Volume I
Planning Report and
Draft Environmental Impact Statement
(Includes Appraisal-Level Alternative Designs and Cost Estimates)

Navajo-Gallup Water Supply Project

New Mexico – Arizona

Navajo Nation **City of Gallup** **Jicarilla Apache Nation**

U.S. Department of the Interior
Bureau of Reclamation

March 2007

Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in a environmentally and economically sound manner in the interest of the American public.

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PLANNING REPORT AND DRAFT ENVIRONMENTAL IMPACT STATEMENT

NAVAJO-GALLUP WATER SUPPLY PROJECT
NEW MEXICO – ARIZONA

Prepared by the U.S. Department of the Interior, Bureau of Reclamation, Upper Colorado Region, Salt Lake City, Utah

This planning report and draft environmental impact statement (PR/DEIS) for the Navajo-Gallup Water Supply Project has been prepared by the Bureau of Reclamation in compliance with the National Environmental Policy Act.

A number of project alternatives, consisting of both structural and nonstructural components, are evaluated in this PR/DEIS. Information on hydrology, water quality, endangered species, wildlife, geology, paleontology, soils, wetlands, cultural resources, recreation, social economic issues, environmental justice, Indian Trust Assets, and the San Juan River Basin Recovery Implementation Program is included.

Cooperating agencies that participated in the development of this PR/DEIS include:

Bureau of Indian Affairs	Navajo Nation
City of Gallup	Navajo Tribal Utility Authority
Indian Health Service	Northwest New Mexico Council of Governments
Jicarilla Apache Nation	State of New Mexico

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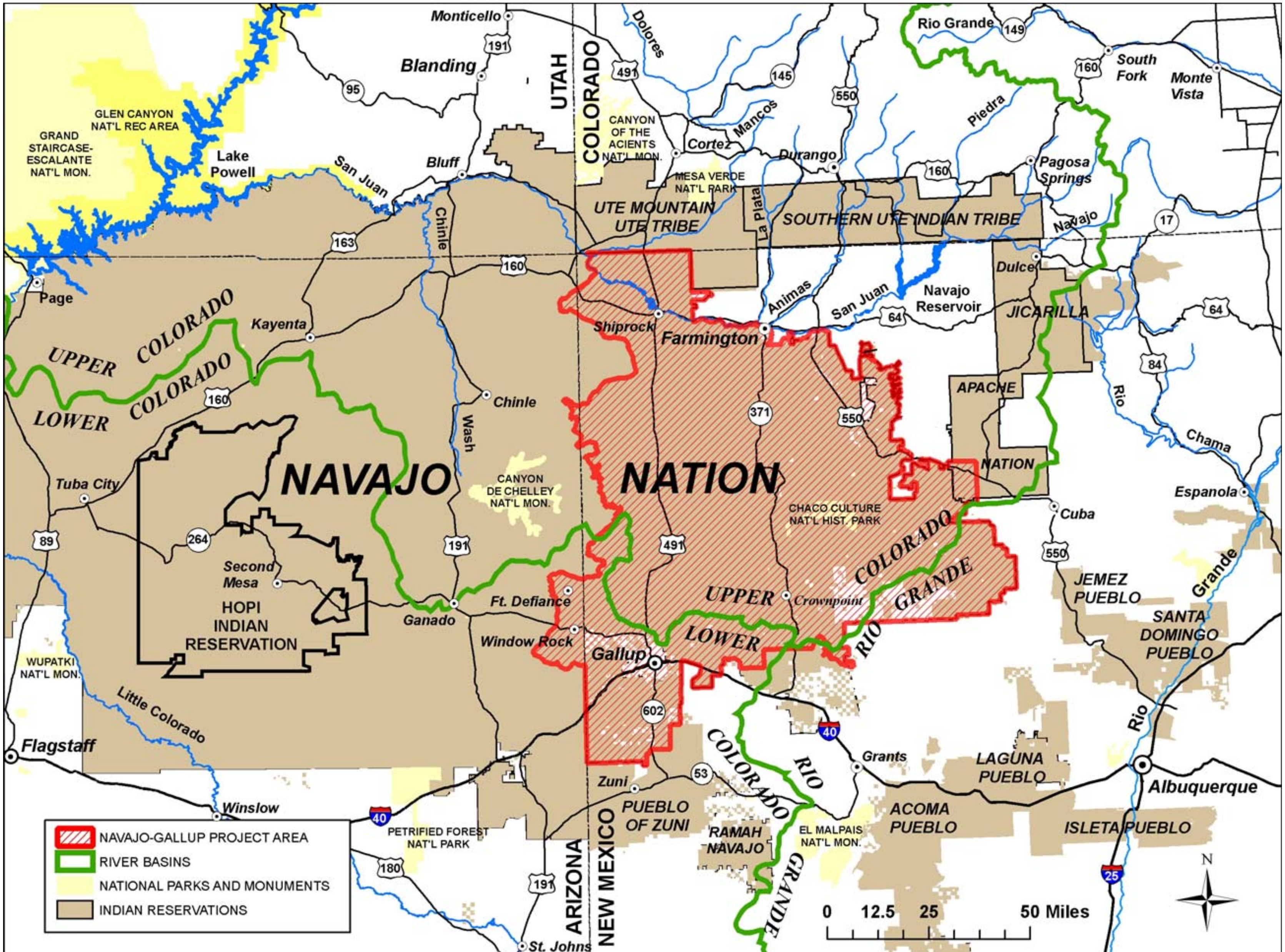

NAVAJO
NATION
HOPI INDIAN RESERVATION
UTAH
COLORADO
ARIZONA
NEW MEXICO
UPPER COLORADO
LOWER COLORADO
UPPER COLORADO
LOWER RIO GRANDE
COLORADO
RIO GRANDE
UTE MOUNTAIN UTE TRIBE
SOUTHERN UTE INDIAN TRIBE
JICARILLA APACHE NATION
GLEN CANYON NAT'L REC AREA
GRAND STAIRCASE-ESCALANTE NAT'L MON.
CANYON OF THE ACIENTS NAT'L MON.
MESA VERDE NAT'L PARK
CANYON DE CHELLEY NAT'L MON.
CHACO CULTURE NAT'L HIST. PARK
WUPATKI NAT'L MON.
PETRIFIED FOREST NAT'L PARK
EL MALPAIS NAT'L MON.
JEMEZ PUEBLO
SANTA DOMINGO PUEBLO
LAGUNA PUEBLO
ACOMA PUEBLO
ISLETA PUEBLO
PUEBLO OF ZUNI
RAMAH NAVAJO
Monticello
Blanding
Bluff
Lake Powell
Page
Kayenta
Chinle
Tuba City
Second Mesa
Ganado
Ft. Defiance
Window Rock
Gallup
Shiprock
Farmington
Crownpoint
Cortez
Durango
Pagosa Springs
South Fork
Monte Vista
Dulce
Cuba
Espanola
Grants
Zuni
Albuquerque
Flagstaff
Winslow
St. Johns
Navajo Reservoir
San Juan
Chinle Wash
Little Colorado
Dolores
Mancos
La Plata
Animas
Piedra
Navajo
Rio Chama
Rio Grande
191
95
491
145
550
160
149
17
163
64
84
371
264
89
602
53
40
180
25
NAVAJO-GALLUP PROJECT AREA
RIVER BASINS
NATIONAL PARKS AND MONUMENTS
INDIAN RESERVATIONS
0 12.5 25 50 Miles
N

ACRONYMS AND ABBREVIATIONS

A

ACHP	Advisory Council on Historic Preservation
ADWR	Arizona Department of Water Resources
AFY	acre-feet per year
ALP	Animas-La Plata

B

Basin	San Juan River Basin
BIA	Bureau of Indian Affairs
BISON-M	Biota Information System of New Mexico
BLM	Bureau of Land Management
BMP	Best Management Practices

C

CAA	Clean Air Act
CAP	Central Arizona Project
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
CNG	compressed natural gas
Commission	Upper Colorado River Commission
CPUE	catch-per-unit effort
CRSP	Colorado River Storage Project
CWA	Clean Water Act

D

DBPs	disinfection byproducts
DEIS	draft environmental impact statement

E

ECP	Environmental Commitments Plan
EIS	environmental impact statement
EPA	Environmental Protection Agency
EQ	environmental quality
ESA	Endangered Species Act
ESRI	Ecosystem Research Institute

F

FEIS	final environmental impact statement
FSEIS	final supplemental environmental impact statement
FWCA	Fish and Wildlife Coordination Act

G

gpcd	gallons per capita per day
GIS	geographic information system
g/m^2	grams per square meter

H

HVAC	heating, ventilation, and air conditioning

I

IGS	Infiltration Gallery System
Indian	American Indian
Interior	Department of the Interior
IRM	Office of Integrated Resource Management
ITAs	Indian Trust Assets

J

JANNRWSP	Jicarilla Apache Nation Navajo River Water Supply Project
JGFD	Jicarilla Game and Fish Department

K

kV	kilovolt

L

LCP	local control panel
LPG	liquefied petroleum gas

M

M&I	municipal and industrial
MAF	million acre-feet
MCL	maximum contaminant level
MGD	million gallons per day
mg/L	milligrams per liter
μg/L	micrograms per liter
MHI	median household income
mW	megawatt

N

NAGPRA	Native American Graves Protection and Repatriation Act
NAPI	Navajo Agricultural Products Industry
National Register	*National Register of Historic Places*
NED	national economic development
NEPA	National Environmental Policy Act
NESA	Navajo Nation Endangered Species Act
NFWD	Navajo Fish and Wildlife Department
NHPA	National Historic Preservation Act
NIIP	Navajo Indian Irrigation Project
NMDGF	New Mexico Department of Game and Fish
NMDPR	New Mexico Department of Parks and Recreation
NMISC	New Mexico Interstate Stream Commission
NMNHP	New Mexico Natural Heritage Program
NMRGISP	New Mexico Resource Geographic Information System Program
NMRPTC	New Mexico Rare Plant Technical Council
NMSHPO	New Mexico State Historic Preservation Officer
NNDFW	Navajo Nation Department of Fish and Wildlife
NNHP	Navajo Natural Heritage Program
NNMP	Navajo Nation Municipal Pipeline
NNPRD	Navajo Nation Parks and Recreation Department
NNTHPO	Navajo Nation Tribal Historic Preservation Officer
NOA	Notice of Availability
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRCS	Natural Resource Conservation Service
NTU	Nestler Turbidity Units
NTUA	Navajo Tribal Utility Authority

O

O&M	operation and maintenance
OM&R	operation, maintenance, and replacement
OPS	Office of Pipeline Safety
OSE	other social effects

P

PIA	practicably irrigable acreage
P.L.	Public Law
Plains Electric	Plains Electric Generation and Transmission Cooperative, Inc.
PNM	Public Service Company of New Mexico
ppm	parts per million
PR/DEIS	planning report/draft environmental impact statement
PR/FEIS	planning report/final environmental impact statement
Principles and Guidelines	*Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*
proposed project	Navajo-Gallup Water Supply Project
psi	pounds per square inch

R

Reclamation	Bureau of Reclamation
RED	regional economic development
RM	river mile
ROD	Record of Decision
ROW	rights-of-way
RPA	reasonable and prudent alternative
RPM	reasonable and prudent measures

S

SDWA	Safe Drinking Water Act
Secretary	Secretary of the Interior
Service	U.S. Fish and Wildlife Service
SHPO	State Historic Preservation Officer
Sithe Global	Sithe Global Power, LLC
SJRPNM	San Juan River Public Service Company of New Mexico
SJRBRIP	San Juan River Basin Recovery Implementation Program
SSURGO	Soil Survey Geographic (database)
SWTR	Surface Water Treatment Rule

T

TCP	traditional cultural properties
TDS	total dissolved solids
THPO	Tribal Historic Preservation Officer
TMDL	total maximum daily load
TOC	total organic carbon
TSC	Technical Service Center

U

UMTRA	Uranium Mill Tailings Remedial Action
U.S.C.	United States Code
USGS	U.S. Geological Survey
UV	ultraviolet

EXECUTIVE SUMMARY

INTRODUCTION

The Bureau of Reclamation (Reclamation) has developed this planning report and draft environmental impact statement (PR/DEIS) pursuant to Public Law 92-199 and the general authority to conduct water resources planning under the Reclamation Act of 1902 and all acts amendatory thereof and supplementary thereto. This document was undertaken to provide a discussion on (1) various ways to provide a municipal and industrial (M&I) water supply to the Navajo Nation, city of Gallup, and the Jicarilla Apache Nation and (2) the associated potential environmental impacts and costs of such an endeavor, should it be undertaken. Reclamation, however, does not have the current substantive or budgetary authorization that is required to construct, operate, and maintain any proposed facilities discussed in this PR/DEIS. It will take an act of Congress to provide such authority. In addition, Reclamation takes no position on whether such a project should be authorized. The indication of a preferred alternative is solely to meet the requirements of the National Environmental Policy Act (NEPA) and is not an indication that a particular alternative should be pursued since, as noted earlier, there is no project authorization that would allow Reclamation to commence this project.

Finally, we are aware that the Navajo Nation and the State of New Mexico have reached an agreement concerning the Navajo Nation's water rights in the San Juan River Basin in New Mexico and that a part of the proposed settlement is the construction, operation, and maintenance of the Navajo-Gallup Water Supply Project (proposed project). We wish to be clear that neither Reclamation, the Department of the Interior, nor the Administration has taken a position on the San Juan River Basin in New Mexico Navajo Nation Water Rights Settlement Agreement executed between the Navajo Nation and the State of New Mexico and that nothing herein is any indication of any position regarding the overall settlement. The cost analysis contained in this PR/DEIS is based on an appraisal level of analysis. As part of Reclamation's efforts to attain greater transparency and accountability with regards to its engineering analyses, the cost estimate is being re-priced. This means that instead of updating the 2005 cost estimates using engineering cost indices, the components of the proposed project will be individually re-priced in order to gain greater confidence in the estimate. Once the re-pricing is completed, which we anticipate to occur during the 90-day public comment period, Reclamation will update the PR/DEIS through an addendum or potentially the use of errata sheets.

Reclamation historically supports projects for construction after a feasibility report is completed, which includes a feasibility-level cost estimate. This appraisal-level cost estimate does not meet that requirement. Additional analysis, detail, and updating of the appraisal-level cost estimates presented in this draft report are needed before project construction authorization can be supported. Failure to complete this additional effort may result in reliance on a cost estimate for the project that is not sufficient to characterize the expected project cost. The appraisal-level design must be upgraded to feasibility level before Reclamation would begin construction. The cost of, and time for, completing this additional work would be substantial.

PURPOSE AND NEED

The proposed project is to provide a long-term (year 2040) supply, treatment, and transmission of M&I water to the Navajo Nation, the Jicarilla Apache Nation, and the city of Gallup, New Mexico.

A long-term sustainable water supply is needed for the area to support current and future populations. The proposed project would be designed to serve a future population of approximately 250,000 people by the year 2040. Existing groundwater supplies are dwindling, have limited capacity, and are of poor quality. More than 40 percent of Navajo households rely on water hauling to meet daily water needs. The city of Gallup's groundwater levels have dropped approximately 200 feet over the past 10 years, and the supply is not expected to meet current water demands within the decade. The Jicarilla Apache people are currently not able to live and work outside the Town of Dulce on the reservation because of a lack of water supply.

THE NAVAJO-GALLUP WATER SUPPLY PROJECT

The proposed project would convey a reliable M&I water supply to the eastern section of the Navajo Nation, the southwestern part of the Jicarilla Apache Nation, and the city of

Gallup via diversions from the San Juan River in northern New Mexico. The Navajo Nation, city of Gallup, and the Jicarilla Apache Nation are part of the project Steering Committee that assisted in preparation of portions of this document.

Navajo Nation communities and the city of Gallup rely on a rapidly depleting groundwater supply that is inadequate to meet present needs and anticipated growth. Other water sources are needed to meet current and future M&I demands of more than 43 Navajo chapters, including the communities of Fort Defiance and Window Rock in Arizona, the city of Gallup, and the Teepee Junction area of the Jicarilla Apache Nation.

The proposed project would deplete approximately 35,893 acre–feet of water annually from the San Juan River (Navajo Nation – 27,193 acre-feet, Jicarilla Apache Nation – 1,200 acre-feet, city of Gallup – 7,500 acre-feet). Based on the expected populations in the year 2040, the proposed project would serve approximately 203,000 people in 43 chapters in the Navajo Nation, 1,300 people in the Jicarilla Apache Nation, and approximately 47,000 people in the city of Gallup.

PLANNING PROCESS

Project planning has been intermittent over the past 40 years. Drawing from past analysis and projecting water needs and environmental conditions into the next 40 years have provided the basis for the planning work described in this report.

A project Steering Committee included representatives from the Navajo and Jicarilla Apache Nations, city of Gallup, State of New Mexico, Bureau of Indian Affairs (BIA), Indian Health Service (IHS), Navajo Tribal Utility Authority (NTUA), Northwest New Mexico Council of Governments, and Reclamation. The Steering Committee was formed in the early 1990s to guide the direction of this proposed project, provide technical analysis, support public involvement, provide political background, and conduct overall project coordination. Reclamation has provided planning, engineering, and environmental expertise to this committee.

Funding for project planning has mostly been through annual congressional write-in funds and cost sharing by the Navajo and Jicarilla Apache Nations and the city of Gallup. The level of analysis—appraisal verses feasibility level work—has been tailored to stay within the funds available.

To expedite planning and environmental steps, it was decided that this document would be a combined PR/DEIS. This document complies with the *Economic Principles and Guidelines for Water and Related Land Resources Implementation Studies* (*Principles and Guidelines*) and NEPA.

The NEPA process began with publishing of a Notice of Intent in the *Federal Register* on March 27, 2000. Scoping meetings were held at five locations in April and May 2000: Crownpoint, Gallup, Shiprock, and Farmington, New Mexico and Saint Michaels, Arizona. The meetings were moderately attended, with a range of 15 to 50 people per meeting. The most common comments from these meetings were that there is a great need for a reliable M&I water supply throughout the proposed project area, that existing groundwater is in limited supply, and that the water is usually of poor quality.

The Navajo and Jicarilla Apache Nations and the city of Gallup provided their current and projected populations and associated M&I water needs to year 2040. An estimated water use rate of 160 gallons per day per person was used for the proposed project design as requested by the Navajo and Jicarilla Apache Nations.[1] It was assumed that available groundwater would continue to be used and that project water would provide the remaining need.

The Steering Committee identified possible alternatives to meet current and future water needs. It was determined in all past studies, as well as in this study, that the San Juan River was the only sustainable source of water. Therefore, all the viable alternatives involved treating river water for use throughout the proposed project area.

Water conservation is currently well established in the proposed project area, and although additional conservation would reduce water use, it would not be enough to provide for future water needs. It is assumed that water conservation will continue with all project alternatives considered. Six physically different, viable alternatives were identified to bring San Juan River water to the proposed project area. These alternatives all would provide the same quantity of treated water to the same delivery locations. The variables included where the water would be diverted and the location of the alternatives' facilities. Maximizing the use of existing facilities and information were important factors in the design of the alternatives. All alternatives use Navajo Reservoir and Navajo Indian Irrigation Project (NIIP) facilities to some extent and have the same Gallup Regional System supplying water to the city of Gallup and surrounding Navajo chapters.

Four of the alternatives obtain all of the water from Navajo Reservoir and the NIIP facilities:

- NIIP Moncisco Alternative
- NIIP Coury Lateral Alternative
- NIIP Cutter Alternative
- NIIP Amarillo Alternative

[1] The city of Gallup uses 160 gallons per capita per day (gpcd) for current and future demand projections. The Navajo Tribal Utility Authority's current average water use rate is 100 gpcd.

The other two alternatives have a San Juan River diversion in addition to the diversion from the NIIP:

- San Juan River Public Service Company of New Mexico (SJRPNM) Alternative
- San River Infiltration Alternative

Table S-1 shows major features for each alternative.

Table S-1.—General summary of components

Component	NIIP Moncisco Alternative	NIIP Coury Lateral Alternative	NIIP Cutter Alternative	NIIP Amarillo Alternative	SJRPNM Alternative	San Juan River Infiltration Alternative
River intake					1	
Infiltration wells						26 (year 2040)
River pumping plant					1	
Treatment plants	1	1	1	2	2	2
Forebay tanks	12	8	11	17	19	20
Pumping plants	12	8	11	17	20	20
Regulating tanks	5	5	5	6	5	5
Community storage tanks	20	20	20	20	20	20
Feet of pipeline	1,361,954	1,389,378	1,466,248	1,286,082	1,237,792	1,189,145
Miles of pipeline	258	263	278	244	234	225
Gallup Regional System						
Pumping plants	4	4	4	4	4	4
Community storage tanks	5	5	5	5	5	5
Feet of pipeline	171,923	171,923	171,923	171,923	171,923	171,923
Miles of pipeline	32.6	32.6	32.6	32.6	32.6	32.6

ALTERNATIVE SCREENING PROCESS

The six viable alternatives were compared using nine factors derived from the four accounts described in the *Principles and Guidelines*. The SJRPNM Alternative surfaced as the highest-ranked, or best, alternative considering all the factors. When considering only environmental factors, the SJRPNM Alternative also ranked the highest or least environmentally impacting. When considering only capital and annual operation, maintenance, and replacement (OM&R) costs as measured by present worth, the SJRPNM Alternative was least costly assuming Colorado River Storage Project (CRSP) power rates. When locally available power rates from the NTUA were used, the NIIP Amarillo Alternative was the least costly.

A detailed analysis of environmental impacts associated with the SJRPNM and NIIP Amarillo Alternatives and the No Action Alternative was completed in the environmental impact statement portion of this document. This analysis concluded that the SJRPNM Alternative is the least environmentally impacting alternative in most resources factors.

The SJRPNM Alternative has been identified as the preferred alternative considering all the factors and resources evaluated.

PREFERRED ALTERNATIVE

The SJRPNM Alternative would divert water from the San Juan River downstream of Fruitland, New Mexico, just above the existing Public Service Company of New Mexico (PNM) diversion structure, treat the water to drinking water standards, and then deliver it along Highway N36 and south to Navajo chapters along U.S. Highway 491. Water would be provided to Window Rock, Arizona, and Crownpoint, New Mexico, through sublaterals. Water delivery would continue to the Navajo Nation capital of Window Rock, Arizona, and to the city of Gallup, New Mexico. Another diversion would originate at Cutter Reservoir, an existing regulating reservoir on the NIIP, and would convey water to the eastern portion of the Navajo and Jicarilla Apache Nations.

The construction cost of this alternative is estimated to be $716,100,000 (Reclamation, March 2005 cost estimate, table S-2)

The annual OM&R costs for the preferred alternative are projected as shown in table S-3.

The appraisal-level design and cost estimate was done by Reclamation’s Technical Service Center. The design and cost estimate was peer reviewed by an independent engineering consulting firm, Boyle Engineering. Revisions were made to the estimate based on the review, and the contingency factor was increased. This estimate represents what this project could be constructed for at a January 2005 price level. This assumes that no unknown factors were encountered or changes made.

Table S-2.—Preferred alternative cost estimate

Feature	Reclamation March 2005[1] cost estimate ($)
Pipelines	154,504,770
Pumping plants	32,270,000
Water treatment plants	46,541,780
Tanks and air chambers	67,730,000
Transmission lines	21,761,661
Turnout structure	1,778,490
Gallup Regional System	21,000,000
Subtotal	345,586,701
Mobilization 5%	17,500,000
Unlisted items 10%	36,913,299
Subtotal	400,000,000
Contingencies 25%	100,000,000
Subtotal (field costs)	500,000,000
Noncontract costs 30%	150,000,000
Subtotal	650,000,000
New Mexico taxes on field costs (estimated at 6%)	30,000,000
Navajo Nation taxes on field costs excluding Gallup Regional System field cost of $30 million (estimated at 3%)	14,100,000
Subtotal	694,100,000
Land, relocation, and damage[2]	7,000,000
Cultural resource mitigation	11,000,000
Environmental mitigation	4,000,000
Total project cost	716,100,000

[1] The cost analysis contained in this PR/DEIS is based on an appraisal level of analysis. As part of Reclamation's efforts to attain greater transparency and accountability with regards to its engineering analyses, the cost estimate is being re-priced. This means that instead of updating the 2005 cost estimates using engineering cost indices, the components of the proposed project will be individually re-priced in order to gain greater confidence in the estimate. Once the re-pricing is completed, which we anticipate to occur during the 90-day public comment period, Reclamation will update the PR/DEIS through an addendum or potentially the use of errata sheets.

[2] The estimate includes rights-of-way (ROW) costs for the San Juan Treatment Plant only. Should it be determined that ROW for the rest of the features needs to be included in the project costs, an additional $30–60 million should be added.

Table S-3.—Yearly OM&R costs ($) (SJRPNM Alternative)

Item	San Juan Lateral	Cutter Lateral	Gallup Regional System
NTUA power costs (relift pumping plant)	4,962,000	597,000	82,000
CRSP power costs (relift pumping plant)	1,678,000	202,000	28,000
NTUA power costs (booster pumping plant)	215,000	35,000	
CRSP power costs (booster pumping plant)	73,000	12,000	—
Relift pumping plant OM&R	1,796,000	693,000	359,000
Booster pumping plant OM&R	73,000	14,000	
Canal OM&R	—	32,000	—
NTUA power cost water treatment plant	511,000	63,000	—
CRSP power cost water treatment plant	171,000	20,000	—
Water treatment OM&R	2,602,157	$1,038,750	—
NTUA water treatment, miscellaneous 10%	311,000	$110,000	
CRSP water treatment, miscellaneous 10%	277,000	$106,000	
Power transmission OM&R	630,000	Included in San Juan Lateral	
Pipeline OM&R	619,000	153,000	32,000
Total NTUA	11,719,157	2,735,750	473,000
Total CRSP	7,919,157	2,270,750	419,000

Notes: (1) CRSP rate is 9.5 mils per kilowatthour and demand charge of $4.04 per kilowatt per month.
(2) CRSP total project power cost is $2,184,000.
(3) NTUA rate is 20 mils per kilowatthour and demand charge of $16.50 per kilowatt per month.
(4) NTUA total project power cost is $6,465,000.
(5) Cost reflects March 2005 project cost estimate with January 2005 price level.

WATER SUPPLY

Water for the Navajo Nation's use in New Mexico would be supplied from the State of New Mexico's Upper Basin apportionment, and water for the Navajo Nation use in Arizona would be supplied from the consumptive use apportionments made to the State of Arizona by compact or decree. Navajo Nation uses by the project in both States must be serviced through long-term water supply contracts between the Secretary of the Interior (Secretary) and the Navajo Nation. The Secretary would make the water available for contract deliveries under existing New Mexico permits that the Secretary holds.

Jicarilla Apache Nation water would come from Navajo Reservoir as part of the water obtained through the Jicarilla Apache Nation Water Right Settlement. The Jicarilla Apache Nation has an existing water supply contract for this water. It is anticipated that the city of Gallup would contract through the Jicarilla Apache Nation and/or Navajo Nation for its water supply. A long-term water supply subcontract among the Jicarilla Apache Nation and/or Navajo Nation, the city of Gallup, and Reclamation would be needed to finalize this arrangement.

ECONOMIC AND FINANCIAL ANALYSIS

The economic analysis compares project benefits measured by willingness to pay and cost of alternative source of water to project cost. The benefit to cost ratio is 1.15, which represents a beneficial use of national resources. The financial analysis addresses the cost of project water delivered to the users. The levelized cost of project water to the user is estimated to be $6.98 per thousand gallons. This compares with $5.56 per thousand gallons for the Lewis and Clark Project and $8.32 per thousand gallons for the Rocky Boy's/North Central Montana Regional System, both of which are authorized Federal rural water projects.

AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

Positive impacts would occur from implementing the preferred alternative. The average flow in the San Juan River would be increased by approximately 5 cubic feet per second between Navajo Dam and the SJRPNM diversion. This increase would provide additional dilution for water quality improvement and would improve the habitat for fish (including the tail water trout fishery). Indian Trust Assets could be put to use by providing the Navajo and Jicarilla Apache Nations a water supply system. The socioeconomic resources would be improved by providing up to 650 jobs during construction and boosting the income to the region. An M&I water supply would help boost the overall economic growth to the region.

Negative impacts associated with construction of such a large project are unavoidable. They consist of a permanent loss of 43 acres of vegetation and associated wildlife habitat, including 1.1 acres of permanent loss of wetlands. There would be potential entrainment losses at the PNM diversion for flannel mouth sucker and speckled dace larva. Forty-three acres of private and Navajo Nation lands would be converted to project use by the alternative. Six families who currently live on the private land would be relocated. During construction there would be a temporary impact to grazing on Navajo Nation lands.

