Maximilian	*Helianthus maximiliani*
swallow, cliff	*Hirundo pyrrhonota*
switchgrass	*Panicum virgatum*

T

tasajillo	*Opuntia leptocaulis*
tern, black	*Chlidonias niger surinamensis*
thrasher, curve-billed	*Toxostoma curvirostre*
three-awn	*Aristida* spp.
toad, great plains	*Bufo cognatus*
, Rocky Mountain	*Bufo woodhousei*
tridens	*Tridens* spp.
trout, brown	*Salmo trutta*
, rainbow	*Oncorhynchus mykiss*
turkey, wild	*Meleagris gallopavo*
turtle, ornate box	*Terrapene ornata*
, yellow musk	*Kinosternon flavenscens*

V

vireo, gray	*Vireo vicinior*

W

walleye	*Stizostedion vitreum*
water snake	*Natrix* spp.
wheatgrass	*Agropyron* spp.

whiptail, checkered	*Cnemidophorus sexlineatus*
willow	*Salix* spp.
, black	*Salix nigra*
, Lindheimer's black	*Salix nigra* var. *lindheimeri*
woodpecker, ladder-backed	*Dendrocopos scalaris*
, red-bellied	*Centurus carolinus*
woollywhite	*Hymenopappus* spp.

Y

yucca	*Yucca* spp.
, narrow-leaf	*Yucca angustifolia*

Z

zinnia	*Zinnia grandiflora*