Special status species would be impacted due to the potential entrainment losses at the SJRPNM diversion for Colorado pikeminnow, razorback sucker, and bluehead sucker. Potential negative impacts would occur to the bald eagle and Southwestern willow flycatcher along the San Juan River. There are also potential negative impacts to the beautiful gilia and Mesa Verde cactus along the pipeline alignment.

Cultural resources could be potentially adversely impacted since there are an estimated 104 cultural resource sites within the area of potential effects. Approximately 90 sites could require treatment.

Mitigation measures addressing these potential impacts have been developed and are included in the preferred alternative design and cost estimate.

CONSULTATION AND COORDINATION

Reclamation, as the lead agency responsible for preparation of this PR/DEIS, used an interdisciplinary team to prepare the document in addition to representatives from the Navajo and Jicarilla Apache Nations and city of Gallup staff and consultants. In addition, the BIA, IHS, NTUA, State of New Mexico, and the Northwest New Mexico Council of Governments participated with the interdisciplinary team in preparing this document.

Consultation under the Endangered Species Act (ESA) is ongoing. Reclamation and the U.S. Fish and Wildlife Service (Service) have consulted, both formally and informally, regarding potential impacts to special status species as a result of potential development and operation of the preferred alternative.

A biological assessment was developed by Reclamation, and the Service issued a draft biological opinion under the ESA. In the draft biological opinion, the Service concluded that the proposed project, as described in the biological assessment and in this PR/DEIS, may affect, and is likely to adversely affect, the Colorado pikeminnow, razorback sucker, and Mesa Verde cactus. The draft biological opinion indicates that the final opinion would contain an incidental take permit for Colorado pikeminnow and razorback sucker larvae that may become entrained as a result of the diversion from the San Juan River.

Mesa Verde cactus may be directly taken during the construction of project features. The Service concurred that the proposed project may affect, but is not likely to adversely affect, the Southwestern willow flycatcher and bald eagle.

The draft biological opinion incorporates a Navajo Nation depletion guarantee, which limits new depletion associated with the project to 5,271 acre-feet at full development (see chapter VI and volume II, appendix C). The opinion concludes that the 5,271 acre-feet of new depletions associated with the proposed project would not adversely impact the Colorado pikeminnow or razorback sucker. However, because larval fish may be lost due to the project diversions, the fish would be adversely affected. The opinion identifies the San Juan River Basin Recovery Implementation Program as the reasonable and prudent measure to reduce incidental take of Colorado pikeminnow and razorback sucker and identifies conservation recommendations to reduce the direct take of Mesa Verde cactus. The opinion also states that if re-initiation is required, the Service will follow the procedures regarding re-initiation of consultation pursuant to the "Principles for Conducting Endangered Species Act Section 7 Consultations on Water Development and Water Management Activities Affecting Endangered Fish Species in the San Juan River Basin." Results of any additional consultation will be included in the final biological opinion and will be incorporated into the planning report and final environmental impact statement.

A Planning Aid Memorandum and draft Fish and Wildlife Coordination Act report have also been completed by the Service and the recommendations included, where appropriate, in the preferred alternative plan.

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Chapter I

INTRODUCTION

PURPOSE OF AND NEED FOR THE PROPOSED PROJECT

The purpose of the Navajo-Gallup Water Supply Project (proposed project) is to provide the long-term (year 2040) supply, treatment, and transmission of municipal and industrial (M&I) water to the eastern part of the Navajo Nation, the Jicarilla Apache Nation, and the city of Gallup, New Mexico. The Federal action is to construct, operate, and maintain a water supply system that meets projected year 2040 water demand. The Bureau of Reclamation (Reclamation) does not have the substantive or budgetary authorization required to construct, operate, or maintain any facilities proposed in this document, and such authorization may only be granted by Congress.

A long-term (year 2040) sustainable water supply is needed for the Navajo and Jicarilla Apache Nations and the city of Gallup to support the current and future populations. The existing groundwater supplies are dwindling and have limited capacity.

THE PROPOSED PROJECT

The project proposes to convey a reliable M&I water supply to the eastern section of the Navajo Nation, the southwestern part of the Jicarilla Apache Nation, and the city of Gallup, New Mexico, via diversions from the San Juan River in northern New Mexico. The Navajo Nation, city of Gallup, and Jicarilla Apache Nation are cooperating project participants.

Navajo Nation communities and the city of Gallup rely on a rapidly depleting groundwater supply that is inadequate to meet present and projected needs to the year 2040. Other water sources are needed to meet current and future M&I demands of more than 43 Navajo chapters,[1] the city of Gallup, the Navajo Agricultural Products Industry (NAPI), and the Teepee Junction area of the Jicarilla Apache Nation.

The proposed project would deplete approximately 35,893 acre-feet of water annually from the San Juan River for M&I use. Based on the expected populations in the year 2040, the proposed project would serve approximately 203,000 people in 43 chapters in the Navajo Nation, 1,300 people in the Jicarilla Apache Nation, and approximately 47,000 people in the city of Gallup.

This planning report and draft environmental impact statement (PR/DEIS) examines six structural alternative plans for achieving water delivery, as well as a non-structural Water Conservation Alternative for the proposed project. It describes the way in which the plans were formulated and evaluated, includes appraisal-level designs and cost estimates, and discloses the environmental impacts of the No Action Alternative and two action alternatives, as required by the National Environmental Policy Act (NEPA). It also meets the guidelines and requirements of other laws and mandates cited at the end of this chapter.

Reclamation historically supports projects for construction after a feasibility report is completed, which includes a feasibility-level cost estimate. This appraisal-level cost estimate does not meet that requirement. Additional analysis, detail, and updating of the appraisal-level cost estimates presented in this draft report are needed before project construction authorization can be supported. Failure to complete this additional effort may result in reliance on a cost estimate for the proposed project that is not sufficient to characterize the expected cost. The appraisal-level design must be upgraded to feasibility level before Reclamation would begin construction. The cost of, and time for, completing this additional work would be substantial.

The ultimate objective of the planning effort in this project is to develop an economically, technically, socially, and environmentally acceptable plan that would provide for present and future water supply needs in the area. The steps necessary to attain this goal are to:

- Delineate present conditions
- Estimate growth and future water demands
- Determine the capability of water resources to meet the needs
- Formulate and weigh alternative plans
- Select a proposed plan

[1] Navajo Nation chapters are centers of local government. The Navajo Nation is divided into 110 chapters.

The proposed project would also facilitate self-governance and sovereignty goals of the Jicarilla Apache and Navajo Nations.

SCOPE

The general project area is on the west slope of the Continental Divide and is within the drainage basins of the Rio Grande and Upper and Lower Colorado Rivers. Figure I-1 depicts the proposed project boundaries and specific locations.

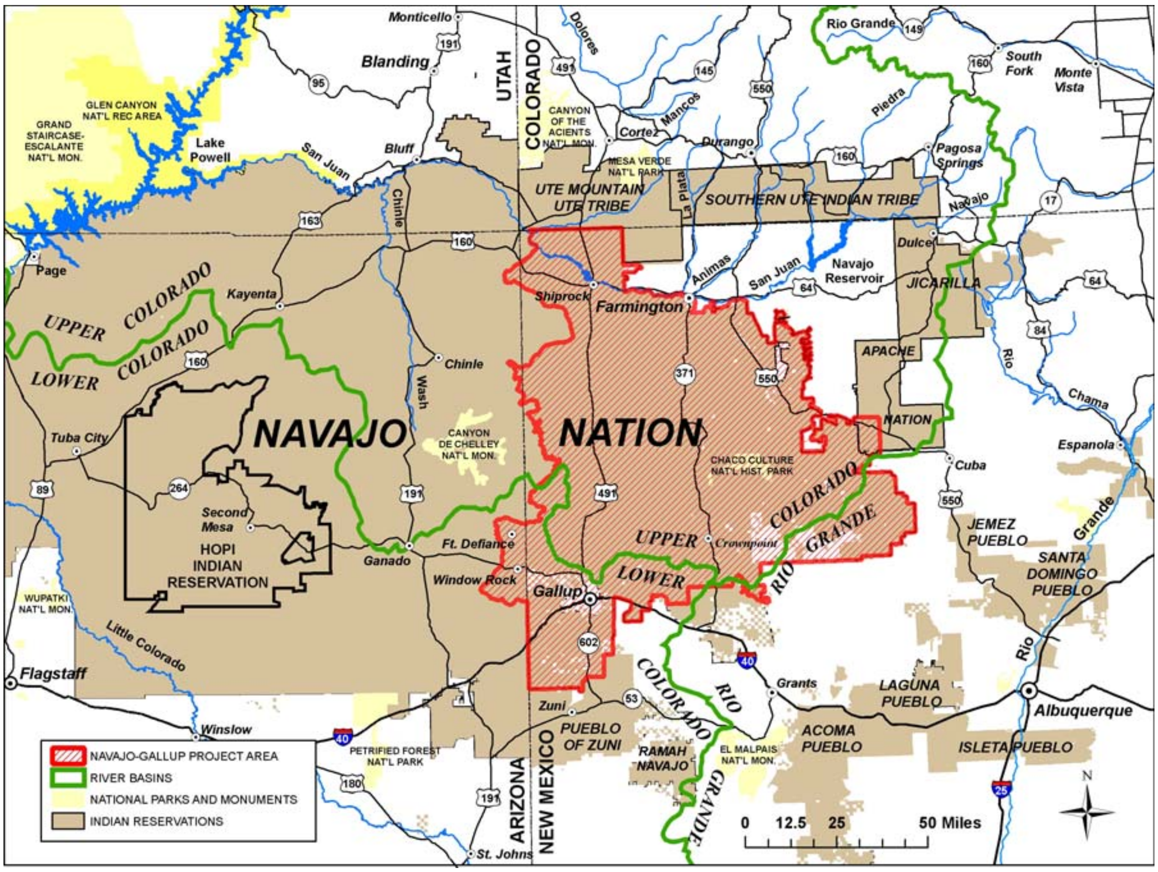

Figure I-1.—Proposed project area.

The Navajo Nation Reservation lands portion of the proposed project area is bounded generally on the west by the New Mexico/Arizona State line, with small parts of the proposed project in Arizona near Teec Nos Pos to the north and Fort Defiance/Window Rock to the south; on the north by the Colorado/New Mexico State line to a point roughly above Waterflow, New Mexico, then south to the San Juan River and eastward to a point near Bloomfield, New Mexico; on the east by U.S. Highway 550 to approximately Counselor, New Mexico; and on the south from a point westward into Arizona near Window Rock, with a dip south of Manuelito to include the city of Gallup.

The Jicarilla Apache Nation Reservation lands portion of the proposed project area is bounded generally on the south and west by U.S. Highway 550 and then north parallel to State Highway 537, on the north by the main reservation, and on the east by the Mundo Ranch area.

The Proposed Project Area

Navajo Nation

The Navajo Nation Reservation was established in 1868 and has been expanded through a series of Executive orders to become the largest American Indian (Indian) reservation in the United States. The Navajo Nation encompasses 26,897 square miles within the States of Arizona, New Mexico, and Utah, constituting an area larger than the State of West Virginia. According to the U.S. Census Bureau (2000), on-reservation population was 181,000, and, nationwide, approximately 300,000 people indicated they were Navajo. The Navajo have a high level of poverty, with more than 56 percent having incomes below the poverty level and a reservation unemployment rate of 54 percent (Rodgers, 1995).

Jicarilla Apache Nation

The Jicarilla Apache Nation is located in north-central New Mexico and includes approximately 742,800 acres. Additional private parcels of land adjacent to the reservation have been acquired by the Jicarilla Apache Nation in recent years, resulting in 97,000 acres being added to the reservation through trust acquisition actions by Congress. The Jicarilla Apache Nation is by far the largest employer of its people, providing social services and management of its natural resources. Tribal unemployment rates are about 16.6 percent in the summer and 28.7 percent in the winter (Jicarilla Apache Nation, 1998).

City of Gallup

The city of Gallup is the county seat of McKinley County, New Mexico, and is the economic center for a 15,000-square-mile trade area. The city is located on two major highways—Interstate Highway 40, from east to west, and Route 491, which extends north to Shiprock. The city is a tourism center and also has industries centering on natural gas, oil, coal, and uranium extraction. Its year 2000 population was approximately 20,200 (North West New Mexico Fact Book, 2003), with about 37 percent of that number Native American residents.

PROPOSED PROJECT AUTHORIZATION, RELATED AGREEMENTS, AND RESOLUTIONS

Reclamation

General authority to conduct water resources planning is delegated to Reclamation by Federal Reclamation Laws of 1902 and subsequent supplements. Specific authority is under Public Law [P.L.] 92-199 of 1971, which authorized Reclamation to conduct feasibility studies for a project to provide water to the Navajo Nation and the city of Gallup. Numerous studies were conducted in the intervening years, and a major study effort has been funded since the year 2000, with in-kind cost sharing by the Navajo Nation, the city of Gallup, and the Jicarilla Apache Nation (volume II, appendix A). These studies have resulted in this PR/DEIS, which includes appraisal-level designs and cost estimates.

Water Resource Development Strategy of the Navajo Nation

The Navajo Nation's water resource strategy that combines Tribal, Federal, State, and private resources includes (Navajo Nation Department of Water Resources, 2001):

- Maintaining a water resource development task force, which will coordinate technical and fiscal resources of the Navajo Nation and Federal agencies
- Preparing a reservation-wide needs assessment and prioritizing projects
- Developing regional water supply projects
- Developing and rehabilitating local water supply and distribution systems
- Completing the Navajo Indian Irrigation Project (NIIP) and continuing to address deficiencies in water storage facilities

City of Gallup and the Navajo Nation

In 1998, the city of Gallup Mayor and the Navajo Nation President signed an agreement to cooperate on the planning for the proposed project. That document commits the city of Gallup and the Navajo Nation to:

- A cooperative effort to proceed with planning and development.
- A project that works conjunctively with the NIIP.
- A project that will result in a fair and equitable distribution of project water between the city of Gallup and Navajo Nation communities.
- A cooperative investigation of all viable alternative project configurations.
- Support for the commitment of the Bureau of Indian Affairs (BIA) to engage in section 7 (endangered species) consultation with the U.S. Fish and Wildlife Service (Service) as quickly as possible. Reclamation, as the lead Federal agency, has responsibility for section 7 consultation.
- Working together to resolve issues affecting the implementation of the proposed project.

The Memorandum of Agreement (attachment A) continues to serve as the basis for the collaborative efforts of the Navajo Nation and the city of Gallup to develop the proposed project.

Upper Colorado River Commission

Recognizing the need to develop depletion schedules for long-range planning, the Upper Colorado River Commission (Commission) periodically assesses the depletion projections for the Upper Colorado Basin States. Projections by the State of New Mexico in May 2006 show the State not exceeding 642,400 acre-feet per year (AFY) through 2060 with full development of this proposed project (table I-1). The Commission passed a resolution in June 2003 supporting the proposed project and consenting to a diversion of water from the Upper Basin for use in the Lower Basin within New Mexico (attachment B). The Commission also passed a resolution in June 2006 supporting a proposed determination by the Secretary of the Interior (Secretary) that sufficient water is reasonably likely to be available to fulfill the project water needs in New Mexico from the Navajo Reservoir water supply (attachment B). This water is in addition to existing

Table I-1.—State of New Mexico schedule of anticipated Upper Basin depletions (May 2006)
(1,000 AFY)

	2000	2010	2020	2030	2040	2050	2060
Irrigation uses[1]							
Navajo Nation Irrigation:							
Navajo Indian Irrigation Project	150.0	215.0	250.0	270.0	270.0	270.0	270.0
Fruitland-Cambridge Irrigation Project	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Hogback-Cudei Irrigation Project	15.5	15.5	21.3	21.3	21.3	21.3	21.3
Chaco River drainage irrigation	3.1	3.1	3.1	3.1	3.1	3.1	3.1
Crystal area irrigation	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Navajo Nation irrigation subtotal	176.9	241.9	282.7	302.7	302.7	302.7	302.7
Non-Navajo Irrigation:							
Above Navajo Dam (including Jicarilla)	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Upper San Juan (excluding Hammond)	10.3	10.3	10.3	10.3	10.3	10.3	10.3
Hammond Irrigation Project	12.1	12.1	12.1	12.1	12.1	12.1	12.1
Animas River ditches	40.7	40.7	40.7	40.7	40.7	40.7	40.7
La Plata River ditches	5.9	5.9	5.9	5.9	5.9	5.9	5.9
Farmers Mutual Ditch	11.2	11.2	11.2	11.2	11.2	11.2	11.2
Jewett Valley Ditch	3.7	3.7	3.7	3.7	3.7	3.7	3.7
Chaco River drainage irrigation	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Non-Navajo irrigation subtotal	86.5	86.5	86.5	86.5	86.5	86.5	86.5
Irrigation total	263.4	328.4	369.2	389.2	389.2	389.2	389.2
Stockpond evaporation and stock use	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Municipal and domestic uses[1]							
Current M&I uses	9.7	9.7	9.7	9.	9.7	9.7	9.7
Animas-La Plata Project:							
San Juan Water Commission	1.0	5.0	10.4	10.4	10.4	10.4	10.4
Navajo Nation	0.0	1.0	2.0	2.3	2.3	2.3	2.3
La Plata Conservancy District	0.0	0.0	0.8	0.8	0.8	0.8	0.8
Ridges Basin Reservoir evaporation - NM share	0.0	0.0	0.1	0.1	0.1	0.1	0.1
Animas-La Plata Project subtotal	1.0	6.0	13.3	13.6	13.6	13.6	13.6
Navajo-Gallup Water Supply Project:[2]							
Navajo Nation	0.0	0.0	7.9	10.2	12.5	12.5	12.5
Jicarilla Apache Nation	0.0	0.0	0.8	1.0	1.2	1.2	1.2
Navajo-Gallup Project subtotal (within Basin)	0.0	0.0	8.7	11.2	13.7	13.7	13.7
Navajo Nation municipal use, future (excluding the Navajo-Gallup Water Supply Project)	0.0	0.0	1.0	1.0	2.0	2.0	2.0
Jicarilla Apache Nation municipal use (excluding the Navajo-Gallup Water Supply Project)	0.0	0.0	0.0	0.4	0.6	0.6	0.6
Scattered rural domestic (including Jicarilla)	1.0	1.0	1.0	1.1	1.1	1.2	1.2
Municipal and domestic total	11.7	16.7	33.7	37.0	40.7	40.8	40.8

Table I-1.—State of New Mexico schedule of anticipated Upper Basin depletions (May 2006) – continued (1,000 AFY)

	2000	2010	2020	2030	2040	2050	2060
Power and industrial uses							
PNM – Navajo Reservoir contract[3]	16.2	16.2	16.2	16.2	16.2	16.2	16.2
BHP Billiton	37.0	37.0	38.0	39.0	39.0	39.0	39.0
Bloomfield Industrial	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Navajo Nation – Shiprock	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Navajo-Gallup Water Supply Project – NAPI[2]	0.0	0.0	0.7	0.7	0.7	0.7	0.7
Small Navajo reservoir contracts	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Power and industrial total	56.1	56.1	57.8	58.8	58.8	58.8	58.8
Exports							
San Juan-Chama Project	105.2	105.2	105.2	105.2	105.2	105.2	105.2
Navajo-Gallup Water Supply Project:[2]							
Navajo Nation in New Mexico	0.0	0.0	4.0	5.8	7.6	7.6	7.6
City of Gallup	0.0	0.0	4.7	6.1	7.5	7.5	7.5
Navajo-Gallup Project subtotal (export)	0.0	0.0	8.7	11.9	15.1	15.1	15.1
Export total	105.2	105.2	113.9	117.1	120.3	120.3	120.3
Reservoir evaporation							
Navajo Reservoir evaporation	28.3	28.0	27.7	27.7	27.7	27.7	27.7
Small reservoir evaporation	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Reservoir evaporation total	29.5	29.2	28.9	28.9	28.9	28.9	28.9
Total depletions[4]	469.9	539.6	607.5	635.0	641.9	642.0	642.0
State share of Upper Basin yield[5]	642.4	642.4	642.4	642.4	642.4	642.4	642.4
Remaining available[5, 6]	172.5	102.8	34.9	7.4	0.5	0.4	0.4
Percent of State share remaining	26.9%	16.0%	5.4%	1.2%	0.1%	0.1%	0.1%

[1] Does not reflect post-1965 transfers from irrigation to M&I uses.

[2] Proposed Navajo-Gallup Water Supply Project depletions in New Mexico total 29,500 acre-feet per year. Exports to Gallup are anticipated to be supplied through a subcontract with the Jicarilla Apache Nation. Exports for Navajo Nation uses in Arizona are not included.

[3] Supplied through a subcontract with the Jicarilla Apache Nation.

[4] This is a schedule of anticipated depletions for planning purposes only. It is not a tabulation or determination of water rights or actual uses. Total depletions exclude New Mexico's share of reservoir evaporation from the major reservoirs constructed under the Colorado River Storage Project (CRSP) Act that are used principally to regulate compact deliveries at Lee Ferry and generate CRSP hydroelectric power. These include Lake Powell, Flaming Gorge Reservoir, and the Aspinall Unit.

[5] This depletion schedule does not attempt to interpret the Colorado River Compact, the Upper Colorado River Basin Compact, or any other element of the "Law of the River." This schedule should not be construed as an acceptance of any assumption that limits the Upper Colorado River Basin's depletion or New Mexico's depletion. Of the water available to the Upper Basin at Lee Ferry, the allocation for use by New Mexico is listed in this schedule, for planning purposes, as 642,400 acre-feet. This amount does not include New Mexico's share of CRSP reservoir evaporation other than Navajo Reservoir evaporation.

Navajo Reservoir water supply contract water for other uses, under the allocations made to New Mexico in Articles III and XIV of the Upper Colorado River Basin Compact.

The proposed hydrologic determination prepared by Reclamation is currently being considered by the Secretary.

State of New Mexico/Navajo Nation Negotiations

The proposed project is a component of the San Juan River Basin in New Mexico Navajo Nation Water Rights Settlement Agreement that was signed by the State of New Mexico and the Navajo Nation on April 19, 2005. The settlement agreement would quantify the Nation's water rights in the San Juan River Basin in New Mexico. The settlement relies on congressional approval of the settlement agreement and Federal funding for Reclamation to construct the proposed project. The settlement agreement includes provisions for a long-term Navajo Reservoir water supply contract for the Nation's use under the proposed project in New Mexico. The quantification and settlement of the Navajo Nation's water rights for its uses under the project in Arizona are currently being discussed between the State of Arizona and the Nation. Reclamation, the Department, nor the Administration has taken a position with respect to the settlement agreement at this time.

Jicarilla Apache Tribal Council Resolution(s)

Participation of the Jicarilla Apache Nation in the proposed project would provide an opportunity for them to utilize a portion (1,200 acre-feet) of their San Juan River Basin (Basin) water rights for on-reservation development. The Tribal Council passed a resolution in June 2000 to participate in planning of the proposed project.

The Jicarilla Apache Nation intends to engage in substantive discussions with the Navajo Nation, the city of Gallup, and Reclamation regarding an appropriate water supply for the proposed project and options for serving a portion of the Jicarilla Apache Nation through the proposed project (attachment C). Stand-alone pipeline projects from the Navajo River or other locations to the Teepee Junction area are cost prohibitive for the Jicarilla Apache Nation.

However, by participating in the proposed project, the Jicarilla Apache Nation may be able to realize its development goals with water delivered to the desired location in a relatively cost-efficient manner by partnering with the Navajo Nation and the city of Gallup.

COOPERATING AGENCIES, PUBLIC INVOLVEMENT, AND SCOPING

In addition to the public information and scoping meetings and formal coordination required by law, as discussed in chapter VII, a number of agencies and entities have been involved in planning. A project Steering Committee has been established and functioning since the early 1990s. The committee's purpose is to oversee and guide the planning and implementation of the proposed project. The committee is composed of representatives from the Navajo and Jicarilla Apache Nations, State of New Mexico, Northwest New Mexico Council of Governments, city of Gallup, Navajo Tribal Utility Authority, BIA, and Indian Health Service. Since 2000, the committee has met quarterly to discuss planning status, address issues, and make assignments. For the purposes of this PR/DEIS preparation, the Steering Committee members also serve as the cooperating agencies for implementation of NEPA.

PREVIOUS STUDIES

Over the past 40 years, a number of proposals have been studied to deliver water from the San Juan River and other sources of water to communities in the Navajo Nation and to the city of Gallup. Reclamation's first investigation for the "Gallup Project, New Mexico,"[2] culminated in a reconnaissance report dated October 1973. A second study[3] was completed in January 1984 and included expanded service to Navajo communities as well as to the city of Gallup. An appraisal-level estimate[4] for a system with a main transmission line along Highway 371 was completed in September 1986. In November 1993, an appraisal-level study[5] was conducted to deliver water from the Gallegos Reservoir, a planned feature of the NIIP. All previous studies have been appraisal-level.

This project has evolved as a major infrastructure initiative to supply approximately 23,900 acre-feet of water per year by year 2020 and approximately 37,800 acre-feet of water per year by year 2040 of municipal water to meet these needs. A detailed history of the proposed project can be found in volume II, appendix A, section 3.0.

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[2] *Gallup Project Reconnaissance Report*, U.S. Department of the Interior, Reclamation, 1973.

[3] *Gallup-Navajo Indian Water Supply Project, Planning Report/Draft Environmental Impact Statement*, U.S. Department of the Interior, Reclamation, Southwest Region, January 1984.

[4] Gallup-Navajo Indian Water Supply Project, New Mexico, Arizona, *Technical Report*, U.S. Department of the Interior, Reclamation, Southwest Region, September 1986.

[5] San Juan River Gallup/Navajo Water Supply Project, Engineering and Cost Estimates, *Technical Appraisal Report*, Reclamation, November 1993.

OTHER PROJECTS AND ACTIONS IN THE SAN JUAN RIVER BASIN

Regulations for implementing NEPA require Reclamation to consider the relationship of the proposed project to other projects and activities in the area. That relationship has been considered by Reclamation, and it helped to determine the appropriate scope of this PR/DEIS. The relationship can be direct, indirect, or cumulative in nature. It extends to activities that are:

- **Connected actions** (40 Code of Federal Regulations [CFR] 1508.25(a)(1)), which means they are closely related and should be discussed in the same environmental impact statement

- **Cumulative actions** (40 CFR 1508.25(a)(2)), which, when viewed with other proposed actions, have cumulatively significant impacts

- **Similar actions** (40 CFR 1508.25(a)(3)), which have similarities to the proposed actions that provide a basis for evaluation together, such as common timing or geography

The status of other projects in the Basin has been particularly important to this project because of a need to secure a water supply in the face of dwindling opportunities. The Upper Colorado River Compact, development of the NIIP, Endangered Species Act (ESA), San Juan River Basin Recovery Implementation Program (SJRBRIP), Indian water rights settlements, the Animas-La Plata (ALP) Project, and current development all play a role in additional water development in the Basin. These projects, primarily cumulative in terms of their impacts, are summarized in the following sections.

Navajo Indian Irrigation Project

The NIIP was authorized in 1962 by P.L. 87-483. This public law authorized the Secretary to construct, operate, and maintain the NIIP for the principal purpose of furnishing irrigation water to approximately 110,630 acres of land. The NIIP consists of the initial land development, water distribution system, water delivery, roads, and other infrastructure. In 1970, the Navajo Nation created NAPI to run the agricultural business venture and take responsibility for operating the NIIP facilities. The NIIP is approximately 70 percent complete, with 77,685 acres developed. The average amount of water diverted by the NIIP from Navajo Reservoir from 2001 through 2005 was approximately 172,000 AFY. Based on an average unit depletion of 2.44 acre-feet per acre, at full build-out, with all of the proposed project acreage irrigated, the NIIP will deplete approximately 270,000 AFY of San Juan River water. Based on the current overall project irrigation efficiency, the NIIP would divert approximately 337,500 acre-feet of water (BIA, 1999).

San Juan River Basin Recovery Implementation Program

Federal and State agencies, water users, and Indian Tribes have been cooperating in the SJRBRIP. Established in 1992, the SJRBRIP is composed of a partnership among the Jicarilla Apache Nation, Navajo Nation, Southern Ute Indian and Ute Mountain Ute Tribes, States of Colorado and New Mexico, BIA, Bureau of Land Management, Reclamation, the Service, and water development interests. The goal of the SJRBRIP is twofold:

(1) To conserve populations of Colorado pikeminnow and razorback sucker (figure I-2) in the Basin, consistent with the recovery goals established under the ESA, 16 United States Code (U.S.C.) 1531 et seq.

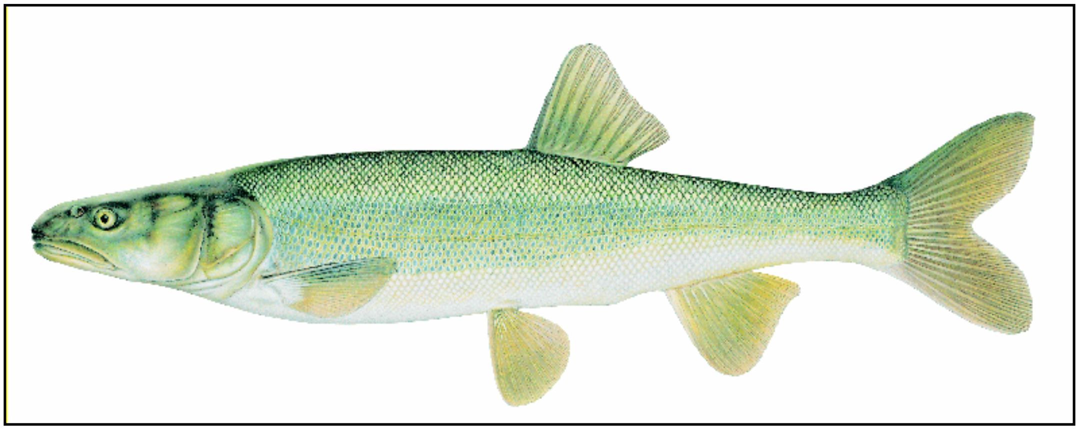
(2) To proceed with water development in the Basin in compliance with Federal and State laws, interstate compacts, Supreme Court decrees, and Federal trust responsibilities to the Southern Ute Indian Tribe, Ute Mountain Ute Tribe, Jicarilla Apache Nation, and Navajo Nation

Program elements include the following:

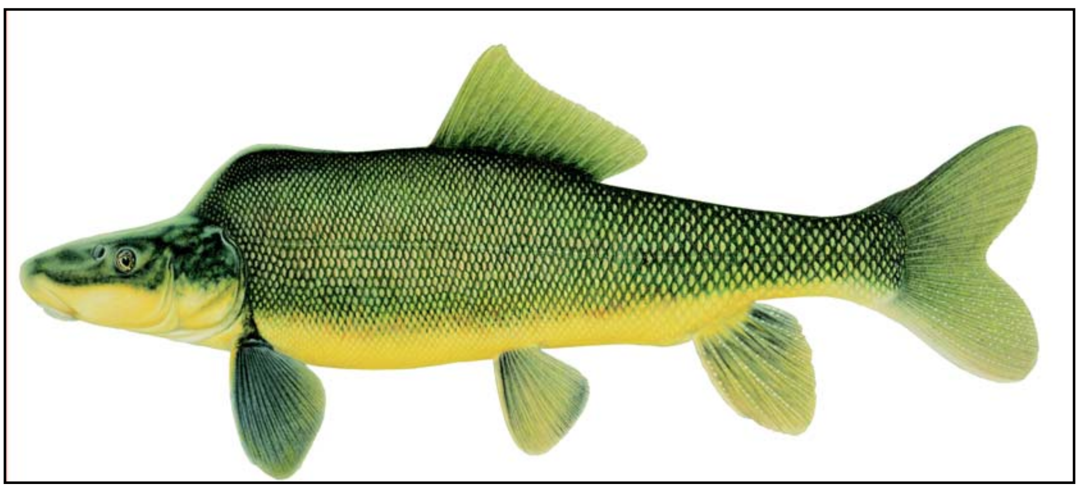
(1) *Protection, Management, and Augmentation of Habitat* – This element identifies important river reaches and habitats for different life stages of the endangered fishes and makes appropriate habitat improvements, including providing flows in the San Juan River and passage around migration barriers so as to provide suitable habitat to support recovered fish populations.

(2) *Water Quality Protection and Enhancement* – This element identifies and monitors water quality conditions and takes actions to diminish or eliminate identified water quality problems that limit recovery.

(3) *Interactions Between Native and Non-Native Fish Species* – This element identifies problematic non-native fish species and implements actions to reduce negative interactions between the endangered fish and non-native fish species.



Colorado pikeminnow



Razorback sucker

Figure I-2.— Colorado pikeminnow and razorback sucker.
(Illustrations copywritten by Joseph R. Tomelleri)

(4) *Monitoring and Data Management* – This element evaluates the status and trends of endangered fish species, as well as other native and non-native species, and measures progress toward achieving recovery goals.

(5) *Protection of Genetic Integrity and Management and Augmentation of Populations* – This element ensures that the SJRBRIP's augmentation protocols maintain genetically diverse fish species while raising new generations of Colorado pikeminnow and razorback sucker to stock in the river system.

A 7-year research program was completed by the SJRBRIP, and Flow Recommendations were approved by the SJRBRIP in 1999. Fish passage has been restored at the Public Service Company of New Mexico, Hogback, and Cudei diversions on the San Juan River.

Animas-La Plata Project

The ALP Project, located in southwestern Colorado and northwestern New Mexico, is being implemented as a settlement of the Colorado Ute tribal water rights. The ALP Project will provide an M&I water supply to the entities listed below (their respective average annual allocated water depletion is shown).

Entity	Depletion (AFY)
Southern Ute Indian Tribe	16,525
Ute Mountain Ute Tribe	16,525
Navajo Nation	2,340
San Juan Water Commission	10,400
Animas-La Plata Water Conservancy District	2,600
State of Colorado	5,230
La Plata Conservancy District, New Mexico	780

Construction is approximately 45 percent complete on the ALP Project, and it is anticipated to be completed in 2012 or 2013. Implementation of the SJRBRIP is the key element of the reasonable and prudent alternative[6] (RPA) for section 7 consultation under the ESA that would permit completion of the ALP Project.

[6] Regulations implementing the ESA, section 7, define reasonable and prudent alternatives as alternative actions that avoid jeopardy identified during formal consultation with the Service.

Navajo Reservoir Operations (Navajo Unit of the Colorado River Storage Project)

Reclamation, in April 2006, completed the Navajo Reservoir Operations Final Environmental Impact Statement (FEIS), and the Navajo Reservoir FEIS Record of Decision (ROD) was signed in July 2006. In accordance with the ROD, the reservoir will be operated in the future so that releases from Navajo Dam will generally range between 250 and 5,000 cubic feet per second (cfs) (the FEIS 250/5000 Alternative). For further details on this and other related projects, see the "Cumulative Impacts, Operation of Navajo Dam" section of chapter V).

As described in the Navajo Reservoir FEIS, Reclamation intends to operate Navajo Dam and Reservoir to implement ESA-related Flow Recommendations (SJRBRIP, above) to assist in conserving endangered fish in the San Juan River downstream from Farmington and to enable Basin water development, including this project, to proceed under applicable laws, compacts, and court decrees.

Navajo Reservoir operations also constitute a connected action to other water resource activities in the Basin, such as the ALP Project and the NIIP. This connection stems from (1) past ESA consultations that relied on the SJRBRIP and listed certain RPAs to avoid jeopardy to the endangered species in question, (2) Flow Recommendations developed and approved by the SJRBRIP, and (3) Reclamation's previous commitment to operate Navajo Reservoir for the benefit of endangered fish in the Basin.

San Juan-Chama Project

Reclamation's San Juan-Chama Project diverted an annual average of 90,800 acre-feet of water from the Basin and transported the water across the Continental Divide for use in the Rio Grande Basin in New Mexico between 1972 and 2004. The long-term average San Juan-Chama Project diversion is anticipated to be about 105,200 AFY, as shown in Table I-1, State of New Mexico schedule of anticipated Upper Basin depletions. This reflects full project demands in the future under the full range of historic flow availability for the period of record. The Jicarilla Apache Nation has rights to divert and deplete 6,500 acre-feet of San Juan-Chama Project water annually, an amount that is included in the environmental baseline for the Basin.

Other Related Actions

- Actions to implement some or all of the Jicarilla Apache Nation water right settlement and related water service contracts

- Actions to develop some of the water rights established in the l986 Colorado Ute Indian Water Rights Settlement Agreement and the Colorado Ute Settlement Act, amendments of 2000

- The exercise of other, presently unquantified Indian or Federal water rights

- Unspecified future non-Indian water development

WATER RIGHTS BACKGROUND

Indian Water Rights

Indian Tribes in and near the proposed project area may have reserved water rights to provide sufficient water to serve the purposes of their reservations. Such reserved rights may date from the time treaties, statutes, and Executive orders established reservations of land for the Tribe and are typically senior to other rights in the Basin. In certain instances, rights have been subordinated to later priority dates by agreement. For example, Indian water uses from Navajo Reservoir and from the ALP Project will be administered with the same priority as non-Indian water uses from these projects in accordance with Federal legislation and water rights settlements. In the Basin, combined Indian water rights constitute a potential right to much of the available water. The major treaties and other settlements implicating Indian water rights in the Basin are:

(1) Jicarilla Apache Tribe Water Rights Settlement Act (P.L. 102-441) of 1992 and the contract between the United States and the Jicarilla Apache Tribe, December 8, 1992

(2) Treaty between the United States of America and the Navajo Tribe of Indians of 1849 (ratified by the Senate on September 9, 1850; proclaimed by the President on September 24, 1850; 9 Stat. 974), and the treaty between the United States of America and the Navajo Tribe of Indians (concluded June 1, 1868; ratification advised July 25, 1868; proclaimed August 12, 1868; 15 Stat. 667)

(3) Colorado Ute Indian Water Rights Settlement Act of 1988 (P.L. 100-585) and Colorado Ute Indian Settlement Act Amendments of 2000 (P.L. 106-554), as amended

Non-Indian Water Rights

Water rights in the Basin are administered by the States of Arizona, Colorado, New Mexico, and Utah according to State water law and to the interstate compacts that divide the use of the waters of the Colorado River and its tributaries among the Colorado River Basin States. Some of the interstate compacts affecting the distribution of the water in the Basin are briefly summarized below:

(1) *Colorado River Compact*[7] – Divides the Colorado River Basin at Lee Ferry, Arizona, into the Upper and Lower Basins, apportions to the Upper Basin the right to the beneficial consumptive use of 7.5 million acre-feet (MAF) per annum, and requires the States of the Upper Basin to not cause the flow at Lee Ferry to be depleted below a total of 75 MAF for any period of 10 consecutive years.

(2) *Upper Colorado River Basin Compact* – Subject to the provisions and limitations contained in the Colorado River Compact, the Upper Colorado River Basin Compact, among other things, divides consumptive use, apportions to, and makes available for use each year by the Upper Basin States, amounts as follows:

- Arizona – 50,000 acre-feet per annum and the amount remaining after deduction of use made in Arizona
- Colorado – 51.75 percent
- New Mexico – 11.25 percent
- Utah – 23 percent
- Wyoming – 14 percent

The Upper Colorado River Basin Compact (Article XIV) apportions the water of the San Juan River and its tributaries in Colorado and New Mexico between the States of Colorado and New Mexico. In short, within the limitations described in Article XIV, the State of Colorado agrees to deliver to New Mexico from the San Juan River and its tributaries water sufficient to enable New Mexico to make full use of its compact apportionment subject to satisfaction first of water uses made at the time the compact was signed and water uses contemplated by water projects authorized at the time the compact was signed.

[7] It should be noted that the Navajo Nation firmly believes that the allocations in the 1922 Colorado River Compact and the 1948 Upper Colorado River Basin Compact do not limit the Navajo Nation's claim to water within the Colorado River system. Not all States agree with this interpretation.

(3) *La Plata River Compact* – This compact divides the waters of the La Plata River between the States of Colorado and New Mexico. In summary, each day during the period February 16 through November 30 of each year, Colorado is to deliver to New Mexico 100 cfs, or an amount equivalent to one-half of the mean daily flow at the Hesperus Station, for the preceding day, or the amount of water then needed for beneficial use in the State of New Mexico, whichever is less.

(4) *Animas-La Plata Compact* **–** This compact states that the water rights to store and divert water in Colorado for ALP uses in New Mexico shall be of equal priority with those rights granted by the Colorado State courts for ALP Project water uses in Colorado.

RESPONSIBILITIES AND COMPLIANCE

Environmental

Clean Air Act (42 U.S.C. 7401 et seq.)
Clean Water Act of l972 (33 U.S.C. 1251 et seq.)
Endangered Species Act of 1973 (16 U.S.C. 1532 et seq.)
Fish and Wildlife Coordination Act (48 Stat., as amended; 16 U.S.C. 661)
National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.)
Wild and Scenic Rivers Act of 1968 (16 U.S.C. 1532 et seq.)
Executive Order 11988, Floodplain Management, 1977
Executive Order 11990, Protection of Wetlands, 1977
Executive Order 11991, Protection and Enhancement of Environmental Quality, 1977

Cultural Preservation

Archaeological and Historic Preservation Act (16 U.S.C. 469 et seq.)
Archaeological Resources Protection Act of l979 (16 U.S.C. 470 et seq.)
Historic Sites, Buildings, and Antiquities Act (16 U.S.C. 461 et seq.)
National Historic Preservation Act (16 U.S.C. 470 et seq.)
Executive Order 11593, Protection and Enhancement of the Cultural Environment, 1971

American Indian

American Indian Religious Freedom Act of 1978, as amended (42 U.S.C. 1996)
Native American Graves Protection and Repatriation Act of 1990
(25 U.S.C. 3001 et seq.)

Religious Freedom Restoration Act of 1993 (P.L. 13-141)
Executive Order 13007 (Indian Sacred Sites)
Secretarial Orders 13175 and 3206 on Indian Trust Assets
General Allotment Act of 1877 (24 Stat. 388, chapter 119, 25 USCA 331)

Other

Executive Order 12898, Environmental Justice in Minority Populations and Low Income Populations, 1994
Reclamation Reform Act of 1982 (P.L. 97-293, Title II, 96 Stat. 1263)
Applicable State and Tribal laws implementing the Federal laws identified above

DOCUMENT REVIEW

Reclamation's Notice of Intent to prepare this PR/DEIS was published in the *Federal Register* on March 27, 2000. Scoping meetings were conducted on April 25, 2000, in Crownpoint, New Mexico; April 26, 2000, in Saint Michaels, Arizona; April 27, 2000, in Gallup, New Mexico; May 2, 2000, in Shiprock, New Mexico; and May 3, 2000, in Farmington, New Mexico. The written responses were reviewed by Reclamation and incorporated when they were within the scope of the Federal action.

The preliminary draft of this PR/DEIS has been reviewed by cooperating agencies. A Notice of Availability (NOA) of the PR/DEIS for a 90-day public review and comment period has been published in the *Federal Register*, which includes an announcement of public hearings.

During the public review and comment period, oral testimony and written comments will be received. Written responses to comments will be published as a separate volume in the planning report and final environmental impact statement (PR/FEIS). A NOA for the PR/FEIS will be published in the *Federal Register*, and responses to substantive comments will be incorporated in the ROD, which concludes the NEPA process.

Copies of this document and volume II (appendices) are available at Reclamation's Western Colorado Area Offices in Durango and Grand Junction, Colorado; the Upper Colorado Regional Office, Salt Lake City, Utah; Technical Service Center, Denver, Colorado; and at area public libraries. The PR/DEIS is also available at <http://www.usbr.gov/uc (select "Environmental Documents" and then the Navajo-Gallup Water Supply Project site). The PR/DEIS was mailed to individuals and parties listed on Reclamation's environmental impact statement mailing list (see chapter VII).

DOCUMENT ORGANIZATION

This PR/DEIS includes two volumes. This document is volume I, and the technical appendices constitute volume II.

Volume I includes:

- **Executive Summary**
- **Chapter I – Introduction**, discusses the general purpose of the proposed project; its location, background, and authorization; and such topics as project coordination, previous studies, related actions, and compliance.
- **Chapter II – Need for Action**, describes the problems this PR/DEIS addresses.
- **Chapter III – Opportunities/Resources and Constraints**, cites resources available to complete the proposed project as well as institutional, technical, and other barriers to its implementation.
- **Chapter IV – Alternatives**, describes earlier planning for the proposed project, standards for plans, various screening/selection criteria, the concept of four-account analysis, and plan selection.
- **Chapter V – Affected Environment and Environmental Consequences**, describes the affected environment and the potential impacts of the alternatives (compared to the No Action Alternative) on each of the environmental parameters. Proposed mitigation measures, if any, are included. Indirect effects and cumulative, connected, and similar actions are also described.
- **Chapter VI – Environmental Commitments and Mitigation Measures,** describes potential environmental commitments associated with implementing the preferred alternative.
- **Chapter VII – Consultation and Coordination**, summarizes the public involvement/scoping process and agency coordination.
- **Chapter VIII – Permits, Approvals, and Regulatory Requirements,** discusses the permits, approvals, and regulatory requirements necessary for the construction, operation, and maintenance of the preferred alternative.

- **Attachments A – J**

  A Memorandum of Agreement between the city of Gallup and the Navajo Nation to Cooperate on the Navajo-Gallup Water Supply Project (IGRF-33-98)

  B Resolutions of the Upper Colorado River Commission

  C Letter from Jicarilla Apache Tribe to the Bureau of Reclamation (February 16, 2001)

  D Letter from Honorable Kelsey A. Begaye, President of the Navajo Nation, and Honorable John Peña, Mayor of the city of Gallup, to Eluid Martinez, Commissioner of the Bureau of Reclamation (November 22, 2000)

  E Letter from Rick L. Gold, Regional Director, Upper Colorado Regional Office, to Honorable Kelsey A. Begaye, President of the Navajo Nation, and Honorable John Peña, Mayor of the city of Gallup (June 13, 2001)

  F Preferred Alternative

  G Screening Report

  H Vegetation

  I List of Wildlife Found in the Project Area and Habitat Associations

  J Soil and Geology Descriptions

Volume II includes appendices A – D

A Technical Memorandum (Final Draft – March 16, 2001)

B Appraisal Level Designs and Cost Estimates (April 2002)

C *Part I* Fish and Wildlife Service Memorandum (December 3, 2002)
Planning Aid Memorandum for the Navajo-Gallup Water Supply Project Environmental Impact Statement (EIS), New Mexico

	Part II	Fish and Wildlife Service Memorandum (January 4, 2005) Draft Fish and Wildlife Coordination Act Report for the Navajo-Gallup Water Supply Project, New Mexico and Arizona
	Part III	Draft Biological Opinion
D	*Part I*	Allocation of Capital and OM&R Costs Among Project Participants (San Juan River - PNM Alternative)
	Part II	Economic Benefit/Cost Analysis
	Part III	Financial and Repayment Analysis
	Part IV	Social Impacts from the Navajo-Gallup Water Supply Project

Chapter II

NEED FOR ACTION

INTRODUCTION

This chapter describes and quantifies water demand and supply problems for the Navajo Nation, city of Gallup, and Jicarilla Apache Nation. In the view of the Navajo Nation, a poverty rate of greater than 50 percent and a growing population combined with a lack of infrastructure, particularly for water, on a vast, arid reservation with widely dispersed communities and households has created an urgent need for adequate water supplies. The lack of infrastructure and economic development and sustained poverty are closely connected, and they are related to a reliable water supply. The city of Gallup's position is that groundwater is being depleted faster than it is being recharged, and the quality does not meet secondary water quality standards. Severe water shortages are anticipated within the next *decade*. The Jicarilla Apache Nation asserts that it needs a reliable, high-quality water supply in areas outside Dulce to continue diversifying their economy for on-reservation employment and to live in a more dispersed manner as they did traditionally and have stated it desires to do so in the future.

The general study area, east of the Chuska Mountains, is primarily semiarid and desert-like in nature, with low rainfall and low carrying capacity for most forms of wildlife. The vegetative diversity is low, and ground cover in many areas is sparse, offering very little habitat for most forms of wildlife. Land use is primarily open range and sparsely populated, except for those scattered communities along Route 491, and generally undeveloped.

The San Juan River valley in the northern part of the Navajo-Gallup Water Supply Project (proposed project) area is an oasis in what is otherwise a dry and almost barren environment. The river valley supports irrigated agriculture, recreation, fish and wildlife, wetlands, riparian vegetation and habitat, and other systems that are dependent on water.

The projected Navajo Nation's population increase in the proposed project area by the year 2040 from the current 90,000 to 180,462 people will have an impact on the area.

The need for water, which is currently limited in quantity and quality, will continue to increase. Changes in land use patterns may occur as the population expands. The existing communities will likely expand, and new communities may be developed with adequate water supplies. Mineral and energy resource development are expected to grow, and new industries are likely to move in to use the area's human capital and natural resources and to provide services.

NAVAJO NATION AND GALLUP, NEW MEXICO – PROBLEM IDENTIFICATION

Navajo Nation

More than 40 percent of Navajo households rely on water hauling to meet daily water needs. Those households with piped water have limited water quantity and pay among the highest water rates in the region. As challenging as the current circumstances are, limited water supplies in the future will pose an even greater challenge. The Navajo Nation's predicted annual population growth rate is 2.48 percent to the year 2040, which will require six times more municipal water than today.

The limited availability of water is part of the larger pattern of a low economic standard of living throughout the proposed project area. The poverty rate of greater than 50 percent on the Navajo Reservation is one of the worst in the United States, and it persists even while the regional economy is booming. The lack of infrastructure and economic development and sustained poverty are closely connected, and they are related to a reliable water supply.

City of Gallup

As a regional trade center, the city of Gallup supports a municipal population of about 23,000, but also serves as an economic hub for a trade area of about 100,000 people. The city relies solely on a groundwater supply that continues to be progressively mined with little recharge into the source aquifers. Current hydrologic projections by the city predict severe shortages in the groundwater supply within the next decade, which would have severe social and economic impacts on the city and on the neighboring Navajo communities (Gallup Town Hall on Water, May 2003). The city of Gallup has investigated other potential water supplies, water conservation, additional groundwater supplies, and surface supplies. Water conservation and mining groundwater can help in the short term, but for a long-term sustainable supply, water from the San Juan River is the only viable option.

NAVAJO NATION AND GALLUP, NEW MEXICO – PROBLEM QUANTIFICATION

Population Projections

The proposed project service area includes more than 66,000 people in New Mexico, including the city of Gallup, and more than 11,000 people in Arizona. Population statistics are based on 1990 census data (Rodgers, 1993) and do not take into account that the U.S. Census Bureau believes the actual population of the Navajos in 1990 to have been approximately 13.9 percent greater than the official count. The 2000 census data were not available at the time of this work; the data have since been reviewed, and it would not have measurably changed the results. Additional material on population growth rates and water demand is included in volume II, appendix A. Tables II-1 through II-5 illustrate population growth and the need for additional water supplies in the proposed project area.

Table II-1.—Projected population in the proposed project service area by basin

Decade	New Mexico Upper Colorado Basin	New Mexico Lower Colorado Basin	New Mexico Rio Grande Basin	Arizona Lower Colorado Basin	Project total
2000[1]	43,453	37,828	2,504	15,033	98,818
2010	55,516	46,494	3,199	19,206	124,415
2020	70,926	57,205	4,087	24,538	156,756
2030	90,614	70,454	5,222	31,349	197,639
2040	115,767	86,861	6,672	40,052	249,352

Note: Annual growth for the city of Gallup is 1.82 percent and 2.48 percent for the Navajo Nation.

[1] Data are based on 1990 census data projections for the year 2000.

Water Resource

The water demand in the proposed project service area is based on three distinct components: current population, per capita water use, and projected growth rates, as shown in tables II-2 through II-6 and in volume II, appendix A. The city of Gallup uses 160 gallons per capita per day (gpcd) for current and future demand projections.

Table II-2.—Municipal water demand by basin for the proposed project **(2020)**

Municipal subarea	Basin of use[1]	1990 census pop.	2020 pop.[2]	2020 demand[3] (AFY)[4]	2020 ground-water production and ALP[5] (AFY)	2020 San Juan River diversion[6] (AFY)	2020 San Juan River depletion[7] (AFY)
Central Area, NM	U.C.	1,493	3,113	558	52	506	506
City of Gallup, NM[8]	L.C.	19,154	32,904	5,,898	0	7,500	7,500
Crownpoint, NM	U.C.	5,287	11,025	1,976	541	1,435	1,435
Gallup area, NM	L.C.	7,904	16,482	2,954	382	2,572	2,572
Huerfano, NM	U.C.	1,492	3,111	558	68	489	489
Navajo Agricultural Products Industry, NM[9]	U.C.	N/A	N/A	7,274	500	500	500
Rock Springs, NM	L.C.	3,749	7,818	1,401	113	1,288	1,288
Route 491, NM	U.C.	10,099	21,060	3,775	635	3,139	3,139
San Juan River, NM[10]	U.C.	13,804	28,786	5,159	4,680	479	240
Torreon, NM[11]	U.C./ R.G.	3,797	7,918	1,419	95	1,324	1,324
New Mexico Upper Colorado Basin	U.C.	34,012	75,013	20,719	6,571	7,874	7,634
New Mexico Rio Grande Basin	R.G.	1,960	4,087	773	95	638	638
New Mexico Lower Colorado Basin	L.C.	30,807	57,205	10,253	496	11,360	11,360
Total New Mexico		66,779	132,218	30,972	7,067	19,234	18,994
Total Arizona[12]	L.C.	11,767	24,538	4,398	905	3,493	3,496
Project total		78,546	156,756	35,370	7,972	22,727	22,490

Note: Rounding error may cause subtotals to be off by 1.
[1] U.C. = Upper Colorado Basin, L.C. = Lower Colorado Basin, and R.G. = Rio Grande Basin.
[2] Annual growth for the city of Gallup is 1.82 percent and 2.48 percent for the Navajo Nation.
[3] Per capita water demand is 160 gallons per person per day.
[4] Acre-feet per year.
[5] ALP = Animas-La Plata; estimated sustainable groundwater production.
[6] Diversions = demand - groundwater use.
[7] Depletions are based on zero return flow and use of sustainable groundwater.
[8] The city of Gallup plans to recharge its aquifer and use groundwater for summer seasonal peaking.
[9] Navajo Agricultural Products Industry depletions are 700 AFY, including 400 AFY for the proposed french fry factory.
[10] Approximately 4,680 AFY of diversion and 2,340 AFY of depletion from the San Juan River subarea's demand is met by the ALP Project, and 1,871 acre-feet of depletion is met by the Navajo Gallup Water Supply Project. Assumes 50 percent of the San Juan River municipal diversions return to the river.
[11] Torreon includes use in the Rio Grande Basin. These depletions are counted toward New Mexico Upper Colorado River allocation.
[12] Window Rock subarea includes depletions, which are counted toward the Upper and/or Lower Colorado allocation.

Table II-3.—Municipal water demand by basin for the proposed project **(2040)**

Municipal subarea	Basin of use[1]	1990 census pop.	2040 pop.[2]	2040 demand[3] (AFY)[4]	2040 ground-water production and ALP[5] (AFY)	2040 San Juan River diversion[6] (AFY)	2040 San Juan River depletion[7] (AFY)
Central Area, NM	U.C.	1,493	5,082	911	77	834	834
City of Gallup, NM[8]	L.C.	19,154	47,197	8,459	1,439	7,500	7,500
Crownpoint, NM	U.C.	5,287	17,996	3,225	752	2,473	2,473
Gallup area, NM	L.C.	7,904	26,903	4,822	506	4,316	4,316
Huerfano, NM	U.C.	1,492	5,078	910	46	864	864
Navajo Agricultural Products Industry, NM[9]	U.C.	N/A	N/A	7,274	0	700	700
Rock Springs, NM	L.C.	3,749	12,761	2,287	169	2,118	2,118
Route 491, NM	U.C.	10,099	34,374	6,161	795	5,366	5,366
San Juan River, NM[10]	U.C.	13,804	46,985	8,421	4,680	3,741	1,871
Torreon, NM[11]	U.C./ R.G.	3,797	12,924	2,316	77	2,240	2,240
New Mexico Upper Colorado Basin	U.C.	34,012	115,767	28,023	7,050	15,100	13,229
New Mexico Rio Grande Basin	R.G.	1,960	6,672	1,196	77	1,119	1,119
New Mexico Lower Colorado Basin	L.C.	30,807	86,861	15,568	2,114	13,934	13,934
Total New Mexico		66,779	209,300	44,788	9,241	30,153	28,282
Total Arizona[12]	L.C.	11,767	40,052	7,179	767	6,411	6,411
Project total		78,546	249,352	51,967	10,008	36,564	34,693

Note: Rounding error may cause subtotals to be off by 1.
[1] U.C. = Upper Colorado Basin, L.C. = Lower Colorado Basin, and R.G. = Rio Grande Basin.
[2] Annual growth for the city of Gallup is 1.82 percent and 2.48 percent for the Navajo Nation.
[3] Per capita water demand is 160 gallons per person per day.
[4] Acre-feet per year.
[5] ALP = Animas-La Plata; estimated sustainable groundwater production.
[6] Diversions = demand - groundwater use.
[7] Depletions are based on zero return flow and use of sustainable groundwater.
[8] The city of Gallup plans to recharge its aquifer and use groundwater for summer seasonal peaking.
[9] Navajo Agricultural Products Industry depletions are 700 AFY, including 400 AFY for the proposed french fry factory.
[10] Approximately 4,680 AFY of diversion and 2,340 AFY of depletion from the San Juan River subarea's demand is met by the ALP Project, and 1,871 acre-feet of depletion is met by the Navajo Gallup Water Supply Project. Assumes 50 percent of the San Juan River municipal diversions return to the river.
[11] Torreon includes use in the Rio Grande Basin. These depletions are counted toward New Mexico Upper Colorado River allocation.
[12] Window Rock subarea includes depletions, which are counted toward the Upper and/or Lower Colorado allocation.

Table II-4.—Chapter water demand for the proposed project **(2020)**

Service area	Chapter	1990 population	2020 population	2020 demand (AFY)[1]	2020 ground-water production and ALP[2] (AFY)	2020 San Juan River depletion[3] (AFY)
City of Gallup, NM	City of Gallup	19,154	32,904	5,898	0	7,500
Central Area, NM	Burnham	246	513	92	0	92
	Lake Valley	436	909	163	34	129
	White Rock	201	419	75	See Lake Valley	75
	Whitehorse Lake	610	1,272	228	18	210
	Subtotal	1,493	3,113	558	52	506
Crownpoint, NM	Becenti	193	402	72	See Crownpoint	72
	Coyote Canyon	1,234	2,573	461	47	414
	Crownpoint	2,658	5,543	993	438	555
	Dalton Pass	313	653	117	0	117
	Little Water	638	1,330	238	See Crownpoint	238
	Standing Rock	251	523	94	55	38
	Subtotal	5,287	11,025	1,976	541	1,435
Gallup area, NM	Bread Springs	1,219	2,542	456	60	396
	Chichiltah	1,555	3,243	581	See Bread Springs	581
	Church Rock	1,780	3,712	665	90	575
	Lyanbito	974	2,031	364	77	287
	Mariano Lake	726	1,514	271	107	164
	Pinedale	609	1,270	228	See Mariano Lake	228
	Red Rock	1,041	2,171	389	48	341
	Subtotal	7,904	16,482	2,954	382	2,572
Huerfano, NM	Huerfano	511	1,066	191	45	146
	Nageezi	981	2,046	367	23	343
	Subtotal	1,492	3,111	558	68	489
Rock Springs, NM	Manuelito	631	1,316	236	23	213
	Rock Springs	1,685	3,514	630	58	571
	Tsayatoh	1,433	2,988	536	32	504
	Subtotal	3,749	7,818	1,401	113	1,288

Table II-4.—Chapter water demand for the proposed project **(2020)** (continued)

Service area	Chapter	1990 population	2020 population	2020 demand (AFY)[1]	2020 ground-water production and ALP[2] (AFY)	2020 San Juan River depletion[3] (AFY)
Route 491, NM	Mexican Springs	711	1,483	266	See Tohatchi	266
	Naschitti	1,539	3,209	575	79	496
	Newcomb	651	1,358	243	12	231
	Sanostee	2,081	4,340	778	121	657
	Sheep Springs	660	1,376	247	14	233
	Tohatchi	1,607	3,351	601	222	378
	Twin Lakes	1,967	4,102	735	120	615
	Two Grey Hills	883	1,841	330	66	264
	Subtotal	10,099	21,060	3,775	635	3,139
Torreon, NM	Counselor	1,365	2,846	510	0	510
	Ojo Encino	596	1,243	223	18	205
	Pueblo Pintado	472	984	176	0	176
	Torreon	1,364	2,844	510	77	433
	Subtotal	3,797	7,918	1,419	95	1,324
San Juan River, NM[4]	Beclaibito	388	809	145	0	73
	Cudei	495	1,032	185	0	93
	Hogback	740	1,543	277	0	138
	Nenahnezad	1,253	2,613	468	0	234
	San Juan	540	1,126	202	0	101
	Shiprock	8,100	16,891	3,027	0	1,514
	Upper Fruitland	2,288	4,771	855	0	428
	Subtotal	13,804	28,786	5,159	4,680	240
Navajo Agricultural Products Industry, NM		N/A	N/A	7,247	N/A	500
NM Upper Basin		35,972	75,013	20,719	6,571	7,634
NM Lower Basin		30,807	57,205	10,253	496	11,360
Total New Mexico		66,779	132,218	30,972	7,067	18,994
Window Rock, AZ	Fort Defiance	6,187	12,902	2,312	905	1,408
	Saint Michaels	5,580	11,636	2,086	See Fort Defiance	2,086
Total Arizona		11,767	24,538	4,398	905	3,493
Project total		78,546	156,756	35,370	7,972	22,487

1 Acre-feet per year.
2 Animas-La Plata Project.
3 Depletions assume zero return flows to the San Juan River.
4 San Juan River depletions do not include Animas-La Plata Project water.

Table II-5.—Chapter water demand for the proposed project **(2040)**

Service area	Chapter	1990 population	2040 population	2040 demand (AFY)[1]	2040 ground-water production and ALP[2] (AFY)	2040 San Juan River depletion[3] (AFY)
City of Gallup, NM	City of Gallup	19,154	47,179	8,459	1,439	7,500
Central Area, NM	Burnham	246	837	150	0	150
	Lake Valley	436	1,484	266	46	220
	White Rock	201	684	123	See Lake Valley	123
	Whitehorse Lake	610	2,076	372	31	341
	Subtotal	1,493	5,082	911	77	834
Crownpoint, NM	Becenti	193	657	118	See Crownpoint	118
	Coyote Canyon	1,234	4,200	753	61	692
	Crownpoint	2,658	9,047	1,622	614	1,008
	Dalton Pass	313	1,065	191	0	191
	Little Water	638	2,172	389	See Crownpoint	389
	Standing Rock	251	854	153	77	76
	Subtotal	5,287	17,996	3,225	752	2,473
Gallup area, NM	Bread Springs	1,219	4,149	744	77	667
	Chichiltah	1,555	5,293	949	See Bread Springs	949
	Church Rock	1,780	6,059	1,086	123	963
	Lyanbito	974	3,315	594	153	441
	Mariano Lake	726	2,471	443	92	351
	Pinedale	609	2,073	372	See Mariano Lake	372
	Red Rock	1,041	3,543	635	61	574
	Subtotal	7,904	26,903	4,822	506	4,316
Huerfano, NM	Huerfano	511	1,739	312	31	281
	Nageezi	981	3,339	598	15	583
	Subtotal	1,492	5,078	910	46	864
Rock Springs, NM	Manuelito	631	2,148	385	46	339
	Rock Springs	1,685	5,735	1,028	77	951
	Tsayatoh	1,433	4,878	874	46	828
	Subtotal	3,749	12,761	2,287	169	2,118

Table II-5.—Chapter water demand for the proposed project **(2040)** (continued)

Service area	Chapter	1990 population	2040 population	2040 demand (AFY)[1]	2040 ground-water production and ALP[2] (AFY)	2040 San Juan River depletion[3] (AFY)
Route 491, NM	Mexican Springs	711	2,420	434	See Tohatchi	434
	Naschitti	1,539	5,238	939	77	862
	Newcomb	651	2,216	397	12	385
	Sanostee	2,081	7,083	1,270	153	1,117
	Sheep Springs	660	2,246	403	15	388
	Tohatchi	1,607	5,470	980	307	673
	Twin Lakes	1,967	6,695	1,200	153	1,047
	Two Grey Hills	883	3,005	539	77	462
	Subtotal	10,099	34,374	6,161	794	5,367
Torreon, NM	Counselor	1,365	4,646	833	0	833
	Ojo Encino	596	2,029	364	15	348
	Pueblo Pintado	472	1,607	288	0	288
	Torreon	1,364	4,643	832	61	771
	Subtotal	3,797	12,924	2,316	77	2,240
San Juan River, NM[4]	Beclaibito	388	1,321	237	0	118
	Cudei	495	1,685	302	0	151
	Hogback	740	2,519	451	0	226
	Nenahnezad	1,253	4,265	764	0	382
	San Juan	540	1,838	329	0	165
	Shiprock	8,100	27,570	4,942	0	2,471
	Upper Fruitland	2,288	7,788	1,396	0	698
	Subtotal	13,804	46,985	8,421	4,680	1,871
Navajo Agricultural Products Industry, NM		N/A	N/A	7,274	N/A	700
NM Upper Basin		35,972	122,439	29,219	7,127	14,348
NM Lower Basin		30,807	86,861	15,568	2,114	13,934
Total New Mexico		66,779	209,300	44,788	9,241	28,282
Window Rock, AZ	Fort Defiance	6,187	21,059	3,774	767	3,007
	Saint Michaels	5,580	18,993	3404	See Fort Defiance	3,404
Total Arizona		11,767	40,052	7,179	767	6,411
Project total		78,546	249,352	51,967	10,008	34,693

1 Acre-feet per year.
2 Animas-La Plata Project.
3 Depletions assume zero return flows to the San Juan River.
4 San Juan River depletions do not include Animas-La Plata Project water.

Table II-6.—Projected municipal demand (excluding Navajo Agricultural Products Industry) in the proposed project service area by basin (acre-feet)

Decade	New Mexico Upper Colorado Basin	New Mexico Lower Colorado Basin	New Mexico Rio Grande Basin	Arizona Lower Colorado Basin	Project total
2000	7,789	6,780	448	2,695	17,712
2010	9,951	8,333	573	3,442	22,299
2020	12,672	10,253	773	4,398	28,096
2030	16,241	12,628	936	5,619	35,424
2040	20,749	15,568	1,196	7,179	44,692
2050	26,509	19,214	1,528	9,171	56,422
2060	33,869	23,738	1,951	11,717	71,275

Per capita water use on Navajo Reservation lands varies depending on the accessibility of the water supply. Surveys in 1993 showed that 44 percent of Navajo households in the proposed project area are without direct access to a public water supply system and use very little water (Bureau of Reclamation [Reclamation], 1993). Per capita water use rates for homes without running water are estimated at 10 gpcd (Murray, 1965). It is estimated that families hauling water for domestic purposes spend the equivalent of $22,000 per acre-foot compared with $600 per acre-foot for a typical suburban water user in the region (Northwest Economic Associates, 1993a).

Billing data from the Navajo Tribal Utility Authority (NTUA) indicate that average use on the NTUA system is approximately 100 gpcd; on non-NTUA systems, it ranges from 20 to 100 gpcd. Low usage rates are often limited by system and supply constraints, not demand.

Accordingly, a per capita use rate of 160 gpcd[1] was used for water resource planning at the request of the Navajo Nation.

The Navajo Agricultural Products Industry (NAPI) has plans for future projects, which require water. To support industrial diversification relating to an agricultural-related food processing plan by NAPI, the proposed project would provide 700 acre-feet of treated water per year.

[1] The 160 gpcd amount is customarily used in New Mexico for planning the municipal and industrial water supply.

Water Infrastructure

Existing local water conveyance systems are being upgraded and expanded. The Indian Health Service will design, fund, and oversee construction of most of these improvements. The systems will be turned over to the NTUA for ownership and operation and maintenance. A limited supply of quality groundwater constitutes a restriction in expansion of these systems to meet people's needs. Funding and housing density also limit expansion.

Regional systems such as this project will connect to these local systems to provide a good quality water supply. Improvements and expansions to these local systems will continue as in the past but with an adequate water supply.

City of Gallup

Problems currently encountered by the city of Gallup center on its use of two confined aquifers with water tables between 900 and 3,000 feet deep and two well fields in which static water levels are declining approximately 200 feet every 10 years. The city of Gallup needs to augment its groundwater supply; the level at the city's Ya-ta-hey Well Field has dropped by more than 800 feet since the 1970s, and the city anticipates a 1-million-gallon-per-day deficit by summer 2010.[2]

The city of Gallup is the economic and commercial center of a 15,000-square-mile trade area that includes parts of northwestern New Mexico and northeastern Arizona, including the surrounding Navajo and Zuni Reservations. The economy of the region is based on retail and wholesale trade; Federal, State, and local government agencies; tourism; light manufacturing; agriculture; and energy extraction industries.

The current limited water situation and its future availability are major concerns of area residents. The city of Gallup presently relies on a series of old wells previously owned by the Atchison, Topeka, and Santa Fe Railway. The city is also relying on a more recent field in the Ya-ta-hey area just north of the city of Gallup. The in-city wells, which are located in the Gallup Sandstone Aquifer that is highly dependent on recharge from local precipitation, have shown a substantial decrease in yield. Production has been reduced from 15 active to 9 usable wells, and the lowering yields have been accompanied by deteriorating quality and excessive pumping costs. Because of dependence on local

[2] The city of Gallup identified two short-term alternatives involving expansion of one well field and developing water to the east, but neither alternative is sustainable. Other sources have proven to be inadequate.

recharge for supply, the city of Gallup administration has assumed that the aquifer would have a safe annual sustained yield of only 2,000 acre-feet. Withdrawals in excess of this amount could lead to a "mining"[3] aquifer condition.

Because of the severe limitation of the in-city well system, the city of Gallup began to develop the Ya-ta-hey Well Field as a supplemental supply. The estimated firm yield of this source is about 3,800 acre-feet per year (AFY), but could be less. Even with the full development of the combined well field system, current peaking requirements during heavy use periods severely tax the ability of the two well fields to meet the demands.

It appears that even without extensive industrial development in the area, the city of Gallup's demand for domestic water will exceed present and potential supplies within the next decade. Beyond this point, the city must find alternative sources or possibly be faced with curtailing growth and/or instituting strict water rationing.

The city of Gallup's present water supply problem is that of both quality and quantity. Groundwater is not an alternative that would meet the city's goals to obtain a long-term good-quality supply. Their existing supply does not meet secondary water quality standards. Other groundwater sources in the area are also questionable from a yield and quality standpoint. Desalting or extensive treatment of groundwater would be expensive. The city of Gallup's desire over the years has been to develop a good source of a dependable water supply that would sustain their long-term needs. By Resolution No. 24-51, June 13, 1967, the city of Gallup made a formal request for 15,000 AFY of water from Navajo Reservoir to the New Mexico Interstate Stream Commission. Following reviews and discussions of this request, the city was allocated 7,500 acre-feet in 1968. Secretarial approval was granted to the State of New Mexico for temporary water contracts from Navajo Reservoir. The temporary allocations were for 10,000 AFY through the year 2005. The city of Gallup's 7,500 acre-feet is part of this allocation.

JICARILLA APACHE NATION – PROBLEM IDENTIFICATION

The need for a dependable municipal and industrial water supply for the southwestern part of Jicarilla Apache Nation Reservation lands is tied to their desire for a basic infrastructure that would allow Tribal members to remain on reservation lands with a lifestyle they choose.

Formerly a widely dispersed population with cattle and sheep ranches, the Jicarilla Apache Nation began to focus on timber sales and the oil and gas industries in the

[3] Mining refers to the condition that occurs when more water is being pumped out of the aquifer than is being replenished or recharged.

mid-l950s, with the population gradually moving into Dulce, New Mexico, the center of its government. The Jicarilla Apache Nation is now by far the largest employer for its people; Tribal members seeking alternative employment or post-secondary education must relocate off-reservation where an estimated 21 percent of the total Tribal population resides. The Jicarilla Apache Nation is striving toward a diversified economy that will permit Tribal members to work on the reservation.

Economic development for the Teepee Junction area centers on an existing casino and planned travel service center and accompanying businesses at and near the U.S. Highway 550/State Road 537 junction, where Jicarilla-refined fuel would be sold at retail and possibly wholesale prices and an estimated 400-plus jobs could be created. In addition, the Jicarilla Apache Tribal Utility Authority may ultimately develop a 100-megawatt, gas-fired "merchant" plant that could supply local power needs and also sell wholesale power on the open market. A major barrier to planning for the Teepee Junction area has been the lack of a reliable, high-quality water supply.

JICARILLA APACHE NATION – PROBLEM QUANTIFICATION

The Tribal Office of Integrated Resource Management (IRM) has prepared estimated population growth figures based on 2000 U.S. Census data adjusted for an undercount estimated at 12 percent based on the actual undercount rate determined for the 1990 census and confirmed by housing counts. Historical population growth has varied by decade in the range of 1.1 percent to 1.8 percent per year. For planning purposes and for this planning report and draft environmental impact statement, the population growth rate of 1.7 percent per year is assumed. It is also assumed that if there were adequate housing and employment opportunities on-reservation, the rate of those residing off-reservation would fall to 10 percent at any given time by 2020. The data in table II-7 were provided by IRM.

Table II-7.—Population projections for the Jicarilla Apache Nation

	1990[1]	2000[2]	2010	2020	2030	2040
On-reservation	2,730	3,283	3,836	4,389	4,942	5,495
Off-reservation	425	694	575	440	494	550
Total	3,155	3,977	4,411	4,829	5,436	6,045

[1] Based on 1990 U.S. Census count of 2,438 for Dulce with a 12-percent increase. The U.S. Census estimated a 12-percent undercount for the Jicarilla Apache Reservation in 1990.

[2] Based on August 2000 IRMP Housing Count of 878 occupied housing units in Dulce and an average household size of 3.74 persons from the Jicarilla Income and Housing Survey conducted by the Office of Community Development in August 2000.

Water Demand

Water demands are based on the assumption that the average occupancy per household will fall from 3.74 to 3.00 as a result of fully meeting the housing demand and increasing prosperity of the Jicarilla Apache people. The per capita use is assumed to be 160 gallons per day (this figure was used for planning purposes by Reclamation in the Dulce Water and Wastewater Systems Environmental Assessment [Reclamation, 2001]).

Table II-8 illustrates the Jicarilla Apache Nation's anticipated water needs for the Teepee Junction areas that would be served by the proposed project.

Table II-8.—Projected water needs for the Jicarilla Apache Nation

Water demands (AFY)	2002[1]	2010	2020	2030	2040
Casino/travel center	30	50	70	70	70
Power generation	0	750	750	750	750
Housing	11	48	105	156	231
Other uses[2]	50	50	60	80	110
Total[3]	91	898	985	1,056	1,161

[1] These uses include anticipated groundwater use for facilities planned for 2002, U.S. Highway 44 road construction, and oil and gas water leases. It is assumed that this groundwater demand would shift to surface water provided through the proposed project once water was available.

[2] Other use categories include miscellaneous sales for construction, oil and gas production, drought relief for livestock operators and wildlife, nonmetered losses, and additional small commercial development as significant housing develops.

[3] The Teepee Junction area population is estimated at 585 persons in 2020 and 1,290 persons in 2040. Water demands above the amount that the pipeline could provide beyond 2040 would be met using treated groundwater developed locally.

Chapter III

OPPORTUNITIES/RESOURCES AND CONSTRAINTS

INTRODUCTION

This chapter describes Navajo-Gallup Water Supply Project (proposed project) opportunities and constraints for meeting water demand needs identified in chapters I and II. Water supply options and limitations are also analyzed.

A primary project opportunity includes adequate San Juan River water supplies for project depletion without jeopardizing endangered fish and their habitat. Another opportunity includes the ability to acquire private water rights for the proposed project use that would remain within the State of New Mexico's Upper Colorado River Basin allocation. Other opportunities include possible use of water from the Navajo Indian Irrigation Project (NIIP), Jicarilla Apache Tribe Water Rights Settlement Act, and the Arizona Upper Colorado River Basin Compact allocation.

Project constraints include the need for water contracts, a hydrologic determination of water availability in New Mexico for Navajo Reservoir, Endangered Species Act (ESA) compliance, congressional authorization of a proposed State-Navajo Nation water rights settlement, restrictions on NIIP water use, and related limitations.

Water supply or resource constraints include the groundwater overdraft problem on the Navajo Nation Reservation, unsustainable groundwater supplies in the city of Gallup, and the lack of adequate water supply infrastructure for development in the southwest part of the Jicarilla Apache Reservation.

PROPOSED PROJECT WATER OPPORTUNITIES/ RESOURCES AND ISSUES

With more than 40 percent of the Navajo population lacking domestic water, and static water levels in the city of Gallup's well fields declining by hundreds of feet, the need for an alternate surface supply is clear. Numerous investigations have found that additional groundwater sources are inadequate and that they can only temporarily delay water supply shortfalls.

Sources of surface water that were considered for the proposed project demand within New Mexico include:

(1) Acquisition of private water rights.

(2) A San Juan River contract for water with the U.S. Department of the Interior (Interior).

(3) A San Juan River contract for water from the Jicarilla Apache Nation.

(4) NIIP water.

(5) Navajo Nation non-NIIP water. Approximately 18 percent of the proposed project's water demand is in the Lower Colorado River Basin within the State of Arizona. In providing for Navajo Reservation, Window Rock, and Arizona area demands, the Navajo Nation is investigating water from three sources: the Central Arizona Project (CAP), Arizona Lower Basin, and Upper Basin Colorado River. Water from the three sources may be physically available to meet the proposed project's Arizona water demand, but legal and administrative issues are limiting constraints.

These water supply options are discussed in greater detail below.

Proposed Project Water Supply in New Mexico

Acquisition of Private Water Rights

One option for providing a permanent water supply for the city of Gallup is to purchase private water rights from water users within the San Juan River Basin (Basin). Considering the potentially available water rights in the Basin, it is unlikely that the city's entire anticipated depletion of 7,500 acre-feet could be available from privately held water rights that are currently being used. Only a portion could be feasibly available.

Private water rights would have the advantage of being currently considered depleted in the baseline hydrology for endangered species consultation, could have a senior priority date, and would be within the State of New Mexico's water allocation within the Upper Colorado River Basin.

Disadvantages include not having a full water supply every year and not having reservoir storage. Depletions associated with these water rights would have to be transferred to the proposed project. It is very likely that these transfers would be protested by numerous parties within the Basin because of potential injury to use of their water or the welfare of the State. A final disadvantage is that private water rights within the Basin, even those purchased and administratively moved to the city of Gallup, might not be exempt from a priority call based upon federally reserved water right claims exerted by the Navajo Nation.

A San Juan River Water Contract with the U.S. Department of the Interior

The city of Gallup has no water rights for San Juan River water, nor does it have any San Juan River water under contract. During the 1950s and 1960s, Gallup filed three Notices of Intent to divert water from the San Juan River. After the construction of Navajo Reservoir, the New Mexico State Engineer indicated that the city of Gallup would need a contract with the Secretary of the Interior (Secretary) for water. In 1966, a contract for 7,500 acre-feet of water was drafted and several meetings were held between the Bureau of Reclamation (Reclamation) and the city of Gallup to work out the details. That contract was never finalized. In 1967, the New Mexico Interstate Stream Commission recommended, and the Secretary granted, a temporary allocation to the city of Gallup of 7,500 acre-feet per year (AFY) through the year 2005. In the 1988 Hydrologic Determination, Reclamation identified 24,000 acre-feet of water in New Mexico and 7,000 acre-feet of water in Arizona that was temporarily available from the San Juan River for the proposed project through the year 2039. A letter (November 22, 2000) from Kelsey A. Begaye, President of the Navajo Nation, and John Peña, Mayor of the city of Gallup, to Eluid Martinez, Commissioner of Reclamation, and the project participants, requested separate water contracts from the Navajo Reservoir water supply (attachment D). The Navajo contract would be for 29,300 AFY and the city of Gallup contract would be for 7,500 AFY.

A letter (December 26, 2000) from the Commissioner of Reclamation and a letter (June 13, 2001) (attachment E) from the Upper Colorado Regional Director agree with working toward water supply contracts from Navajo Reservoir. The letters identified the following unresolved issues that would have to be addressed before pursuing long-term water supply contracts:

- Hydrologic determination of water availability in New Mexico from Navajo Reservoir
- ESA compliance for any Federal action to contract and provide water
- National Environmental Policy Act (NEPA) compliance for the contracts and the proposed project to provide the water
- Colorado River Basin issues relating to diverting and depleting water in New Mexico and Arizona
- Congressional authorization of the construction and operation of the proposed project
- Congressional approval of long-term contracts from Navajo Reservoir
    - The Act of June 13, 1962 (76 Stat. 96, Public Law [P.L.] 87-483), authorizing the NIIP and the San Juan-Chama Project, provides in section 11 that the Secretary shall not enter into long-term contracts for the delivery of water from Navajo Reservoir until (1) it has been made certain by hydrologic determinations as to water availability, (2) such determinations have been submitted to Congress, and (3) Congress has approved such contracts. The act also authorized the Secretary to market water from Navajo Reservoir for other M&I uses in New Mexico if it is determined on the basis of hydrologic investigation that such water is reasonably likely to be available.

A hydrologic investigation (hydrologic determination) has been proposed by Reclamation and a resolution accepting it passed by the Upper Colorado River Commission (attachment B). The proposed determination is currently being reviewed by the Secretary before being forwarded to Congress. Projections by the State of New Mexico in May 2006 show the State not exceeding 642,400 AFY through 2060 with full development of this proposed project (table I-1). Based on the proposed draft hydrologic determination, sufficient water is reasonably likely to be available within New Mexico's Upper Basin apportionment and from the Navajo Reservoir water supply for the Secretary to enter into a long-term water supply contract for the Navajo Nation's uses in New Mexico under the proposed project. There is no water anticipated to be available from New Mexico's Upper Basin apportionment and the Navajo Reservoir water supply for a long-term contract between the city of Gallup and the Secretary. However, the city of Gallup may subcontract with the Navajo Nation or the Jicarilla Apache Nation, or both, for part of their Navajo Reservoir supply contract allocations.

ESA Compliance.—Formal section 7 (endangered species) consultation is under way for constructing, operating, and issuing long-term water supply contracts for the proposed project. Reclamation, the action agency, submitted a biological assessment, which was accepted as complete, initiating formal consultation with the September 22, 2005, letter from the U.S. Fish and Wildlife Service (Service).

A key element in the action to reduce impacts to the endangered fish recovery program on the San Juan River is a depletion guarantee provided by the Navajo Nation. The Navajo Nation offered to reduce its water depletion as necessary up to 20,782 AFY to alleviate impacts to the San Juan River Basin Recovery Implementation Program (SJRBRIP) that could be created by the full development of the proposed project. Such a depletion guarantee was developed by the Nation along with both Reclamation and the Service. Because it involves voluntary limitations on the Nation's use of water as it regards potential effects to endangered species, and because Reclamation, as the action agency, is prepared to administer and operate the proposed project, if authorized, under such potential limitations, such a guarantee is entirely within the requirements of the ESA and the principles of the SJRBRIP. This is but one of other potential ways this proposed project might be constructed and operated under the rubric of the ESA and the SJRBRIP.

NEPA.—This planning report and draft environmental impact statement covers NEPA compliance for construction and operation of the recommended alternative and required water supply contracts from Navajo Reservoir.

Colorado River Basin Issues in New Mexico and Arizona.—The project proposes to divert water from the Upper Colorado River Basin out of the San Juan River in New Mexico. Approximately 39 percent (13,934 AFY) of the depleted water would be used in New Mexico's Lower Colorado Basin. Approximately 18 percent of the depleted water would be used in Arizona's Lower Colorado Basin. There are varying opinions on whether the Colorado River Compacts allow this. The Upper Colorado River Commission passed a resolution on June 19, 2003, in support of the diversion of water from the Upper Basin for use in the Lower Basin in New Mexico for the proposed project (attachment B). A similar resolution would be needed for support of a diversion from the San Juan River in New Mexico for use of Arizona's Upper Basin water in the Window Rock area of Arizona's Lower Basin. If Arizona and the Navajo Nation choose to identify Lower Basin water for the Window Rock, Arizona, area, agreement between the Colorado Basin States will be required. A contract through Reclamation may also be required to divert and use Lower Basin water.

Congressional Authorization of the Proposed Project.—A proposed water rights settlement negotiated between the Navajo Nation and the State of New Mexico has been executed by the State and the Nation and has resulted in draft legislation. This proposed settlement contemplates authorization for construction and operation, maintenance, and replacement of facilities and for development of water supply contracts for Navajo Nation uses under the proposed project between the United States and the Navajo Nation. The proposed settlement was signed on April 19, 2005, between the State of New Mexico and the Navajo Nation. In order for the settlement to become effective, however, it must be ratified by the United States through an act of Congress, and while the United States has had a negotiations team for the San Juan River in New Mexico since 2001, there has been no formal position adopted by the Administration on the proposed settlement as of the date of this document. It is unclear at this time whether certain factors, such as Federal legislation necessary for the settlement, will occur.

Congressional Approval of Long-Term Water Supply Contracts.—Long-term water contracts for water from Navajo Reservoir require congressional authorization. The proposed water right settlement legislation, as mentioned above, includes authorization language for entering into long-term water supply contracts for water from Navajo Reservoir and the San Juan River. This includes water supply contracts between the Navajo Nation and the Secretary for the Nation's uses under the proposed project and subcontracts between the city of Gallup and the Navajo Nation and/or Jicarilla Apache Nation for the city's uses under the project.

Contract Water from the Jicarilla Apache Nation

Under the 1992 Jicarilla Apache Tribe Water Rights Settlement Act and associated Federal contract, the Nation has the right to deplete 25,500 AFY from the Navajo Reservoir supply and the right to subcontract this water when it is not needed for on-reservation use. The Jicarilla Apache Nation is pursuing a variety of development options for using its San Juan River Basin depletions, including potential third-party contracts and on-reservation water projects.

The Jicarilla Apache Nation water has a quantified water right and shares priority with other Navajo Reservoir users. The Secretary has already determined that sufficient water is available to fulfill the Jicarilla Apache Nation's settlement. While third-party contracts for Jicarilla Apache Nation water must be approved by the Secretary (through Reclamation), no further congressional action is necessary for subcontracting the use of its water. In addition, these depletions will be recognized in future hydrologic determinations.

Navajo Indian Irrigation Project Water

The NIIP was authorized in 1962 by P.L. 87-483. This law authorized the Secretary to construct, operate, and maintain the NIIP for the principal purpose of furnishing irrigation water to approximately 110,630 acres of land. The NIIP consists of the initial land development, water distribution system, water delivery, roads, and other infrastructure. In 1970, the Navajo Nation created the Navajo Agricultural Products Industry (NAPI) to run the agricultural business venture and take responsibility for operating the NIIP facilities.

The NIIP is approximately 70 percent complete, with 77,685 acres developed. Based on an average unit depletion of 2.44 acre-feet per acre, at full build-out, with all of the proposed project acreage irrigated, the NIIP would deplete approximately 270,000 AFY of San Juan River water. Based on current overall project irrigation efficiency, the NIIP would divert approximately 337,500 acre-feet of water (Bureau of Indian Affairs, 1999).

The NIIP, through the Bureau of Indian Affairs, consulted with the Service on approximately 270,000 acre-feet of depletion which, according to the Service, can be depleted without jeopardizing the endangered fish. However, the NIIP was only able to acquire the water it needs to complete Blocks 9, 10, and 11 by shifting more than 16,000 acre-feet of baseline depletions away from the Hogback and Fruitland irrigation projects. Even so, the NIIP's depletions may include two types of water that may, under certain circumstances, be available for municipal use: (1) unused NIIP water and (2) water made available by forbearing the use of NIIP irrigation water. These options, which would need to overcome considerable legal and political hurdles, are described in the following sections.

Municipal Use of Unused NIIP Water.—The authorized purposes of the NIIP facilities include conveying water for municipal, domestic, and industrial uses, and for other beneficial purposes. The Secretary is authorized to provide capacity for M&I water supplies or miscellaneous purposes over and above the diversion requirements for irrigation of the NIIP, but such additional capacity would not be constructed and no appropriation of funds for such construction would be made until contracts have been executed that provide satisfactory assurance of repayment of all costs properly allocated.

Even if the Navajo Nation were willing to convert unused NIIP water from irrigation uses to municipal uses, under the present contract the Secretary is not authorized to deliver water for uses other than irrigation. The NIIP's statutory authorization, and the Navajo Nation's contract with the Secretary, allocate to the NIIP an average annual diversion of up to 508,000 acre-feet of water per year from the San Juan River for the principal purpose of furnishing irrigation water to approximately 110,630 acres of land. It is presently unresolved whether (and how) NIIP irrigation water can be used for M&I

purposes. The Secretary has authority to contract for delivery of water from Navajo Reservoir provided that unreasonable shortages to the NIIP and the San Juan Chama Project are avoided.

A more critical issue is that unused NIIP water is only temporarily available, perhaps for a 10- to 30-year period. The municipal demand, however, requires a long-term supply. Committing this water temporarily to non-NIIP municipal water demand would create significant disincentives for the completion of the NIIP, and it might eventually result in a conflict between irrigation and municipal uses. Even with these concerns, the unused NIIP water might allow the proposed project to proceed.

A Forbearance Agreement for NIIP Water.—Another water supply option is for the Navajo Nation to enter into a forbearance agreement to provide water for municipal needs. Unlike the "unused" water described in the previous section, under a forbearance agreement, the NIIP would forbear the use of a specific volume of water that it could otherwise make use of for a designated period of time. This foregone use might come at the expense of not irrigating a specific number of acres. Based on an average depletion of 2.44 acre-feet per acre, the city of Gallup water supply would require idling or fallowing approximately 3,000 acres, and the Navajo demand would require approximately 10,000 acres.

Instead of idling acreage, it might be possible to change the proposed crop mix to include crops that require less water or to underirrigate some of the irrigated crops in the current mix. However, these approaches would have agronomic impacts on the NIIP, including lower revenue, fewer jobs, and greater risk of crop failure. From the State of New Mexico's perspective, agricultural water rights can only be transferred from irrigated land if the irrigated land is fallowed or dry-farmed.

In conclusion, although a relatively large amount of water under the NIIP has undergone section 7 consultations and other environmental compliance, forbearance agreements for NIIP water have to be developed around the current contractual constraints and without creating disincentives to the completion of the NIIP. However, this option might provide a bridge until broader water issues are resolved.

Navajo Nation Non-NIIP Water

One option to provide a water supply for the proposed project would be for the Navajo Nation to assume the responsibility for guaranteeing depletions out of water supplies allocated to the Navajo Nation, either through existing statutes or an eventual settlement of the Navajo Nation's federally reserved water claims. Such an approach would not require the city of Gallup to deal directly with Basin interests and would provide the

Navajo Nation the opportunity to re-distribute its water resources consistent with its internal policies. The primary disadvantage with this approach is that the Navajo Nation has very limited non-NIIP water in the Basin with a quantified water right and with the potential for leasing to the city of Gallup. For instance, as a result of its section 7 consultation with the Service, unused water from the San Juan River irrigation projects has already been temporarily utilized by the NIIP to ensure that the NIIP's construction can continue. When this depletion is restored to the Shiprock irrigation projects, it may, under certain circumstances in the future, be available for the proposed project. However, utilizing Navajo Nation water to meet non-Navajo municipal demands raises issues that would need to be addressed.

The Navajo Nation is concerned that using non-NIIP water for temporary use for the proposed project might hinder other future Navajo water development. Even if Navajo Nation non-NIIP water became available under favorable terms, it would not necessarily be less expensive than acquiring private water rights. Consequently, in the short term, this non-NIIP water option may not meet the city of Gallup's need to secure a long-term water supply.

Proposed Project Water Supply in Arizona

Central Arizona Project or Other Main Stem Arizona Lower Basin Colorado River Water

Water allocated to the Lower Colorado River Basin might fit most readily into existing compact allocations for use in such Lower Basin areas as Window Rock, Arizona. The Arizona Water Settlements Act, which became law in December 2004, identified 6,411 acre-feet of CAP water for use by the Secretary in settlement of the Navajo Nation's water rights in Arizona. Other possibilities are to acquire non-CAP main stem water or lower priority non-municipal water.

Moving CAP water or other main stem Colorado River water would require an adequate accounting system to ensure that system gains and losses were accurately calculated and that other issues, such as lost power revenues and environmental impacts, were addressed.

Arizona Upper Colorado River Basin Water

The Upper Colorado River Basin Compact of 1948 provided Arizona 50,000 AFY of annual consumptive use from the Upper Basin. The 1988 Hydrologic Determination identified 7,000 acre-feet of water in the Upper Basin of Arizona for the Arizona portion of this project. Arizona's estimated water depletion in 2000 was 38,100 acre-feet (Reclamation, 2004). The *Colorado River System Consumptive Uses and Losses Report, 1996–2000* shows there is currently adequate water remaining in Arizona's Upper Basin apportionment to meet the proposed project's Arizona demand. Other demands for this water, such as the 950 acre-foot request by the Navajo Nation, and the 1,000 acre-foot request by the city of Page, Arizona, must be considered. The Navajo Generating Station has been fully developed and its water depletion is included in Arizona's annual consumptive use from the Upper Basin. An additional 5,400 acre-feet of depletion remains unused from the station's water supply contract from Lake Powell. The Navajo Nation and the State of Arizona will need to identify how the remaining unused water will be divided.

NAVAJO NATION

Existing Opportunities/Resources

Outside the San Juan River chapters in the northern part of the proposed project area, Navajo Nation communities in the region and the city of Gallup rely almost entirely on groundwater for their water supply. The public water systems in the proposed project service area derive water from a variety of groundwater sources ranging from shallow, unconfined aquifers to deep, confined aquifers, as shown in table III-1.

There were more than 50 public water supply systems in the proposed project area in 1996 (Navajo Nation Environmental Protection Agency), the largest of which was the Navajo Tribal Utility Authority, which operates more than 30 water systems in the area. The Navajo Department of Water Resources operates nine systems in the proposed project area. Descriptions of groundwater conditions in the subareas and constraints to the use of that groundwater are presented in detail in volume II, appendix A (Rodgers, 1993) (Navajo Nation Environmental Protection Agency, 1996).

Constraints

Most of the aquifers investigated are undesirable for additional long-term municipal development because of the harmful impacts of continued over-drafting of the groundwater. Continued over-drafting of the groundwater may:

- Lower the water levels in wells and increase pumping depths
- Reduce the yield of the well fields
- Reduce the quality of the water supply

Table III-1.—Regional municipal water production during 2005

Municipal subarea	Production (acre-feet)	Source aquifer
1. City of Gallup	3,460 (2006)	Gallup Sandstone Dakota-Westwater
1. Central	28	Alluvium Picture Cliffs Menefee
2. Crownpoint	439	Westwater Morrison Menefee Gallup Sandstone Point Lookout
3. Gallup area (Navajo land adjacent to the city of Gallup)	389	Gallup Sandstone Dakota-Westwater
4. Huerfano	88	Alluvium Ojo Alamo
5. Rock Springs	95	Gallup Sandstone
6. Route 491	767	Alluvium Morrison Menefee Point Lookout Gallup Sandstone Mesa Verde Dakota
7. San Juan River	2,181 (2004)	Surface Water
8. Torreon	166	Ojo Alamo
9. Window Rock	991	Alluvium De Chelly Gallup Sandstone Shinarump
10. Thoreau-Smith Lake	208	Glorieta
Regional total	8,812	

Source: Navajo Tribal Utility Authority and city of Gallup.

- Increase capital and operating costs
- Deplete the groundwater available for a drought reserve
- Lower the water table in riparian areas
- Cause land subsidence

JICARILLA APACHE NATION

Existing Opportunities/Resources

The water resources of the Jicarilla Apache Nation are shaped in part by the Jicarilla Apache Tribe Water Rights Settlement Act.

Beginning in 1972, the Jicarilla Apache Tribal Council initiated efforts to address its future water right needs by filing a Federal lawsuit. Through years of litigation and negotiation with the United States, the Jicarilla Apache Tribe Water Rights Settlement Act (P.L. 102-441, 106 Stat. 2237) was enacted in 1992. The act, the associated Federal contract, and the Partial Final Decree in the San Juan River adjudication entered in 1999 entitled the Jicarilla Apache Nation to a number of water rights, including the following:

- The right to deplete up to 25,500 acre-feet from the Navajo Reservoir water supply under contract with the Secretary

- The right to deplete up to 6,500 acre-feet of water from the San Juan-Chama Project under contract with the Secretary

- Secured rights in Federal and State court to quantified historic and existing uses of water in both the San Juan and Rio Grande Basins

Part of these quantified historic and existing use rights are designated as 2,195 acre-foot depletions from the Basin for irrigation and domestic uses. An additional 2,187 acre-feet of historic and existing uses, established for net evaporation on lakes and stock ponds, may be used for future domestic needs as determined by the Jicarilla Apache Nation. These water rights, as well as a substantial portion of the Nation's Federal contract water rights for future uses, are reflected in the environmental baseline established during the Animas-La Plata section 7 consultations under the ESA.

The proposed project's 1,200 acre-foot water demand for the Jicarilla Apache Nation would be met by delivery of a portion of their 25,500 acre-foot contract allocation from the Navajo Reservoir water supply as a result of their water rights settlement and/or a portion of their unused historical rights. Contingent upon successful negotiation of a subcontract between the Jicarilla Apache Nation and the city of Gallup, the

7,500 acre-foot demand for the city would be met from deliveries from the Navajo Reservoir water supply under the Jicarilla Apache Nations settlement contract. The Secretary would need to approve the subcontract.

Constraints

One of the major impediments for development planning in the southwest part of the Jicarilla Apache Reservation has been a lack of a reliable, high-quality water supply.[1] Previous planning efforts have investigated the possibility of diverting water from the Navajo River to Heron Lake and pumping the Jicarilla Apache Nation's surface water rights by pipeline to points south for development purposes. However, pipeline projects from these sources to the Teepee Junction area are very costly and have not been pursued.

In addition, by providing leased water to the city of Gallup, revenues from this source would provide the funding necessary to pay for development and operations and maintenance costs associated with the Jicarilla Apache Nation's proportional share of these expenses. By participation in the proposed project, the Jicarilla Apache Nation may be able to realize its development goals with water delivered to the desired location in a relatively cost-efficient manner in partnership with the Navajo Nation and the city of Gallup.

CITY OF GALLUP

Existing Opportunities/Resources

City of Gallup records for 2006 report an average daily water production of 3.08 million gallons per day, or 3,460 AFY. The maximum daily use peaked at approximately 5.5 million gallons per day. Annual water demand has been decreasing over the past several years as a result of increased water conservation and management efforts, as shown in figure III-1.

[1] Pockets of groundwater are available for small-scale development; however, treatment is required to provide water to drinking standards. For significant development, substantial groundwater mining would be necessary, making this source unreliable for the long term. Sustainable groundwater use can be obtained by dispersing the impacts to the aquifer(s), using small-volume wells, and using poorer quality water for stock operations, wildlife, other agricultural uses, and remote domestic supplies.

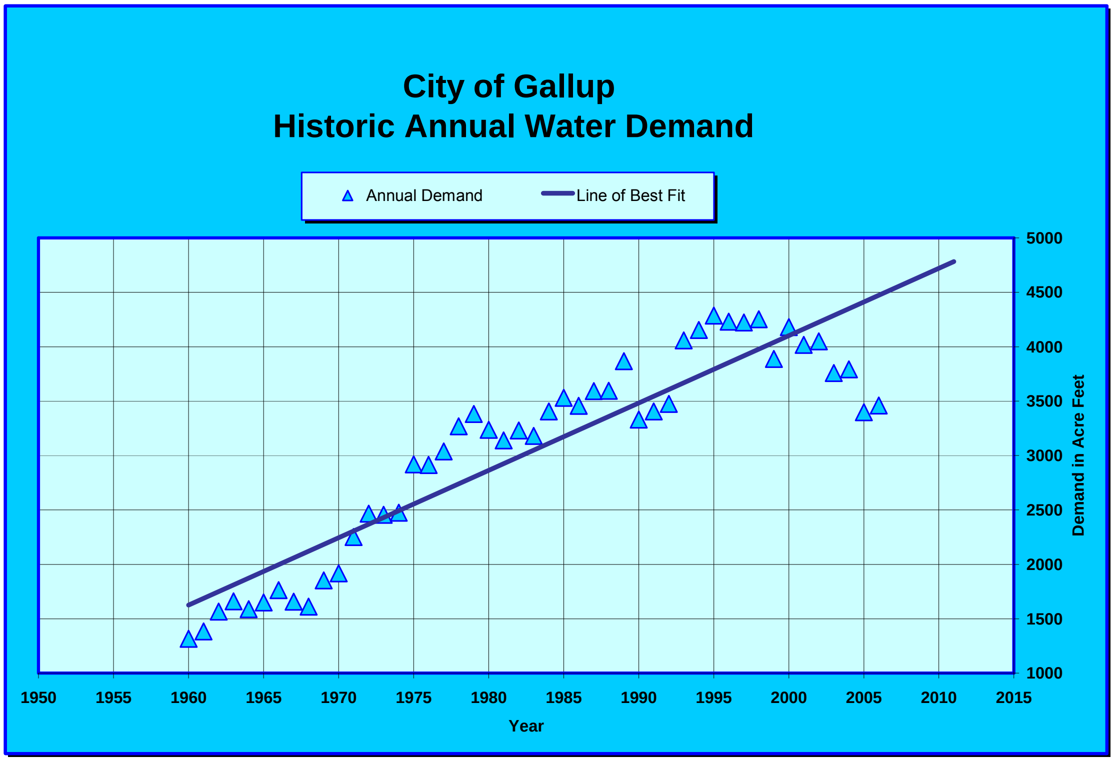


Figure III-1.—City of Gallup historic annual water demand.

The city of Gallup operated two well fields—the Santa Fe and the Ya-ta-hey. Historic water table data indicate that the static water level in its wells is declining at the average rate of 200 feet per 10 years (figure III-2). It is projected that in the next decade current demands may not be met by the existing water supply

In 1991, the city of Gallup's 40-year master water supply plan (Shomaker, Inc., 1991) identified two short-term alternatives, including the expansion of the Ya-ta-hey Well Field to the north and developing water in the Ciniza area to the east. Neither alternative is sustainable; however, they are being developed. The city of Gallup has also investigated new appropriations of San Andreas Glorietta water from an application acquired by the Plains Electric Generation and Transmission Cooperative (Plains Electric). Plains Electric Application Nos. G-22 through G-22-S-58 were intended to appropriate 7,000 acre-feet of water from wells located between Gallup and Grants for power generation. In 1982, the Office of the State Engineer issued an order limiting the maximum withdrawal of water under the permit to 5,000 AFY. In 1988, the application was broadened to expand the purpose and place of use to include the city of Gallup water service area, and Plains Electric was subsequently dismissed as a party after Gallup acquired the application. Numerous entities protested the application. The city of Gallup is developing a Plan of Replacement that is intended to address those objections.

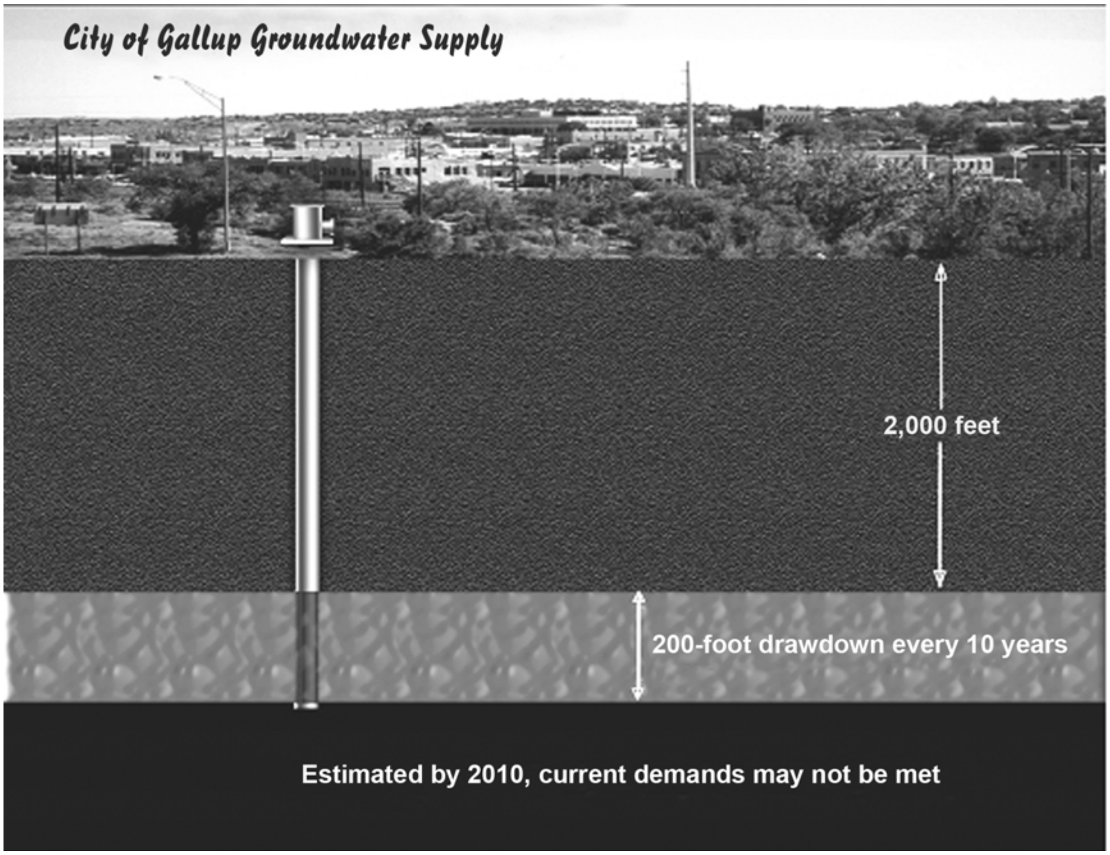


Figure III-2.—City of Gallup static water table.

Application No. G-22-PR has been amended once again to include southern chapters of the Navajo Nation. Assuming that the protests can be satisfactorily addressed, the "G-22" water supply may be able to provide a partial short-term water supply for the city of Gallup and the Navajo Nation until the proposed project is completed. In 1976, the U.S. Geological Survey completed groundwater investigations of the nearby Zuni Mountain and Malpais Region and the Westwater Canyon Aquifer in the vicinity of Church Rock. The results indicated that the groundwater resources of those areas are inadequate to meet the M&I needs for the city of Gallup. These findings have been reiterated in numerous studies conducted since that time. In 1998, the city of Gallup collaborated with Reclamation and the Pueblos of Acoma and Laguna on an investigation of using existing de-watering wells at the inactive Mount Taylor Mine located near San Mateo, New Mexico. In a technical appraisal (Reclamation, 1999), Reclamation estimated that a 4,000 acre-foot yield is possible for a 40-year period. The water source is approximately 70 miles from the city of Gallup and 43 miles from the Pueblo of

Laguna. The proposed project would create large cones of depression that could trigger objections by local interests. The Mount Taylor Project is not sustainable and does not meet the purpose and needs of the proposed project (Reclamation, 1999).

Constraints

Based on the various water supply studies for the city of Gallup over the past several decades, it can be summarized that the groundwater sources cannot be expected to provide a truly permanent supply. A surface water supply should be sought. The San Juan River offers the best hope because of the reliability of the supply, and the potential for a very long life, and because it is the closest surface water source. The city currently has no surface water supply but is working with the Navajo and Jicarilla Apache Nations for a long-term supply contract.

The city of Gallup has a relatively low rate of water consumption at 154 gallons per capita per day and has recently instituted an inclined water rate structure to help reduce consumption. An extensive water education program is active throughout the city of Gallup. Most outdoor irrigation in the city is done with treated waste water from the city's municipal waste water system. The city is investigating the feasibility of treating municipal waste water for a broader range of re-use and possibly for drinking. Although there is still potential for more conservation, the obvious conservation methods are already in place.

ALTERNATIVES

INTRODUCTION

The first part of this chapter of the Navajo-Gallup Water Supply Project (proposed project) planning report and draft environmental impact statement describes the eight alternatives that were considered for meeting the water demand needs presented in preceding chapters. The eight alternatives fall into three categories: no action, nonstructural, and structural. A No Action Alternative is included and an environmentally preferred alternative is identified, as required by the National Environmental Policy Act (NEPA) of 1969, for comparison with all action alternatives. A nonstructural Water Conservation Alternative (includes water re-use) and six structural alternatives are also described.

The second part of this chapter explains the methods used to screen out some of the eight alternatives that did not meet the proposed project purpose and need. Overall, the plan formulation/evaluation process included the following steps, some of which were discussed in detail in the preceding chapters of this document:

- Identifying existing and projected problems and needs
- Evaluating resource capabilities
- Formulating alternative plans to solve problems and meet needs with available resources
- Analyzing the alternative plans to determine the advantages and disadvantages of each
- Selecting the preferred alternative from among viable alternatives

The plan selection process (also referred to as screening) included two categories of screening criteria: the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (*Principles and Guidelines*) four tests of viability and nine factors covering the four accounts (national economic development [NED], environmental quality [EQ], regional economic development [RED], and other social effects [OSE]).[1] Under the four tests of viability, the Water Conservation and No Action Alternatives and the six 2020 design capacity alternatives did not meet initial screening criteria. The year 2020 capacity alternatives were not retained for further analysis because by the time of project completion, their capacity would be exceeded.

Only the six structural alternatives at the larger year 2040 capacity adequately meet the proposed project purpose and need.[2] Of the six alternatives, two were found, through the screening process, to have the lowest cost, as measured by their present worth. These two action alternatives and the No Action Alternative were then evaluated using the NEPA process, as described in chapter V. A preferred alternative, the San Juan River Public Service Company of New Mexico (SJRPNM) Alternative (year 2040) was identified, which ranked the highest among the nine factors (four accounts) and was the least environmentally impacting.

For the planning report requirements of this document, alternative plans for meeting the identified needs in the proposed project area had to meet a number of general criteria and standards, including those that encompass water quality, hazardous material concerns, endangered species preservation, and others.

PLAN FORMULATION PROCESS

The formulation of alternatives began with an evaluation of existing needs and solutions:

- Because of continued over-drafting of the groundwater table and limited surface water resources in the area, planning for the proposed project has been limited to surface water supplies from the San Juan River.

[1] A guide component in the formulation and subsequent evaluation of alternatives is the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*, Water Resources Council, March 10, 1983.

[2] Another six structural year 2020 capacity alternatives were included early in the planning process for comparison purposes, but they were not retained for further analysis because by the time of project completion, their capacity would have been exceeded.

- Nonstructural alternatives—water conservation, water re-use, conjunctive use of groundwater, and aquifer storage—could not replace the proposed project. Rates of water use are already very low, and re-use is likely to be implemented with or without the proposed project to further reduce reliance on groundwater. Conjunctive use is planned to be an adjunct to project operation in the future.

- Plan formulation was influenced by public scoping meetings, informal public contacts, coordination with other entities, and interagency consultations. Specifically, the Bureau of Reclamation (Reclamation) worked closely with the Navajo and Jicarilla Apache Nations and the city of Gallup throughout the planning process.

- A project Steering Committee to guide the proposed project's development has been in existence since the early 1990s. It is made up of representatives from the Navajo and Jicarilla Apache Nations, city of Gallup, State of New Mexico, Northwest New Mexico Council of Governments, Navajo Tribal Utility Authority (NTUA), Indian Health Service, Bureau of Indian Affairs, and Reclamation. The committee provided guidance throughout the planning process through technical experts representing the entities. The plan formulation process for this project spans nearly 30 years and is described in detail in volume II, appendix A.

- Taken into account were the laws and mandates listed at the end of chapter I, as well as agency guidelines and procedures.

THE NO ACTION ALTERNATIVE

As required by NEPA, a No Action Alternative was formulated to provide the basis against which impacts of the action alternatives could be evaluated (chapter V). The No Action Alternative projects reasonably foreseeable future conditions without implementation of the proposed plan. Under the No Action Alternative, it is assumed that the action alternatives' municipal and industrial (M&I) water supplies and delivery systems would not be constructed on the eastern side of the Navajo Nation, for the city of Gallup, or for the southwestern area of the Jicarilla Apache Nation.

The No Action Alternative assumes that water development in the San Juan River (Basin) would continue for projects with completed Endangered Species Act (ESA) section 7 compliance. It is also assumed that Navajo Dam and Reservoir will be operated to implement ESA-related Flow Recommendations to assist in conserving endangered fish in the San Juan River and to enable Basin water development (for more detail, see chapter I, "Other Projects and Actions in the San Juan River Basin," and chapter V, "Connected, Cumulative, and Related Actions").

The No Action Alternative would not limit the Upper Basin States' right to develop and use their compact apportionment. Apportionment planned for use in the proposed project may be available for other projects within the Basin. However, by failing to implement the settlement of the Navajo Nation's water rights and forcing the Nation to reinitiate their claims, local water users could potentially be adversely affected.

Under the No Action Alternative, the benefits of the proposed project would probably not be realized. Water shortages would be expected to intensify, reaching 1 million gallons per day (MGD) in the city of Gallup during peak periods as early as 2010 and continuing to worsen, with comparable shortages elsewhere in the proposed project area.

Water conservation and water re-use would not make up the shortfall, and new groundwater sources would not provide a full supply. The groundwater table would be further depleted. The economic development represented by the Navajo Agricultural Products Industry and the potential infrastructure in the Jicarilla Apache and Navajo Nations would be adversely affected by the absence of an adequate and reliable water supply. This deficiency would, in turn, contribute to continuing high poverty rates, high unemployment, and increasing outmigration from reservation lands.

NONSTRUCTURAL ALTERNATIVES

These alternatives approached the proposed project purpose by reducing the need for water through water conservation and water re-use.

Water Conservation

Water conservation is accomplished through public education, economic incentives, and regulatory tools. The city of Gallup currently has a water use ranging from 150 to 164 gallons per capita per day (gpcd), one of the lowest water use rates of communities in the Southwest. It has instituted a public education program and a tiered water rate structure to deter excessive water use. This approach to water use must continue into the future with or without this project for the city to have adequate water in the future. While conservation measures may help meet short-term needs, conservation is not a viable solution to meet long-term needs, and water conservation will not address the problem of declining water quality (increased salinity).

Throughout the proposed project area of the Navajo Nation, water use is approximately 110 gpcd where piped water is available and 10 to 20 gpcd where water is hauled. These are extremely low water use rates that would be difficult to reduce. The Jicarilla Apache Nation plans to develop the area around Teepee Junction from a crossroads to a permanent residential and commercial area. Because there is currently no appreciable water use there, water conservation is not applicable. As a nonstructural alternative, water conservation did not meet the proposed project purpose and need and is considered incomplete and ineffective.

Water Re-Use

Although current Safe Drinking Water Act regulations limit water re-use applications, water re-use can significantly increase a community's usable water supply. Under certain circumstances, reclaimed water can be used on outdoor landscaping and athletic facilities. The city of Gallup has implemented several innovative water re-use projects to irrigate its golf course and athletic fields. On the Navajo Nation, irrigated landscaping is very limited and most waste water ends up in individual septic systems or evaporation ponds. The Navajo Nation and Reclamation have contracted with Westlands Resources to investigate water re-use opportunities, and appraisal-level studies have been conducted in Tuba City and Ganado. The National Park Service has received a grant from the Arizona Water Protection Fund to use NTUA effluent in Ganado for a riparian restoration project.

Out of necessity, within the next couple of decades, water re-use systems will become commonplace. At the current time, there are no direct municipal effluent-to-drinking water systems in use in Arizona or New Mexico. The city of Gallup is considering treating its waste water for direct re-use. Assuming 60 to70 percent of the waste water can be re-used, this is only a short-term (10- to 15-year) relief from needing a perpetual long-term water supply. This does not meet the proposed project's intended goals and is therefore not a complete alternative. It is assumed that waste water re-use will continue to be part of the city of Gallup's long-term water management methods with or without the proposed project.

STRUCTURAL ALTERNATIVES

Introduction

Six structural alternatives were identified at two design capacities (2020 and 2040). The proposed project's purpose is to meet the 2040 water demand, but 2020 design capacities were considered for comparison purposes. The six alternatives are:

- Navajo Indian Irrigation Project (NIIP) Moncisco
- NIIP Coury Lateral (also referred to as NIIP Coury)
- NIIP Cutter Lateral (also referred to as NIIP Cutter)
- NIIP Amarillo

- SJRPNM
- San Juan River Infiltration

All of the alternatives have one or more surface water diversion points. The four NIIP alternatives would divert water entirely from the NIIP system originating at Navajo Reservoir. The differences among the NIIP alternatives center on the points at which the water would be diverted before entering the proposed project pipeline system. For the two San Juan River alternatives, one of the options for diverting water from the San Juan River would be to construct a new turnout structure just upstream from the existing Public Service Company of New Mexico (PNM) diversion structure. Another San Juan River alternative diversion option includes a proposed Infiltration Gallery System (IGS) that would obtain water from the San Juan River downstream from the Hogback (see figure IV-6) and upstream of its confluence with the Chaco River. This diversion option would tie into the previously proposed alignment for the SJRPNM Alternative at the most feasible point.

In all of the alternatives, surface water would be treated to meet primary safe drinking water standards before entering the proposed project conveyance system. All of the proposed alternatives would include the same Gallup Regional System and be fully automated systems.

Basic Design Considerations

Water supply for the alternatives would originate directly from the San Juan River below Navajo Dam and/or from Navajo Reservoir through the NIIP facilities. Various river diversion points were considered, and the use of existing facilities to reduce impacts and costs was considered a priority in locating points to evaluate for diversion. The PNM diversion was considered the most logical to investigate because a fish passage exists at that point to help control impacts to fish and access to utilities and land for facilities is readily available at this point. Just downstream from the PNM diversion, prior investigation on an under-river drainage diversion had been done that led to evaluation of another diversion alternative. Consideration was also given to use of the existing NIIP facilities to transport project water, where possible, to capitalize on existing structures and reduce impacts and costs of new facilities.

Two facility sizes were evaluated based on providing a future water supply to 2020 and 2040. The year 2020 was selected as the minimum time horizon a future water supply should be considered, and 2040 demand was considered to be the most realistic projection of water need. The proposed project's purpose is to meet the 2040 water demand, and 2020 design capacities were shown for comparison purposes in the alternative comparison process but were not considered viable alternatives.

Conjunctive Use of Groundwater and Aquifer Storage

It is planned that groundwater would be used conjunctively with the proposed project water supply to enhance the overall water supply available to the city of Gallup and the Navajo Nation. Two approaches for conjunctive use have been considered: (1) utilizing wells during the summer when the water demand is at its peak and (2) using aquifer storage and recovery. These approaches are described in greater detail in the following sections.

Utilize Wells for Peak Summer Demand.—During the first few years of project operation, the proposed project would have adequate capacity to greatly reduce groundwater withdrawals. Eventually, however, the city of Gallup and NTUA would need to utilize their wells for short periods during the summer when the water demand is at its peak. By the year 2040, it is projected that the city's system will need to produce approximately 1,400 are-feet of groundwater, primarily during the summer months. The aquifers will be able to recharge during the remainder of the year.

Although the city of Gallup's well fields may be able to supplement the total projected peak demands for a short period of time, it is unlikely that they will be able to replace the total projected summer demand. The estimated recharge to the source aquifers is very low, far less than current withdrawals. During the early life of the proposed project, the proposed project would greatly reduce or eliminate the city's dependence on groundwater; however, by the year 2040, groundwater would be needed to help meet the summer peak demands.

Aquifer Storage and Recovery.—According to a technical review of aquifer storage (Shomaker, Inc., 1991), it may be possible to store and recover project water. Eventually, it may also be economically possible to store and recover treated waste water. Conceptually, production wells in the Ya-ta-hey and Santa Fe Well Fields would be used as injection wells during periods when water was available in excess of the city of Gallup's demand. This water would then be available during periods when surface water was not available in adequate amounts. During the first years of the proposed project, the city might only be able to utilize approximately 4,500 acre-feet per year (AFY) out of the total project allocation of 7,500 acre-feet, and the difference might be available for recharge. Typically, the storage and recovery cycle is seasonal. With a seasonal cycle, the stored water does not have enough time to move far from the recovery well, and the groundwater head does not have enough time to dissipate to pre-storage levels before the water is recovered.

The source aquifers for the city of Gallup are confined, and they have very low hydraulic conductivities and storage coefficients (Shomaker, Inc., 1991). Because of the low conductivity, groundwater movement is relatively slow. For these reasons, the injected water would stay within reach of a recovery well for a longer than typical period, and the rise in water levels would take a long time to dissipate. Therefore, a longer recovery period might be feasible. Injecting project water could restore part of the large decline in water levels in the wells and extend the life of the fields beyond the limits predicted by the city. The cost of storing this water would be partly offset by a reduction in the pumping lifts. Water levels are so deep that water may be injected successfully by gravity flow, requiring no pumping; aquifer storage is especially sensitive to the quality and chemical characteristics of the water (Shomaker, Inc., 1991). It is concluded that the concept is worth considering, but a complex analysis is needed before the feasibility of the concept can be determined.

All structural alternatives would rely on available groundwater in addition to the proposed project's surface water. Aquifer storage may help the city of Gallup and the Navajo Nation manage its water more efficiently if proven feasible.

Delivery Data

Delivery data for water demand in 2020 and 2040 were based on estimated population and demand for each of the six alternatives for each community each year. At the delivery points, the proposed project would connect to existing service connections.

Based on expected populations in the year 2040, the proposed project would serve approximately 203,000 people in 43 chapters in the Navajo Nation, 1,300 people in the Jicarilla Apache Nation, and approximately 47,000 people in the city of Gallup. Peak daily demand was computed by multiplying the surface diversion for this project by a 1.3 peaking factor. The peaking factor was derived from a 7-day average in mid-July. The proposed project would connect to approximately 31 existing Navajo municipal systems and would provide a pressure of 70 pounds per square inch (psi) at those locations. The pressure requirement will vary with individual turnout. Storage capacity was based on the individual service area 5-day demand for the year 2020 for those communities with existing water distribution systems.

The city of Gallup and Jicarilla Apache Nation surface diversion requirements are 7,500 and 1,200 AFY, respectively, for all years in the proposed project. An independent analysis conducted by the city of Gallup identifies the system requirements for the city and the surrounding Navajo communities served by the city's system. No storage is included for the Jicarilla Apache Nation.

Commonalities of the Structural Alternatives

The structural alternatives for this project have similar design considerations, but the components vary for each alternative. All of the structural alternatives would have one or more surface water diversion points. The two San Juan River alternatives would divert water from both the San Juan River and from Cutter Reservoir. Cutter Reservoir is an existing feature of the NIIP system, which receives water from Navajo Reservoir.

The four NIIP alternatives would divert water entirely from the NIIP system originating at Navajo Reservoir. The differences between the NIIP alternatives center on the points at which the water would be diverted before entering the proposed project pipeline system. The NIIP Moncisco Alternative would convey water through the NIIP system and would store water in the proposed Moncisco Reservoir. The NIIP Coury Lateral Alternative would require construction of a smaller storage facility near the existing Coury Lateral. The NIIP Cutter Alternative would divert water from Cutter Reservoir. The NIIP Amarillo Alternative would convey water through the NIIP system and would require construction of a storage facility near the end of the Amarillo Canal, but also would divert water from Cutter Reservoir. The NIIP Coury Lateral, NIIP Cutter, and NIIP Amarillo Alternatives would require modification to NIIP facilities for winter use.

In all of the structural alternatives, surface water would be treated to meet primary safe drinking water standards before entering the proposed project conveyance system. Treatment plant designs are based on the quality of the water at the point of diversion. Treated water would then be conveyed in pipelines toward points of use. When necessary, relift pumping plants would be included to keep the water flowing in the pipeline. Navajo communities that have an existing water distribution system would have a storage tank and a method to increase (by means of a turnout pumping plant) the pressure for proper distribution. Delivery locations in the transmission line that do not have an existing water distribution system would be provided with a tee and a blind flange for future use.

A typical relift pumping plant has a forebay tank, pumps and motors within an enclosed building, an air chamber, and re-chlorination equipment. The forebay tank provides an adequate supply of water to minimize the number of times the pumps cycle on and off. The air chamber provides protection of the pumping plant and pipeline when the pumps are started and stopped. Re-chlorination equipment provides the required chlorine residual in the treated water.

The turnout pumping plants would have the same components as the relift pumping plants except that a storage tank would replace the forebay tank. Re-chlorination equipment might not be necessary if chlorine residuals were adequate. A summary of the major components required for each of the alternatives is shown in table IV-1.

Table IV-1.—General summary of components

Component	NIIP Moncisco Alternative	NIIP Coury Lateral Alternative	NIIP Cutter Alternative	NIIP Amarillo Alternative	SJRPNM Alternative	San Juan River Infiltration Alternative
River intake					1	
Infiltration wells						26
River pumping plant					1	
Treatment plants	1	1	1	2	2	2
Forebay tanks	12	8	11	17	19	20
Pumping plants	12	8	11	17	20	20
Regulating tanks	5	5	5	6	5	5
Community storage tanks	20	20	20	20	20	20
Feet of pipeline	1,361,954	1,389,378	1,466,248	1,286,082	1,237,792	1,189,145
Miles of pipeline	258	263	278	244	234	225

Project facilities serving the Gallup area are collectively called the Gallup Regional System, and they are common to all alternatives. They consist of one new pumping plant, upgrades to three storage tanks, and 32 miles of pipeline, as shown in table IV-2. None of the alternatives' facilities physically connect with the Animas-La Plata Project's Navajo Nation Municipal Pipeline.

Table IV-2.—Gallup Regional System

Component	NIIP Moncisco Alternative	NIIP Coury Lateral Alternative	NIIP Cutter Alternative	NIIP Amarillo Alternative	SJRPNM Alternative	San Juan River Infiltration Alternative
Pumping plants	4	4	4	4	4	4
Community storage tanks	5	5	5	5	5	5
Feet of pipeline	171,923	171,923	171,923	171,923	171,923	171,923
Miles of pipeline	32.6	32.6	32.6	32.6	32.6	32.6

Surface Water Diversions

NIIP Alternatives

Cutter Reservoir.—For the NIIP Cutter Alternative only, existing Cutter Reservoir would supply all of the water for the entire project, and there would be no diversion from the San Juan River.

Moncisco Dam and Reservoir.—Moncisco Dam and Reservoir would be constructed specifically for the proposed project. Water would be delivered to Moncisco Reservoir from the existing Burnham Lateral, part of the NIIP. The designs for Moncisco Dam would include a river outlet works with a tee for diverting water into the water treatment plant.

The Moncisco Water Treatment Plant would deliver treated water to a pumping plant, which would then pump water into the proposed Cutter and San Juan Laterals for transmission to the various communities.

Coury Lateral.—A canal turnout structure would be constructed near the beginning of Coury Lateral for the NIIP Coury Lateral Alternative. Water from the Coury Lateral would be diverted into a 4,500 acre-foot storage pond and, from that point, would be pumped into a treatment plant.

Amarillo Canal.—A canal turnout structure would be constructed near the end of the Amarillo Canal for the NIIP Amarillo Alternative. Water from the Amarillo Canal would be diverted into a 4,500 acre-foot storage pond and, from that point, would be pumped into a treatment plant.

San Juan River Alternatives

PNM Diversion Structure.—For the San Juan River alternatives, one of the options for diverting water from the San Juan River is to construct a new turnout structure just upstream from the existing PNM diversion structure, which is located about 1.5 miles northwest of Fruitland, New Mexico. The PNM diversion conveys water for a coal-fired steam electric plant.[3] The use of the existing PNM facilities was evaluated, but because of the potential impact on PNM's water quality, it was determined that a study should

[3] A report was prepared for Reclamation by Tetra-Tech Inc. In this report, Tetra-Tech developed a simple HECRAS model of the PNM diversion and settling channel describing the hydraulics and theoretical settling characteristics of sediment in the PNM intake channel.

proceed with the concept of constructing a water intake structure independent of the existing PNM intake facility and to include independent sediment removal facilities. It was assumed that the new concrete structure would be located just upstream from the existing intake/turnout on the north side of the San Juan River.

The structure would have a side intake with a trash rack and fish screen. The flow was assumed to be 0.5 foot per second through the trash rack. There would be a ramp at a 10:1 slope down which equipment would be driven to the pumping plant sump from which silt buildup would be removed. A pump would also be provided to remove sediment from the sump. The pumping plant would have a maximum capacity of 60 cubic feet per second (cfs). Each of the vertical turbine pumps would be rated at 100 horsepower. At the top of the ramp would be a 24-foot square parking/loading area. The entire site would be fenced with a 7-foot-high chain link fence. The pumping units would pump from the sump to settling basins and the treatment plant.

Infiltration Gallery System.—The San Juan River Infiltration Alternative includes an IGS that would obtain water from the San Juan River downstream of the Hogback and upstream of its confluence with the Chaco River. This diversion option would tie into the previously proposed alignment for the SJRPNM Alternative at the most feasible point. The proposed IGS components would include a series of infiltration galleries placed in the river alluvium, collection wells and pumps, a collection manifold system and tank, a pumping plant, and a pipeline to the proposed water treatment plant site.[4] The gallery caissons were spaced approximately 500 feet apart along the San Juan River and were at locations influenced by environmental considerations. For this study, the yield of each well was estimated at 1.5 MGD (2.33 cfs).

A typical collector well is constructed of a concrete caisson typically ranging from 12 to 20 feet in diameter and approximately 20 feet deep. Each collector well would include a pump and a backup pump housed in a weatherproof enclosure. Numerous infiltration pipes would radiate out from the caisson into the river alluvium. The infiltration pipe would be perforated to allow water filtering through the alluvium to enter the pipe and be transported to the collector well, from which it would then be pumped. The well pumps would convey water through a collection manifold that would gather the water from the entire infiltration gallery (well field) to a collection sump and pumping plant. The pumping plant would lift the water approximately 120 feet in elevation from the river elevation to the bluffs south of the San Juan River into the water treatment plant.

[4] The location and cost estimate for the collection wells were prepared by Ranney, a company that specializes in the design and construction of infiltration gallery systems.

Cutter Dam and Reservoir (Existing Features of the NIIP).—The Cutter Lateral is part of the San Juan River alternatives and would serve communities in the eastern portion of the Navajo Nation and the Jicarilla Apache Nation. The Cutter Lateral would obtain water from Cutter Reservoir via the river outlet works. Cutter Dam and Reservoir are existing features of the NIIP. The Cutter water treatment plant would deliver treated water to a pumping plant, which would then pump the water into Cutter Lateral for transmission to the various communities.

Description of the Alternatives

NIIP Moncisco Alternative

The NIIP Moncisco Alternative would utilize two laterals to deliver water to different portions of the Navajo Nation, but both would begin at one location, the proposed Moncisco Reservoir (figure IV-1). This alternative would use existing NIIP canals and features to convey water to the proposed Moncisco Reservoir during the irrigation season. From the proposed water treatment plant near Moncisco Reservoir, the East Lateral would convey water south to communities in the eastern portion of the Navajo Nation and the Jicarilla Apache Nation. The West Lateral would convey water south to communities in Navajo chapters along Highway 491 in the eastern portion of the Navajo Nation and to the city of Gallup. Several sublaterals would convey water to the communities of Window Rock, Arizona, and the Nahodishgish Chapter/Dalton Pass, New Mexico.

Water for the NIIP Moncisco Alternative would be conveyed from the existing Burnham Lateral to the proposed Moncisco Reservoir via a proposed stabilized channel. The NIIP system would convey water from Navajo Reservoir and through a series of canals, siphons, and tunnels to the Gallegos Pumping Plant, which conveys water to Burnham Lateral. An existing wasteway in Burnham Lateral would be used with the proposed stabilized channel to convey water to Moncisco Reservoir. Moncisco Dam and Reservoir would be constructed specifically for the proposed project and would have an approximate capacity of 12,000 acre-feet of active storage. This storage would be provided because the NIIP system would not operate during the winter months. Previous designs, estimates, and quantities from two Reclamation reports[5] were evaluated and refined, and the costs for these designs were indexed for this study.

A water treatment plant would be located immediately downstream of Moncisco Dam and Reservoir to treat the water before it is conveyed to the Navajo communities, the Jicarilla Apache Nation, and the city of Gallup. The treatment plant would utilize an

[5] Technical Memorandum No. GG-8311-2, "Gallegos Dam, Reconnaissance Design Summary" and *Water Supply and Storage Options, Gallup Navajo Pipeline Project, Engineering and Cost Estimates Appraisal Level Report*.

enhanced coagulation and hollow fiber ultrafiltration treatment system. Treated water would be pumped into the West and East Laterals. The NIIP Moncisco Alternative would have the a capacity of 42.75 cfs (27.6 MGD) for the expected flow requirements in 2020 or 67.52 cfs (43.6 MGD) in 2040.

NIIP Cutter Alternative

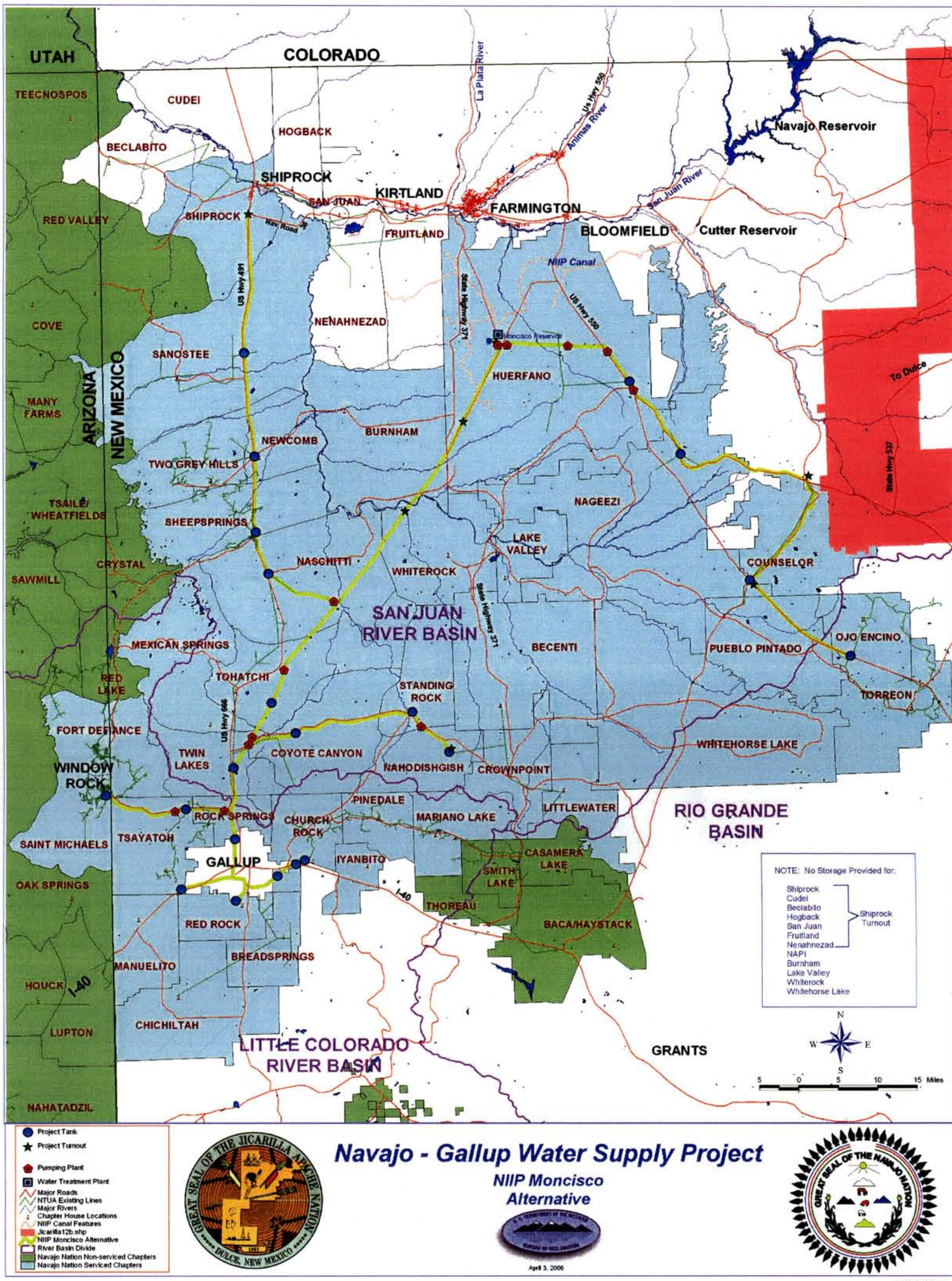
The NIIP Cutter Alternative would be similar to the NIIP Moncisco Alternative, but would not require the construction of Moncisco Dam and Reservoir (figure IV-2). Water would be released from Navajo Reservoir and conveyed through the existing NIIP system to Cutter Reservoir throughout the year, requiring improvements for winter use of a portion of the existing NIIP facilities. The treatment plant would be constructed at the base of Cutter Dam. Water would be pumped from the base of Cutter Dam through the Cutter Lateral to Highway 550, at which point the pipeline would serve the East and West Laterals following the same alignments as the NIIP Moncisco Alternative.

NIIP Coury Lateral Alternative

The NIIP Coury Lateral Alternative is similar to the NIIP Moncisco Alternative, but instead of constructing Moncisco Dam and Reservoir, the existing NIIP facilities would be winterized to convey project water throughout the year (figure IV-3). A turnout structure would divert water from the Coury Lateral and tie into the alignment proposed in the NIIP Moncisco Alternative. The turnout structure was sized based upon a standard canal turnout with a 48-inch-diameter outlet pipe. This alternative requires a 4,500-acre-foot lined storage pond located near the Coury Lateral, which would provide storage capacity for the summer months when NIIP facilities could not provide both peak irrigation demand and project demands (volume II, appendix B). The pond was assumed to be square, with a 20-foot water depth and 3 feet of freeboard. The pond was partially excavated below original ground, and a compacted embankment was assumed to be 5 feet above original ground and 6 feet wide at the top. The interior was assumed to be lined with a 40 mil membrane liner and 6 inches of riprap.

The water treatment plant, as described in the NIIP Moncisco Alternative, would be located near the storage pond and the Coury Lateral, and flows would be the same as those discussed under that alternative.

All flows for the proposed project remain the same, as described in the NIIP Moncisco Alternative.



USBR Drawing No. 1695-406-46

Figure IV-1.—NIIP Moncisco Alternative.

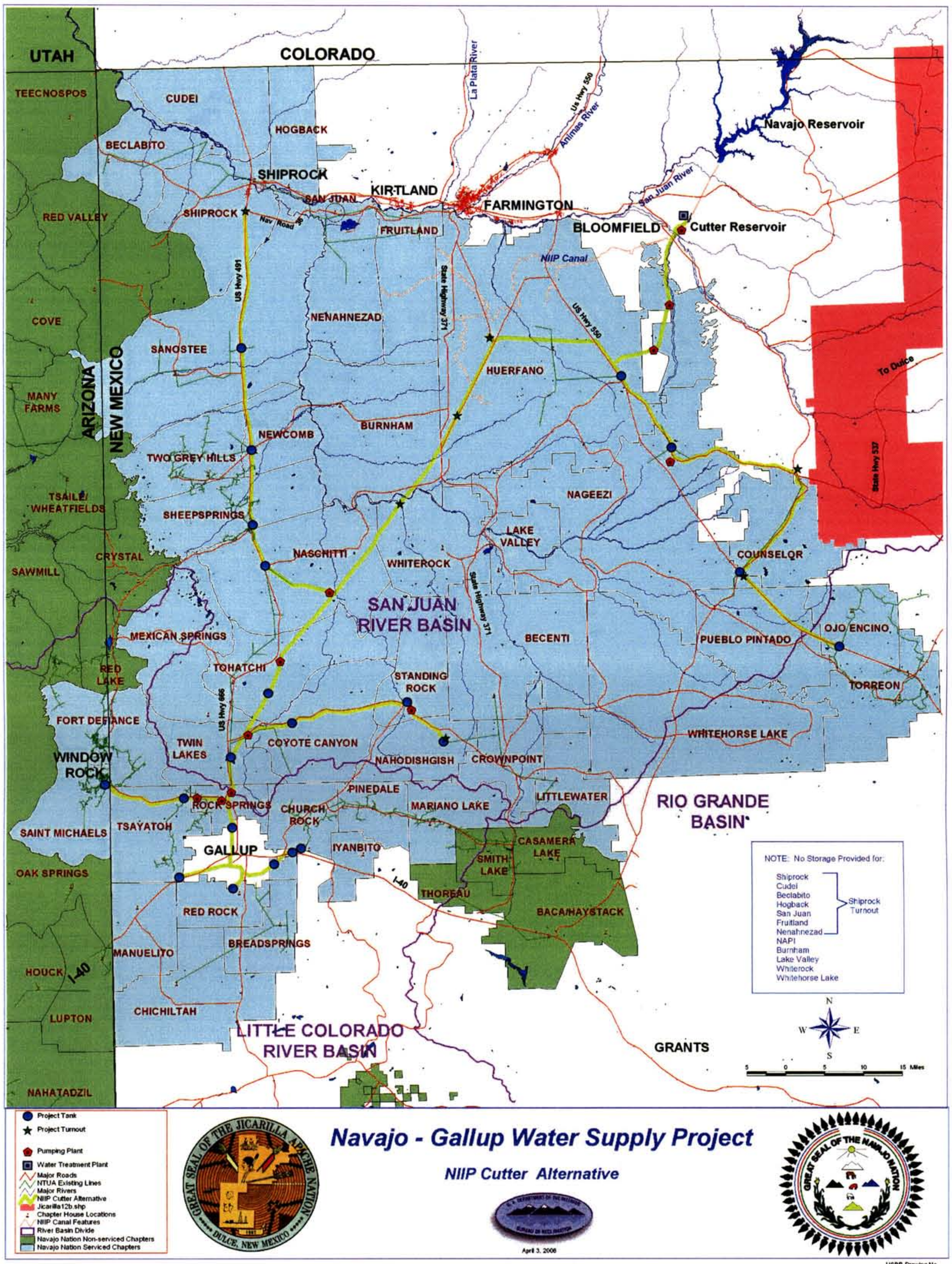


Figure IV-2.—NIIP Cutter Alternative.

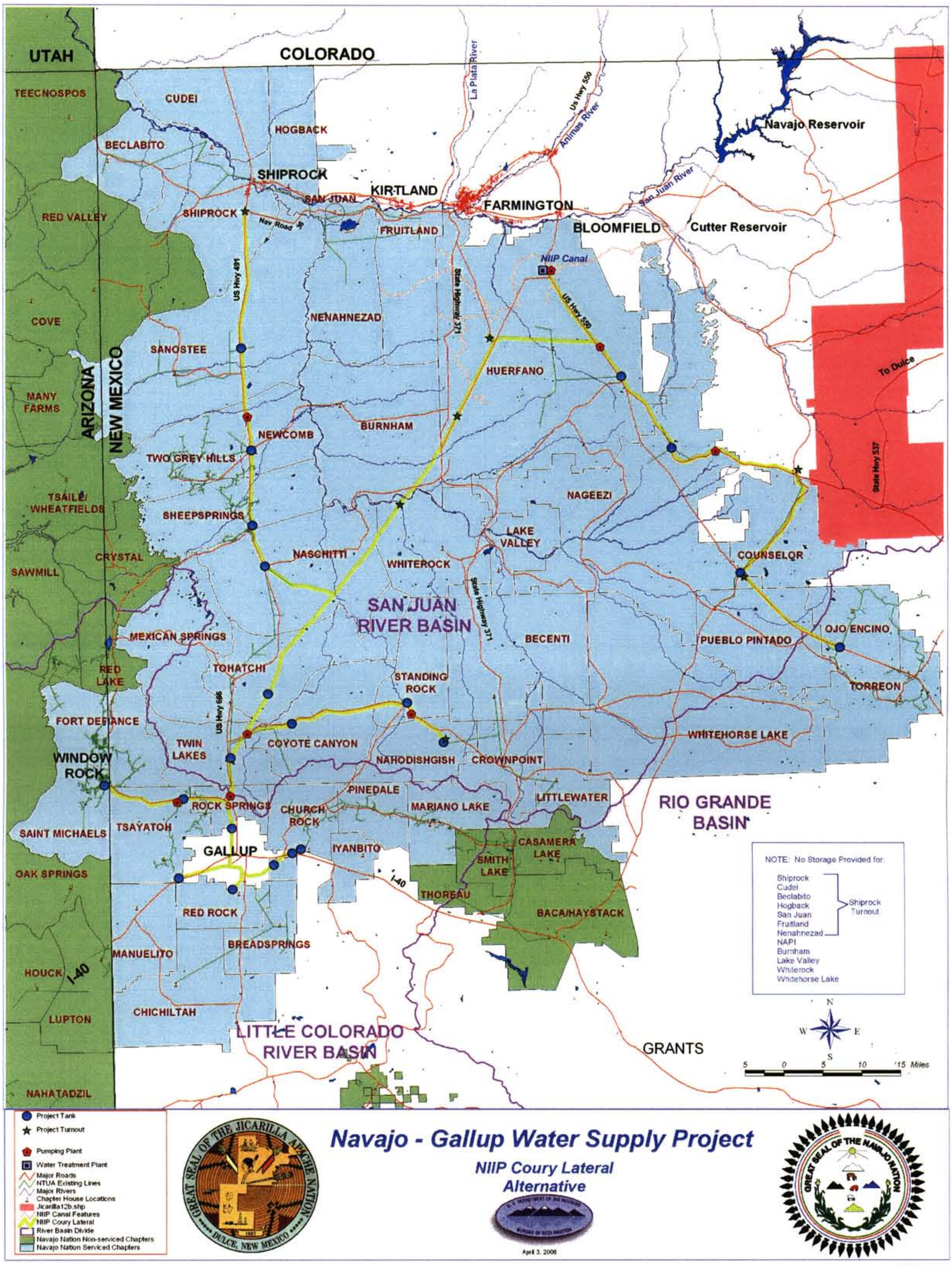


Figure IV-3.—NIIP Coury Lateral Alternative.

NIIP Amarillo Alternative

The NIIP Amarillo Alternative is similar to the NIIP Coury Lateral Alternative in that the existing NIIP facilities would be improved for winter use to convey project water throughout the year (figure IV-4). However, this alternative diverts water from the end of the Amarillo Canal for one lateral, as well as from Cutter Reservoir for the Cutter Lateral. A turnout structure would divert water from the Amarillo Canal and tie into the alignment proposed for the SJRPNM Alternative (see below). The turnout structure was sized based upon a standard canal turnout with a 48-inch-diameter outlet pipe. This alternative requires a 4,500 acre-foot lined storage pond located near the canal.

A water treatment plant would treat the water from the Amarillo Canal before the water was transmitted to the Navajo communities and the city of Gallup. Another treatment plant immediately downstream of Cutter Dam would provide treated water to the eastern portion of the Navajo and Jicarilla Apache Nations. Both treatment plants would utilize an enhanced coagulation and hollow fiber ultrafiltration treatment system. Flows would be divided between the Amarillo Canal and Cutter Reservoir.

SJRPNM Alternative

The SJRPNM Alternative is made up of two separate lateral systems—the San Juan Lateral and the Cutter Lateral (figure IV-5). The San Juan Lateral would divert water from the San Juan River downstream of Fruitland, New Mexico, and treat and deliver the water west along Highway N36 and south along Route 491 (formerly Route 666) to communities in the eastern portion of the Navajo Nation in New Mexico and the city of Gallup. This lateral utilizes several sublaterals to serve such communities as Window Rock, Arizona, and the Nahodishgish Chapter/Dalton Pass, New Mexico. As noted, the SJRPNM Alternative would divert water from the San Juan River just upstream from the existing PNM diversion structure. A side channel inlet structure would be designed with a sump, and water would then be pumped to settling basins and a treatment plant. The Cutter Lateral would obtain water from the NIIP system at the existing Cutter Reservoir and treat and deliver the water south to communities in the eastern portion of the Navajo Nation and the Jicarilla Apache Nation.

A water treatment plant would treat the water from the San Juan River before the water was transmitted to the Navajo communities and the city of Gallup. The treatment plant immediately downstream of Cutter Dam would provide treated water to the eastern portion of the Navajo and Jicarilla Apache Nations. Both treatment plants would utilize an enhanced coagulation and hollow fiber ultrafiltration treatment system.

San Juan River Infiltration Alternative

The San Juan River Infiltration Alternative is the same as the SJRPNM Alternative except that the water would be diverted from the San Juan River through an IGS just downstream from the Hogback irrigation diversion, an existing structure further downstream than the PNM diversion (figure IV-6). All other aspects would be the same as for the SJRPNM Alternative.

Overall Operational Configuration

Each of the proposed alternatives would be fully automated systems. The water treatment plants would operate automatically to maintain availability of treated water. The system downstream of the treatment plants would be a series of pumping plants, regulating or forebay tanks, and community storage tanks. Each pumping plant operation along the main water transmission line would be controlled by float level switches in the forebay or a regulating tank downstream from that plant. During periods of low water demand from a local community, water altitude valves in the community storage tanks would reduce flows into the storage tank at predetermined elevations by shutting down pumps as demand decreased. As demand increased, staged pumps (one pump for each increment of 10 cfs) would start. The pumping plants would not need to be attended on a full-time basis, but would require a daily physical inspection. Each pumping plant would have one backup pump and an emergency generator capable of meeting full load power requirements for that plant in the event of a power outage.

Pumps.—The pumps at the pumping plants were assumed to be of equal size with a maximum capacity of 10 cfs each. There is one standby pump unit at each pumping plant. The majority of the pumps would be horizontal split-case type. Each pump would have a suction and discharge valve with an electric or hydraulic operator. The pumps in the relift pumping plants and the turnout deliveries all would require a minimum of 15 feet of head on the suction side. Pumps would be controlled by level switches that sense the water levels in the regulating, forebay, and storage tanks. There are also two pumps (one plus standby) rated at 2.32 cfs at each infiltration well (Infiltration Gallery) system.

Air Chambers.—A typical air chamber size would be a 20-foot-diameter sphere. It was assumed that this would be an average size air chamber, and this size was used at all locations where an air chamber was needed.

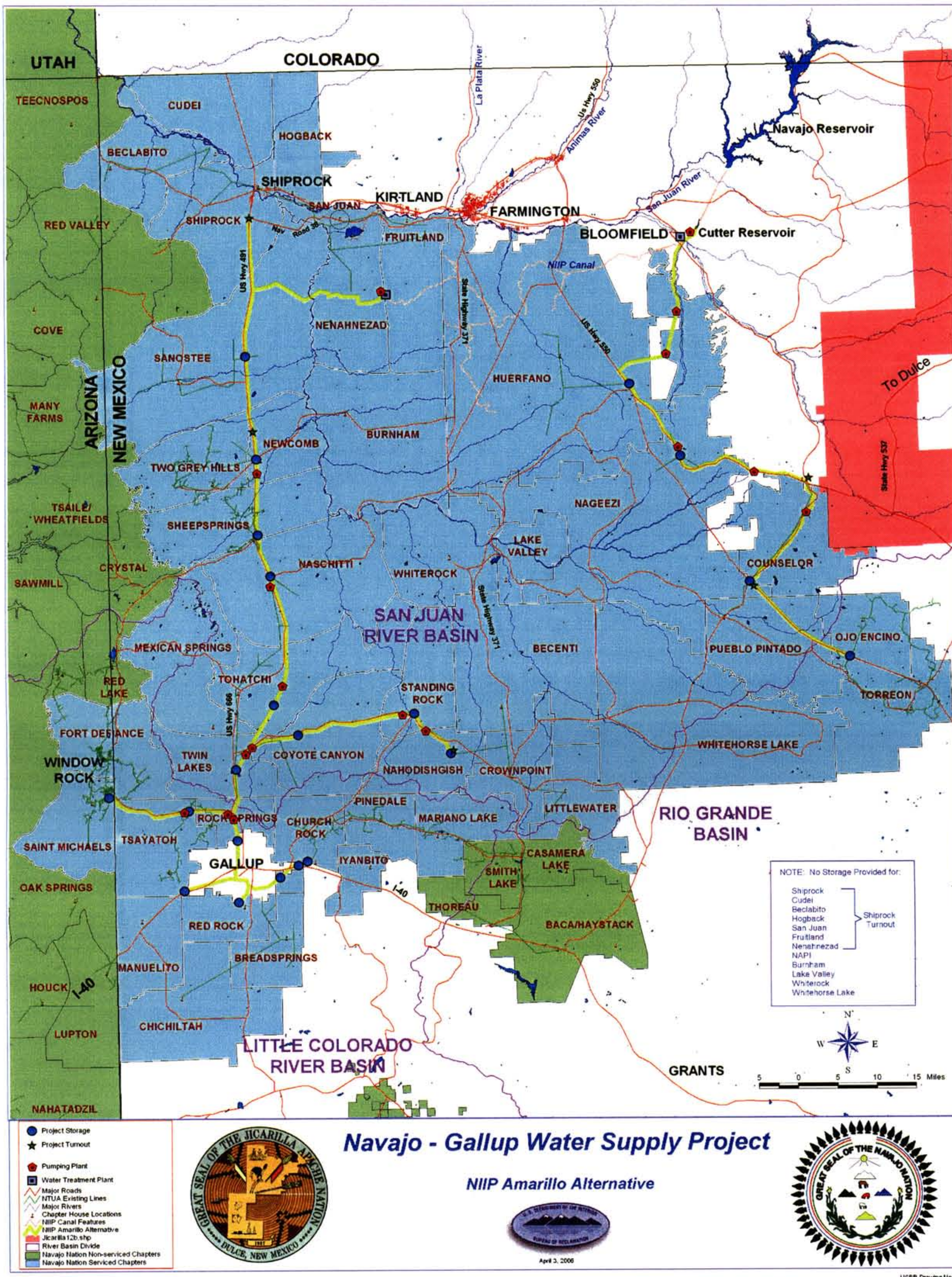


Figure IV-4.—NIIP Amarillo Alternative.

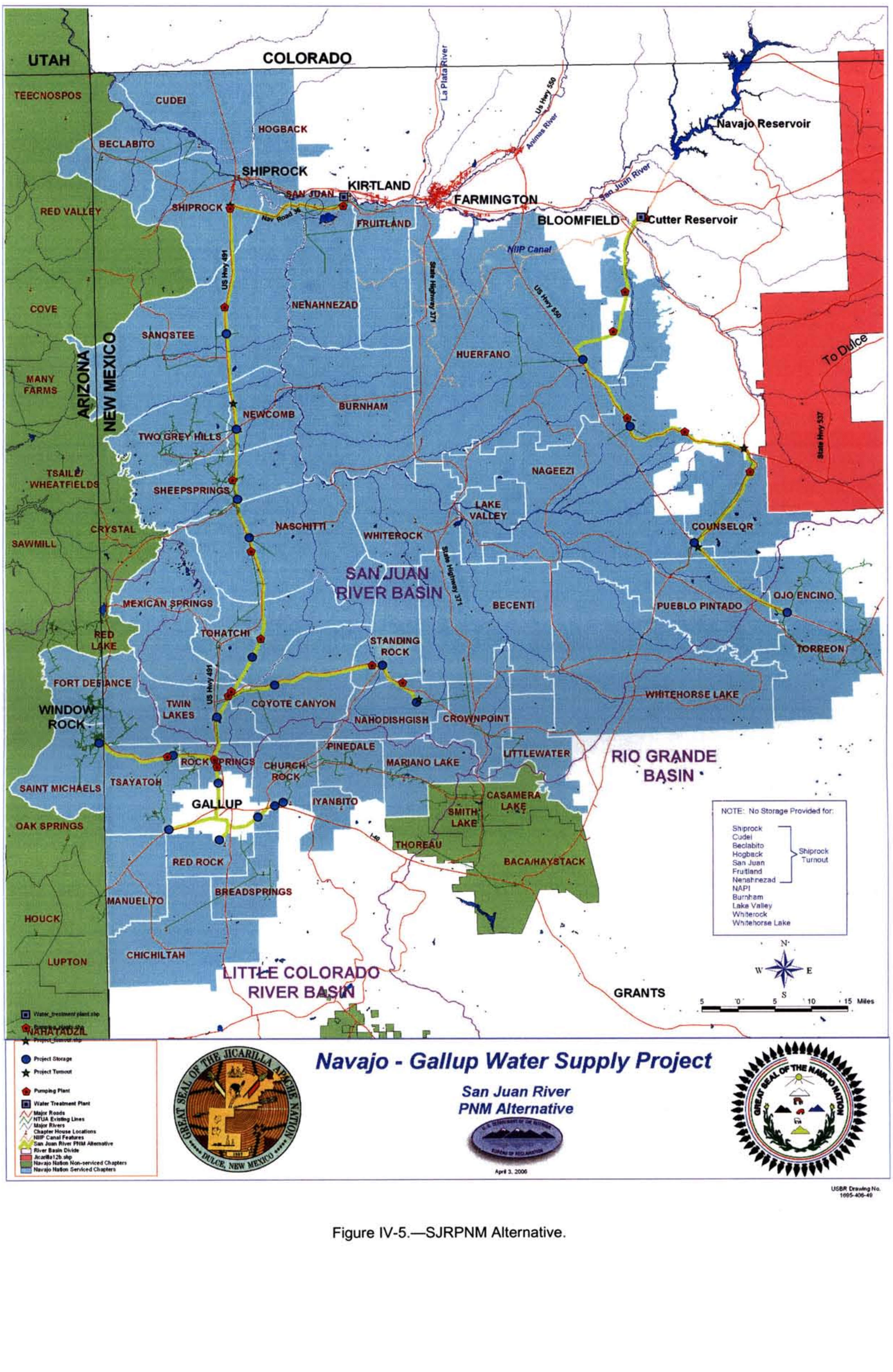


Figure IV-5.—SJRPNM Alternative.

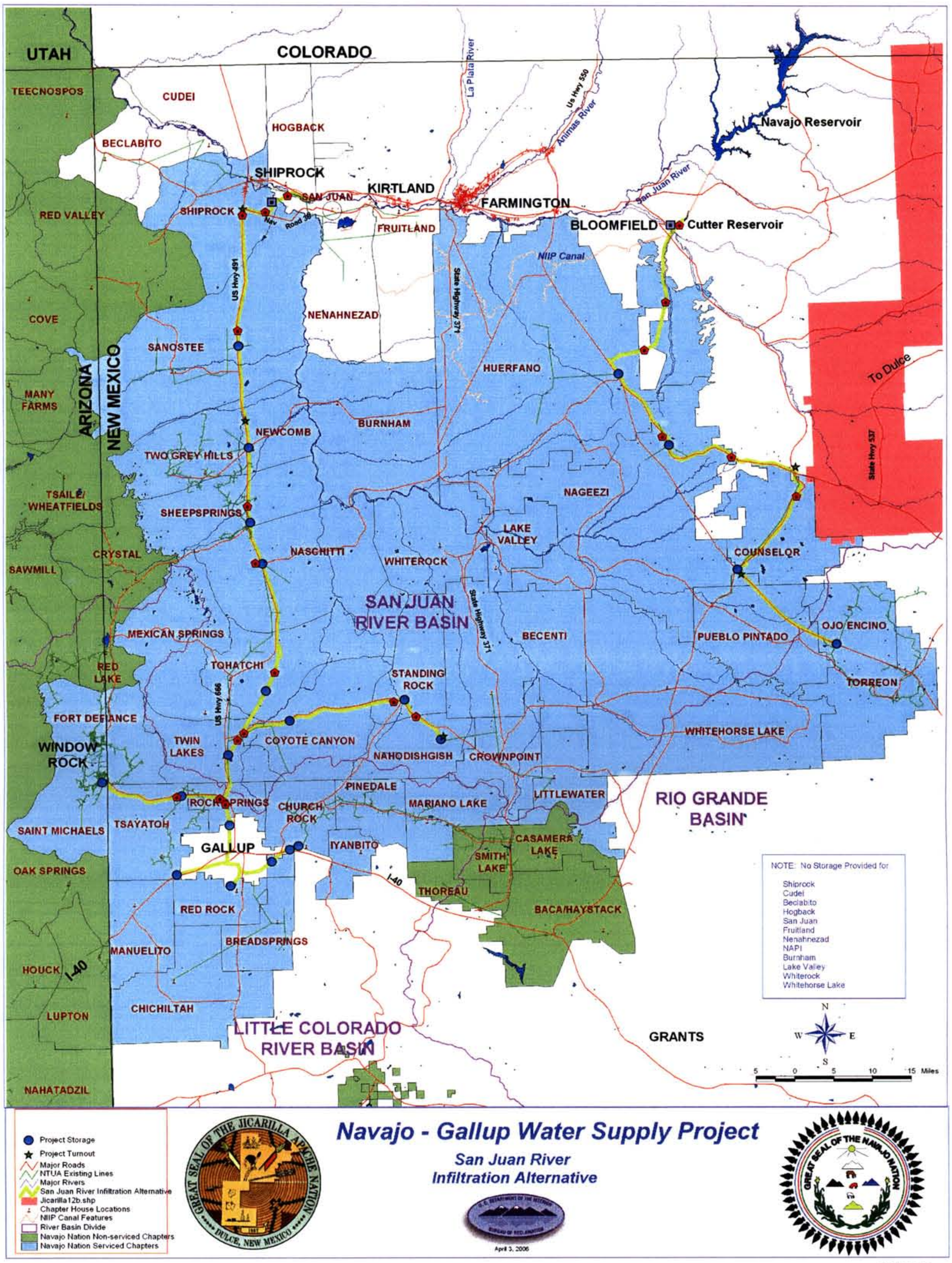


Figure IV-6.—San Juan River Infiltration Alternative.

Tanks.—Forebay tanks would be required upstream of almost every pumping plant to supply water during startup of the pumps and during shutdown to reduce damages. Altitude valves would be installed at most sites to prevent the forebay tanks from overtopping (volume II, appendix B). All of the forebay tanks were estimated to be 8 feet in diameter and 40 feet tall. In the next level of study, each of these tanks would be sized on an individual basis. Where possible, regulating tanks were placed at high points, and gravity flow could then be used to deliver water to lower points in the system. By assuming that the pumps in the pumping plants would be 10 cfs or less and that the minimum run time was 15 minutes, the regulating tank diameters were found to be 40 feet. Then, depending on the number of pumps, the heights of the tanks were computed. Tank heights ranged from 9 to 22 feet. The height included 2 feet for bottom dead space and 5 feet for overflow and top freeboard space. Tank water surfaces would be the primary control for automatically stopping and starting the pumps. Storage tanks were provided at the delivery turnouts for the communities that had existing water distribution systems. These tanks store a 5-day water supply for the community, which is then boosted by the pumping plant to a pressure of 70 psi into the community water system. It was assumed that the height of the storage tanks would be 20 feet, and the diameters were computed based on the values for the 5-day storage for 2020 demands.

Electrical.—Several locations would be tapped to provide power for the pumping plants and miscellaneous equipment. The NTUA is installing a 115 kilovolt (kV) line (energized at 69 kV) from Tohatchi to Newcomb. This proposed powerline was assumed to be constructed by the time the proposed project began. The proposed project would extend this NTUA powerline along Route 491 north to Shiprock and south along the pipeline alignment to Window Rock and the Nahodishgish Chapter/Dalton Pass, New Mexico.

The pumping plants located in the eastern portion of the Navajo Nation would obtain power from an existing 230-kV powerline owned by PNM. There are two locations where this powerline could be tapped to provide power, depending on the alternative plan and the distance of new transmission line construction. The transmission line would include one overhead optical ground wire for T1 fiber optic communications. A small switchyard with at least one circuit breaker would be required to provide electrical protection for the downstream facilities.

The following are the lengths of miles and substations for each alternative:

SJRPNM Alternative	107 miles and 1 substation near Nageezi
San Juan River Infiltration Alternative	107 miles and 1 substation near Nageezi
NIIP Moncisco Alternative	73 miles and 1 substation near Moncisco
NIIP Coury Lateral Alternative	74 miles and 1 substation near Nageezi
NIIP Cutter Alternative	93 miles and 1 substation near Nageezi
NIIP Amarillo Alternative	107 miles and 1 substation near Nageezi

The substations would tap power from a 230-kV line owned by PNM and would convert to 69 kV. Kutz substation would be used to serve the pumping plant near the Coury Lateral of the NIIP Coury Lateral Alternative. Transmission line lengths may change due to pumping plant location changes.

Pipelines.—Design velocity would be about 5 feet per second or less and the maximum pump lift would be about 400 feet. The minimum system pressure along the pipe laterals was 15 feet. Pipe friction losses were limited to about 25 percent of the total dynamic head for the pumps. It was assumed that all of the lateral pipe would be mortar-lined steel pipe with full inside diameters.

OTHER ALTERNATIVE COST ATTRIBUTES

Land, Relocations, and Damages

Facilities of all alternatives are primarily located on Navajo Nation lands and public land with the exception of the water treatment plant for the SJRPNM Alternative. This plant and associated facilities would be located on private land, and purchase of land and relocation of existing families would be required, which is discussed in chapter V and attachment F. There is the possibility of crossing sections of private land and Tribal allotments with the pipeline, but specific pipeline locations have not yet been identified. It is assumed that a no-cost agreement can be made with private landowners and allottees or the pipeline would be realigned.

All land requirements and rights-of-way (ROW) required on Navajo Nation and public land are assumed to be at no cost except for identification, processing, and recording. Damages caused by construction of the proposed project would be paid to those impacted, as was estimated and included in the costs of all alternatives. Damages are based on the estimated number of families disrupted along the alignment of the alternative facilities and the proposed projected impact of facility construction, as discussed in attachment F. The estimated cost for each alternative is shown in table IV-4. The estimate includes ROW costs for the SJRPNM treatment plant only. Should it be determined that ROW for the rest of the features needs to be included in the proposed project costs, an additional $30–60 million should be added.

All land rights would be acquired pursuant to the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 and the Uniform Relocation Act Amendments of 1987 (42 U.S.C. § 4601). It is the policy of Reclamation to compensate for crop damages occasioned by nontortious[6] activities of Reclamation during construction, operation, and maintenance under pipeline ROW or easements regardless of the method of acquisition.

Environmental Mitigation

Mitigation costs considered under all alternatives are determined by the impacts of construction and operating and maintaining the facilities. The mitigation is associated with land-disturbing activities and associated impacts to vegetation, wildlife, and other resources. Along the San Juan River, impacts to riparian areas are assumed to be mitigated with improvement in a ratio of 3 acres to every 1 acre impacted. Along the pipeline alignment and other facility locations, the improvement was assumed to occur in the disturbed area. Mitigation would be area-specific, but would generally consist of improved vegetation, fencing, and land management. Mitigation costs are directly related to the area that would be impacted by each alternative. The associated cost for each alternative is shown in attachment G.

Chapter IV describes environmental commitments and mitigation measures.

Cultural Resources

The anticipated cost of mitigation of impacts to cultural resources is based on the cost of similar mitigation work on projects in the area—the Dolores and Animas-La Plata Projects. Four percent of the capital construction costs of each alternative is considered an appropriate relative cost to use in the evaluation of the alternatives. A specific archaeological survey was completed on two project alternatives and was used to provide an impact analysis and cost estimate (Wharton and Cleveland, 2002). This information was used to define a specific mitigation plan used in the next step of defining the selected alternative. The associated cost for each alternative is shown in attachment G.

SCREENING PROCESS

Eight alternatives were initially screened for meeting the *Principles and Guidelines*' four tests of viability, including the six structural alternatives at the 2020 design capacity. The result was that the six structural alternatives (2040 design capacity) were carried forward for a more detailed comparison for screening. The next level of screening, in part to meet *Principles and Guidelines*' four account requirements, included a comparison of the total

[6] Nontortious actions do not involve civil actions for injury or damage.

costs of each alternative as measured by its present cost per-acre-foot value. The six action alternatives were then rated, weighted, scored, and ranked according to nine factors. More detail about the screening process is in attachment G.

The Principles and Guidelines

The Four Tests of Viability

The *Principles and Guidelines* describe four overarching tests of viability to be considered for each alternative. The tests assess the completeness, effectiveness, efficiency, and acceptability of the alternative plans. Alternatives that met a minimum standard under all four tests were considered viable plans and were investigated in greater detail.

> ***Completeness* –** This factor measures the extent to which a given alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planned effects. This may require relating the plan to other types of public or private plans if the other plans are crucial to realization of the contributions to the objective.
>
> ***Effectiveness* –** This factor measures the extent to which an alternative plan alleviates the specified problems and achieves the specified opportunities.
>
> ***Efficiency* –** This factor measures the extent to which an alternative plan is the most cost-effective means of alleviating the specified problems and realizing the specified opportunities and is consistent with protecting the Nation's environment.
>
> ***Acceptability* –** This factor measures workability and viability of the alternative plan with respect to acceptance by State and local entities and the public and compatibility with existing laws, regulations, and public policies.

Table IV-3 displays the results of applying the four tests of viability to the eight alternatives. The No Action and Water Conservation Alternatives did not meet the *Principles and Guidelines*' four tests of viability; therefore, the Water Conservation Alternative was screened out and the No Action Alternative was retained solely to meet NEPA plan formulation requirements. Additionally, although the year 2020 design capacities for the six structural alternatives are not shown in table IV-3, they were found to be incomplete, ineffective, and unacceptable because they did not meet the proposed project's objective of providing an M&I water supply for the year 2040.

Table IV-3.—Application of the viability tests

Alternative	Completeness	Effectiveness	Efficiency	Acceptability
No Action	No	No	No	No
Water Conservation	No	No	No	No
SJRPNM	Yes	Yes	Yes	Yes
San Juan River Infiltration	Yes	Yes	Yes	Yes
NIIP Moncisco	Yes	Yes	Yes	Yes
NIIP Coury Lateral	Yes	Yes	Yes	Yes
NIIP Cutter	Yes	Yes	Yes	Yes
NIIP Amarillo	Yes	Yes	Yes	Yes

The Four Accounts

The four accounts specified in the *Principles and Guidelines* are used to evaluate information on the effects of viable plans—NED, EQ, RED, and OSE accounts. Each account describes particular aspects of anticipated effects of the viable alternatives on the economy and environment.

The NED account measures changes in the economic value of the national output of goods and services, while the RED account gauges changes in the distribution of regional economic activity. The EQ account measures significant effects on natural and cultural resources, and the OSE account measures effects from perspectives that are relevant but not reflected in the other three accounts. The *Principles and Guidelines* require that the plan chosen must maximize net NED benefits as the preferred alternative, or else Reclamation must obtain an exception from the Secretary of the Interior to formulate a plan to meet other needs. The economic benefits of each alternative are essentially the same; therefore, the alternative with the smallest present worth value (also referred to as the total project cost measured in terms of cost per acre-foot of water) would represent the alternative that maximized NED benefits, and those results are discussed below in the "Comparative Total Costs of the Alternatives" section.

Comparative Total Costs of the Alternatives

The next step was to calculate the total project cost or present worth value (capital, construction, and operation, maintenance, and replacement [OM&R] costs) of the proposed project in order to satisfy requirements for the NED—the most critical of the four *Principles and Guidelines* accounts. The alternatives are ranked from highest to lowest cost, and the total estimated costs of the alternatives are reflected in table IV-4.

Table IV-4.—Present worth of alternatives

	Alternatives					
	NIIP Moncisco	**NIIP Coury**	**NIIP Cutter**	**NIIP Amarillo**	**SJRPNM**	**SJR Infiltration**
Construction cost	570,000,000	550,000,000	620,000,000	470,000,000	440,000,000	470,000,000
Rank	2	3	1	4	6	4
Total project cost (construction, fish and wildlife, land, archaeology)	599,700,000	578,700,000	652,000,000	495,100,000	465,600,000	494,700,000
Rank	2	3	1	4	6	5
Total project cost (construction, fish and wildlife, land, archaeology) per acre-foot	15,881	15,325	17,266	13,111	12,330	13,100
Rank	2	3	1	4	6	5
OM&R costs NTUA	8,900,000	8,000,000	9,500,000	10,100,000	12,500,000	11,400,000
Rank	5	6	4	3	1	2
OM&R costs NTUA per acre-foot	236	212	252	267	331	302
Rank	5	6	4	3	1	2
OM&R costs CRSP	6,400,000	6,000,000	6,500,000	7,500,000	8,500,000	7,600,000
Rank	5	6	4	3	1	2
OM&R costs CRSP per acre-foot	169	159	172	199	225	201
Rank	5	6	4	3	1	2
Present worth total project NTUA	732,955,541	698,480,261	794,239,060	646,322,580	652,756,658	665,386,872
Rank	2	3	1	6	5	4
Present worth total project NTUA per acre-foot	19,409	18,496	21,032	17,115	17,286	17,620
Rank	2	3	1	6	5	4
Present worth total project CRSP	695,524,209	668,535,196	749,321,462	607,393,995	592,866,528	608,491,248
Rank	2	3	1	5	6	4
Present worth total project CRSP cost per acre-foot	18,418	17,703	19,843	16,084	15,700	16,113
Rank	2	3	1	5	6	4

Notes: Costs shown above are obtained from “Navajo-Gallup Water Supply Project, Appraisal-Level Design and Cost Estimates," Bureau of Reclamation, Technical Service Center, 2002c. Present worth costs include construction and OM&R costs for 50 years. The estimate includes ROW costs for the San Juan Treatment Plant only. Should it be determined that ROW for the rest of the features needs to be included in the project costs, an additional $30–60 million should be added.

Costs used in this analysis are at the October 2001 price level.[7] The present worth analysis is based on a 50-year alternative life and an interest rate of 6.37 percent. OM&R cost estimates are shown for both Colorado River Storage Project (CRSP) and NTUA power costs. Results of this comparative analysis show that the SJRPNM and NIIP Amarillo Alternatives have the lowest present worth. The SJRPNM Alternative is the lowest using CRSP power rates, and the NIIP Amarillo Alternative is the lowest using NTUA power rates. The economic benefits of all the 2040 alternatives are essentially equal for this project, and the present worth is considered reflective of the NED account.

Alternatives Comparison and Weighting

Nine factors were identified to compare the alternatives:

(1) Capital cost per acre-foot delivered

(2) OM&R cost per acre-foot delivered

(3) Impacts to endangered species

(4) Impacts to environmental resources (aquatic, wildlife, vegetation, land use and recreation, excluding endangered species

(5) Impacts to cultural resources

(6) The quality of drinking water provided

(7) Social/economic impacts

(8) Acceptability to project participants

(9) Risks associated with construction, implementation, and OM&R

For factor definitions, please see attachment G.

[7] October 2001 cost estimates were available when this analysis was done.

Comparison of Alternatives by All Factors

Each alternative was rated within each factor and compared to each other numerically (1 through 12), with 12 being the least impacting or least costly. Each factor was then given a weight of importance for implementation of the proposed project (tables IV-5 and IV-6).[8]

Two separate analyses were done—one with all nine factors considered to reflect the overall alternative comparison and the other using only the environmental factors to reflect the environmentally preferred alternative (least impacting). The environmental factors—endangered species, environmental resources, socioeconomics, and cultural resources—were used to reflect the least impacting alternative.

The rating (1 through 12) of each alternative under each factor was multiplied by the weighting of each factor. The products for each were added together to give a total score of each alternative, and the alternatives were arranged, high to low, with high being the best. This process was done for the nine combined factors as well as only the environmental factors. For more information about the weighting process and the results, see attachment G.

Capital Cost.—The comparison of the total estimated capital cost per acre-foot of water delivered to implement the alternatives shows the SJRPNM Alternative is the least costly. These comparisons are based on October 2001 price levels. The SJRPNM Alternative was projected to have one of the shortest lengths of pipeline to construct for delivering water to the service area and had the least costly river diversion.

OM&R.—The NIIP Coury Alternative had the least projected cost per acre-foot to operate and had fewer facilities to maintain and the lowest power cost.

Endangered Species.—The NIIP Moncisco and NIIP Coury Alternatives had the least potential to impact endangered species because they had less potential for impacting critical habitat and populations of endangered aquatic, wildlife, and vegetation resources.

[8] For weighting and ranking purposes, the 2020 design capacities were treated as viable alternatives.

Table IV-5.—Alternative selection criteria
(May 14, 2003)

Alternatives	Total cost per acre-foot	OM&R per acre-foot NTUA	Endangered species	Environmental resources	Cultural resources	Drinking water quality	Socio-economics	Acceptability	Risk	Total	Combined resource rank
SJRPNM	12	4	5.5	12	11	2.5	9.5	12	11		12
Rank*weight[1]	20.00	6.67	9.17	20.00	2.75	0.42	2.38	2.00	9.17	72.54	
SJR Infiltration	11	5	1	10	9	2.5	9.5	11	7		8
Rank*weight	18.33	8.33	1.67	16.67	2.25	0.42	2.38	1.83	5.83	57.71	
NIIP Moncisco	7	11	9.5	2	1	8.5	9.5	10	1		7
Rank*weight	11.67	18.33	15.83	3.33	0.25	1.42	2.38	1.67	0.83	55.71	
NIIP Coury	8	12	9.5	7	7	8.5	9.5	8	3		11
Rank*weight	13.33	20.00	15.83	11.67	1.75	1.42	2.38	1.33	2.50	70.21	
NIIP Cutter	5	10	7	1	7	8.5	9.5	9	7		5
Rank*weight	8.33	16.67	11.67	1.67	1.75	1.42	2.38	1.50	5.83	51.21	
NIIP Amarillo	10	8	3	4	7	8.5	9.5	7	4.5		6
Rank*weight	16.67	13.33	5.00	6.67	1.75	1.42	2.38	1.17	3.75	52.13	

[1] * denotes "multiplied by."

Notes:

Capital cost	–	The costs of construction (including contract and noncontract [indirect]) per acre-foot of water.
OM&R	–	Operations, maintenance, replacement, and energy costs (energy costs are part of operations).
Endangered species	–	Endangered species and environmental impacts (e.g., depletions from San Juan River, Southwestern willow flycatcher, Mexican frog, and cacti).
Environmental resources	–	Environmental other than endangered species (e.g., aquatic, land use, habitat, recreation, and regulatory).
Cultural resources	–	Impacts to archeological, ethnographic, and in-use sites.
Drinking water quality	–	Quality of water from the source (all alternatives meet safe drinking water standards; NIIP water has a lower concentration of salts).
Socioeconomic	–	Social and economic impacts.
Acceptability	–	Project sponsor ranking (e.g., 2020 less acceptable than 2040, impacts to NIIP operations and future development, unit cost of water for year 2020 is higher for the city of Gallup and Jicarilla Apace Nation).
Risk	–	Reliability and constructability.
Total	–	Total points including the weight.

For ranking and weighting purposes, there are 12 alternatives for the project (the 6 alternatives at 2 design capacities each—2020 and 2040). For all rankings, see attachment G. Each selection criterion is ranked between 1–12, with 12 being the preferred and 1 the least preferred. Each criterion is weighted and the points associated with an alternative for a specific criterion are then rank weighted for that criteria (e.g., a rank of 10 out of 12 with a weight of 20 derives 16.67 points).

Table IV-6.—Alternative comparison for environmental factors
(May 14, 2003)

Alternatives	Endangered species	Environmental resources	Cultural resources	Socioeconomics	Total	Environmental preferred rank
SJRPNM	5.5	12	11	9.5		12
Rank*weight[1]	13.75	30.00	18.33	15.83	77.92	
SJR Infiltration	1	10	9	9.5		8
Rank*weight	2.50	25.00	15.00	15.83	58.33	
NIIP Moncisco	9.5	2	1	9.5		7
Rank*weight	23.75	5.00	1.67	15.83	46.25	
NIIP Coury	9.5	7	7	9.5		11
Rank*weight	23.75	17.50	11.67	15.83	68.75	
NIIP Cutter	7	1	7	9.5		5
Rank*weight	17.50	2.50	11.67	15.83	47.50	
NIIP Amarillo	3	4	7	9.5		6
Rank*weight	7.50	10.00	11.67	15.83	45.00	

[1] * denotes "multiplied by."

Notes:

Endangered species – Endangered species and environmental impacts (e.g., depletions from San Juan River, Southwestern willow flycatcher, Mexican frog, and cacti).
Environmental resources – Environmental other than endangered species (e.g., aquatic, land use, habitat, recreation, and regulatory).
Cultural resources – Impacts to archeological, ethnographic, and in-use sites.
Socioeconomic – Social and economic impacts.
Total – Total points including the weight.

There are 12 alternatives for the proposed project (the 6 alternatives at 2 design capacities each—2020 and 2040). Each selection criteria is ranked between 1–12, with 12 being the preferred and 1 the least preferred. Each criterion is weighted and the points associated with an alternative for a specific criterion is then rank weighted for that criterion (e.g., a rank of 10 out of 12 with a weight of 20 derives 16.67 points).

Environmental Resources.—The SJRPNM and San Juan River Infiltration Alternatives had the least potential to impact non-endangered environmental resources because additional water would be released from Navajo Reservoir into the San Juan River to the diversion point. The San Juan River Infiltration Alternative has a larger riparian impact area and, therefore, had a lower ranking than the SJRPNM Alternative.

Cultural Resources.—The SJRPNM Alternative is predicted to have the fewest impacts to cultural resources.

Drinking Water Quality.—Water from Navajo Reservoir is expected to have better quality than water from the San Juan River. The proposed water treatment for all alternatives would provide water that would meet drinking water quality standards. Some quality parameters, such as total dissolved solids, would not be reduced by the proposed treatment and would reflect the raw water levels. All alternatives that would use water from Navajo Reservoir were ranked highest in this category.

Socioeconomics.—Providing water for quality of life improvement and economic growth were the primary socioeconomic factors used in comparing the alternatives. Alternatives that would provide water for the estimated population growth to year 2040 were ranked higher than the design capacities for 2020 needs. The temporary positive contribution to the economy through the infusion of construction money and jobs was not significantly different among the alternatives.

Acceptability.—This element is considered the proposed project participants' concept of the preferred alternative. The factors they considered in this element were political acceptability and compatibility with future development or vision. Letters were received from the Navajo Nation and the city of Gallup supporting the SJRPNM Alternative. The Jicarilla Apache Nation did not have a specific alternative preference under this criterion. The SJRPNM Alternative was given the highest ranking, followed by the San Juan River Infiltration Alternative.

Risk.—The factors under this criterion are constructability and reliability. Alternatives that were considered technically unproven or sophisticated with a high level of unknowns were rated lower for constructability. Alternatives that had less reliable elements (e.g., those that depended on other projects like the NIIP) were given a lower rating. The SJRPNM Alternative had the highest ranking because it would use proven technology, has fewer unknowns, and would be less dependent on the NIIP.

ALTERNATIVES CONSIDERED BUT ELIMINATED

Nonstructural Alternatives Eliminated

The No Action and Water Conservation Alternatives did not meet the *Principles and Guidelines'* four tests of viability; therefore, the Water Conservation Alternative was screened out and the No Action Alternative was retained solely for NEPA requirements.

Water Conservation – Significant, cost-effective water conservation opportunities are currently being implemented. This is evident through the relatively high water rates and low use in Navajo communities in the proposed project area and the city of Gallup. Continued conservation will help the city of Gallup meet short-term needs, and it would be essential in addition to the proposed project's surface water supply to meet long-term needs.

Water Re-Use – Treated effluent is currently being used for the golf course and park irrigation and is seriously being considered for direct re-use as drinking water by the city of Gallup. The quantity of water available will only supplement the anticipated project surface water supply.

Conjunctive Use of Groundwater and Aquifer Storage – Conjunctive use groundwater in addition to surface water is considered part of the plan to provide a long-term water supply for the proposed project area. Aquifer storage and recovery would require further analysis to determine if applicable. If feasible, storage and recovery could provide additional water management opportunities but would not alleviate the need for a long-term surface water supply in addition to available groundwater.

Structural Alternatives Eliminated

The 2020 capacity alternatives were not retained for further analysis because their capacity would be exceeded by the time the proposed project was completed. The following are only 2040 capacity alternatives.

NIIP Moncisco – This alternative had an overall combined ranking of 7 and an environmental ranking of 7 out of 12. Its present worth ranking was 2 out of 6. Therefore, it was not considered for further analysis.

NIIP Cutter – This alternative had an overall combined and environmental ranking of 5 out of 12. Its present worth ranking was 1 out of 6. Therefore, it was not considered for further analysis.

NIIP Coury – This alternative had an overall and environmental ranking of 11. Its present worth ranking was 3 out of 6. This was a competitive alternative, but because of its high construction costs and risk factors associated with being tied to the NIIP Canal, it received a lower ranking and was not further considered.

San Juan River Infiltration – This alternative had an overall and environmental ranking of 8 out of 12. Its present worth ranking was 4 out of 6. Its weaknesses are risk associated with installing and maintaining the drainage gallery and a greater impact to the riverine area. This was a competitive alternative, but it was not as favorable as other alternatives in any factor.

PREFERRED ALTERNATIVE SELECTION

The result of all the analyses discussed in this chapter was the retention of the SJRPNM and NIIP Amarillo Alternatives. The No Action Alternative was retained for comparison and for NEPA compliance purposes.

The SJRPNM Alternative is the highest ranked in the comparison of the entire range of factors. The comparison of only the environmental factors also ranked the SJRPNM Alternative the highest; therefore, it is considered the environmentally preferred alternative. The present worth of the total alternative costs (capital and OM&R) is the factor used to compare the NED attributes of each alternative. The SJRPNM Alternative had the lowest present worth (highest ranked) assuming electrical power at CRSP rates. The NIIP Amarillo Alternative had the lowest present worth (highest ranked) assuming NTUA power rates.

The evaluation of these two action alternatives was continued into Chapter V–Affected Environment and Environmental Consequences. The result of this analysis, shown in table V-19, is that the SJRPNM Alternative has fewer negative and more positive impacts than the NIIP Amarillo Alternative.

The conclusion of this alternative analysis is that the SJRPNM Alternative is superior from an economic, environmental, and overall perspective. In addition, the Navajo Nation formally identified this alternative as their preferred alternative. Further detailed environmental analyses are presented in later chapters. Attachment F presents a specific, detailed description of the SJRPNM Alternative, including a physical description and cost estimates at January 2005 levels, and an economic analysis, including cost allocation, cost/benefit analysis, socioeconomics, and associated project details.

Reclamation historically supports projects for construction after a feasibility report is completed, which includes a feasibility-level cost estimate. This appraisal-level cost estimate does not meet that requirement. Additional analysis, detail, and updating of the appraisal-level cost estimates presented in this draft report are needed before project construction authorization can be supported. Failure to complete this additional effort may result in reliance on a cost estimate for the proposed project that is not sufficient to characterize the expected cost. The appraisal-level design must be upgraded to feasibility level before Reclamation would begin construction. The cost of, and time for, completing this additional work would be substantial.

Chapter V

AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

INTRODUCTION

This chapter presents a description of the environment and how it may be affected by the No Action, San Juan River Public Service Company of New Mexico (SJRPNM), and Navajo Indian Irrigation Project (NIIP) Amarillo Alternatives. These alternatives are described in chapter IV. This chapter is organized by resource topic. Under each resource is an overview, a discussion of the affected environment, the methodology used to determine impacts, an impacts analysis, and potential mitigation measures. Each resource topic concludes with a summary of impacts.

The impacts analysis presents short-term, long-term, direct, indirect, and cumulative effects on resources and, when applicable, potential mitigation measures. It assumes that related projects described in chapter I—the NIIP, San Juan River Basin Recovery Implementation Program (SJRBRIP), Animas-La Plata (ALP) Project, and Navajo Reservoir Operations—are fully implemented. There would, however, be an interim period, possibly decades, before full development of these projects, and during this time additional San Juan River water would be available to meet other purposes, as discussed in the Navajo Reservoir Operations Final Environmental Impact Statement (FEIS) (Bureau of Reclamation [Reclamation], 2006).

In this chapter, the resources described are those potentially affected by or central to changes related to the Navajo-Gallup Water Supply Project (proposed project) and include water uses and water resources, Indian Trust Assets (ITAs), water quality, vegetation, wildlife and aquatic resources, special status species, recreation, land use, hazardous material sites, soils and geology, paleontology, air quality, socioeconomics, environmental justice, land use, and cultural resources.

Potential measures to mitigate adverse impacts of the proposed project are presented in this chapter, and environmental commitments are described in chapter VI.

SETTING

For purposes of the impacts analysis, the study area (frontispiece map) includes Navajo Reservoir in New Mexico and Colorado; the San Juan River and its flood plain downstream from the reservoir in New Mexico, Colorado, and Utah to Lake Powell; Navajo Nation Reservation lands, specifically in and near more than 230 miles of pipeline corridors; the southwest portion of Jicarilla Apache Reservation lands; and the city of Gallup, New Mexico. Under some resource topics (e.g., economics and social factors), the study area includes a larger geographic area in order to reflect the scope of impacts to those resources.

The proposed project area includes three major river basins—those of the Upper Colorado River, Lower Colorado River, and Rio Grande. Most of the project is located within the San Juan River sub-basin of the Upper Colorado River Basin. The San Juan River sub-basin encompasses approximately 25,000 square miles, and the river extends 350 miles from its headwaters in the San Juan and La Plata Mountains of Colorado to Lake Powell. The river has drainages that cross reservation lands of the Ute Mountain Ute Tribe, Southern Ute Indian Tribe, and the Navajo and Jicarilla Apache Nations and extends approximately 225 miles from Navajo Dam to the San Juan arm of Lake Powell near Paiute Farms.

The region south of the San Juan River, which is predominately Navajo Nation Reservation lands, is characterized by desert landscape, where broad dry washes carry significant sediment loads during periodic thunderstorms. The area is semiarid to arid; most of the San Juan River Basin (Basin) is less than 6000 feet in elevation and receives less than 8 inches of precipitation annually. Sandstone rocks are interspersed with shale, volcanic, and igneous rocks. There are mesas, cliffs and canyons, rock terraces, and dry arroyos. The San Juan River is the only perennial stream of significance in the area; its corridor supports riparian vegetation such as cottonwood, willow, and non-native salt cedar and Russian olive. Where better soils occur, vegetation is used as open rangeland for cattle and sheep. Overgrazing of the native vegetation has denuded many areas, and on these unprotected soil, erosion is severe. Wildlife species are primarily limited to those that are adapted to drier conditions, except along the San Juan River valley.

Towns and communities in New Mexico in the northern part of the study area include Farmington at the confluence of the San Juan and Animas Rivers; Bloomfield, Blanco, and Archuleta upstream; and Fruitland and Shiprock downstream from Farmington. Energy development, agriculture, power production, tourism, and recreation are important industries in the area.

In the southern part of the proposed project area, the city of Gallup, although located off-reservation, has a significant and growing population (estimated currently at 36 percent) of Native American residents. As noted in chapter I, the city serves as an economic center for the surrounding area. To the east, the community of Crownpoint is the site of the Eastern Navajo Agency of the Bureau of Indian Affairs (BIA). To the west, Window Rock is the capital and center of government of the Navajo Nation, and nearby Fort Defiance also houses government functions and a large regional hospital. More than 20 smaller communities are located along Route 491 between the city of Gallup and Shiprock.

These areas around the city of Gallup are drained by a stream—the Rio Puerco of the West (Lower Colorado River Basin). The Rio Puerco of the West is the largest drainage in the area, originating east of the city of Gallup and flowing southwest into Arizona. Flow in the Rio Puerco of the West is intermittent, usually associated with thunderstorms and spring snowmelt, and is short-lived.

Navajo Nation lands in the southeastern portion of the proposed project area are within the Rio Grande Basin. These include the Huerfano, Nageezi, Counselor, Pueblo Pintado, Whitehorse Lake, Ojo Encino, and Torreon Chapters of the Navajo Nation.

The frontispiece map shows the general project area. Figure V-1 identifies the approximate location of gauging stations and primary locations along the San Juan River.

NAVAJO RESERVOIR OPERATIONS

Reclamation, in April 2006, completed the Navajo Reservoir Operations FEIS, and the Navajo Reservoir FEIS Record of Decision (ROD) was signed in July 2006. In accordance with the ROD, the reservoir will be operated in the future so that releases from Navajo Dam will generally range between 250 to 5,000 cubic feet per second (cfs) (the FEIS 250/5000 Alternative). For further details on this and other related projects, see the "Cumulative Impacts, Operation of Navajo Dam" section).

AFFECTED RESOURCES

To identify affected resources, issues were derived by using the scoping process, review of agency and public comments, and meeting with cooperating agencies.[1] Significant issues are discussed for each resource.

[1] Cooperating agencies for preparation of the environmental impact statement portion of this document include the Navajo and Jicarilla Apache Nations, State of New Mexico, Northwest New Mexico Council of Governments, city of Gallup, Navajo Tribal Utility Authority, BIA, and Indian Health Service.

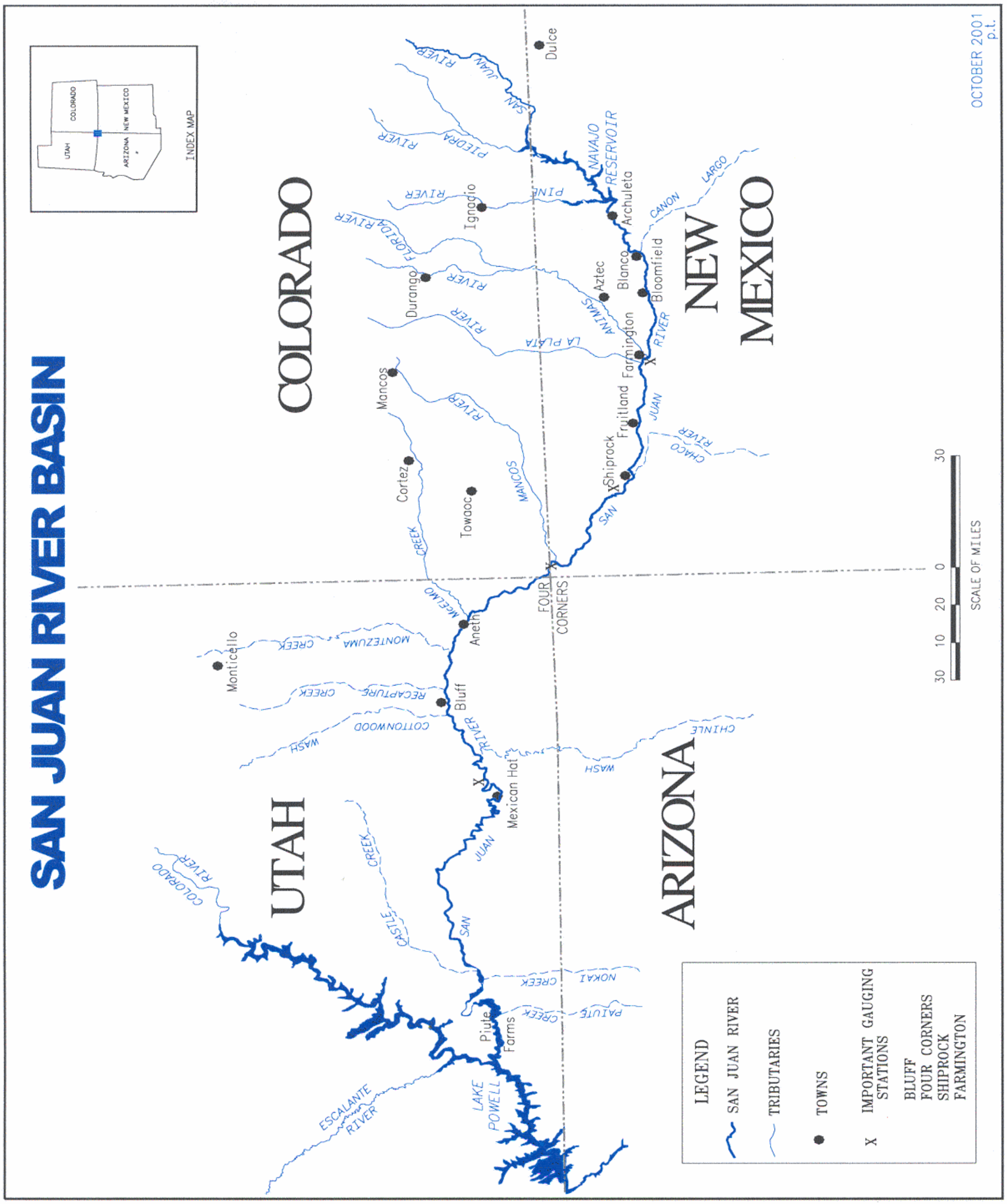


Figure V-1.—River mile locations and gauging stations.

Water Uses and Resources

This section addresses the potential impacts to water rights and water supplies that could result from actions associated with the proposed project alternatives considered.

Issue: How would the No Action and action alternatives affect water rights, riverflows, reservoir levels, and water uses?

Overview

Scope

The scope includes Navajo Reservoir and the San Juan River to Lake Powell. For water rights discussions, the scope is extended to the Upper and Lower Colorado River and Rio Grande Basins.

Impact Indicators

Impacts to water resources are indicated by effects on the following:

(1) Senior water right holders or contractors from the Navajo Reservoir supply

(2) Existing water users in the Basin

(3) Identified future uses for which valid water rights and environmental clearances are in place

(4) Implementation of the Flow Recommendations formulated by the SJRBRIP for endangered fish and designated critical habitat, or exceeding the existing depletions included in the Endangered Species Act (ESA) baseline

(5) Future water use, including the exercise of American Indian (Indian) water rights under the protection of the U.S. Department of the Interior (Interior)

(6) The Upper Basin States' ability to develop and use their compact apportionment[2]

Water Uses and Resources – Affected Environment

Navajo Reservoir.—Navajo Reservoir has a maximum content of 1,701,300 acre-feet as measured at the spillway crest (at elevation 6085 feet) with a corresponding water

[2] Colorado River Compact (1922) and Upper Colorado River Compact (1948).

surface area of 15,610 acres. The inactive content, defined as the storage below the NIIP inlet works, is 625,675 acre-feet with a corresponding water surface elevation of 5985 feet. During the irrigation season, the minimum operating level for the NIIP diversion intake is at elevation 5990 feet, or 661,800 acre-feet of storage; however, the reservoir can be drawn down during the winter to elevation 5985 feet, or 625,675 acre-feet of storage, as long as the reservoir recovers sufficiently prior to the NIIP irrigation season.

San Juan River.—The San Juan River below Navajo Dam is the largest river in the Basin and collects inflow from perennial tributaries—the Animas, La Plata, and Mancos Rivers—and other intermittent tributaries. At its confluence with Lake Powell, the San Juan River produces a long-term average natural flow[3] of about 2.0 million acre-feet[4] (MAF). The San Juan River above the Animas River confluence contributes about one-half of this amount.

Mean annual runoff to the San Juan River at Farmington just downstream of the confluence with the Animas River is about 1.3 MAF under present depletion conditions. Near Bluff, Utah, mean annual runoff increases to about 1.4 MAF under present conditions. The increase is accounted for by tributary or side inflow downstream of Farmington.

As with the other rivers, flows peak in the spring and remain low from summer to fall, punctuated by short-duration peaks resulting from storm events. The river is partially regulated by Navajo Dam, and its tributaries are substantially used for irrigation. Navajo Dam has tended to reduce peak spring flows and to supplement flows in other seasons since its operation began in 1962. Implementation of Flow Recommendations, as described in the Navajo Reservoir Operations FEIS, would result in a more "natural" hydrograph with higher spring flows and lower base flows, as depicted in figure V-2.

Water Rights Background.—See chapter I, "Water Rights Background," for information about Indian water rights, the Colorado River compacts, and the La-Plata River and Animas-La Plata compacts.

New Mexico –

New Mexico Water Law – New Mexico water law is based on the prior appropriation doctrine. Basically, the first user (appropriator) in time has the priority to

[3] Natural flows are flows that would exist in the San Juan River, excluding any manmade uses of the flows.
[4] Natural flow data for the period 1929–93 developed for the SJRBRIP.

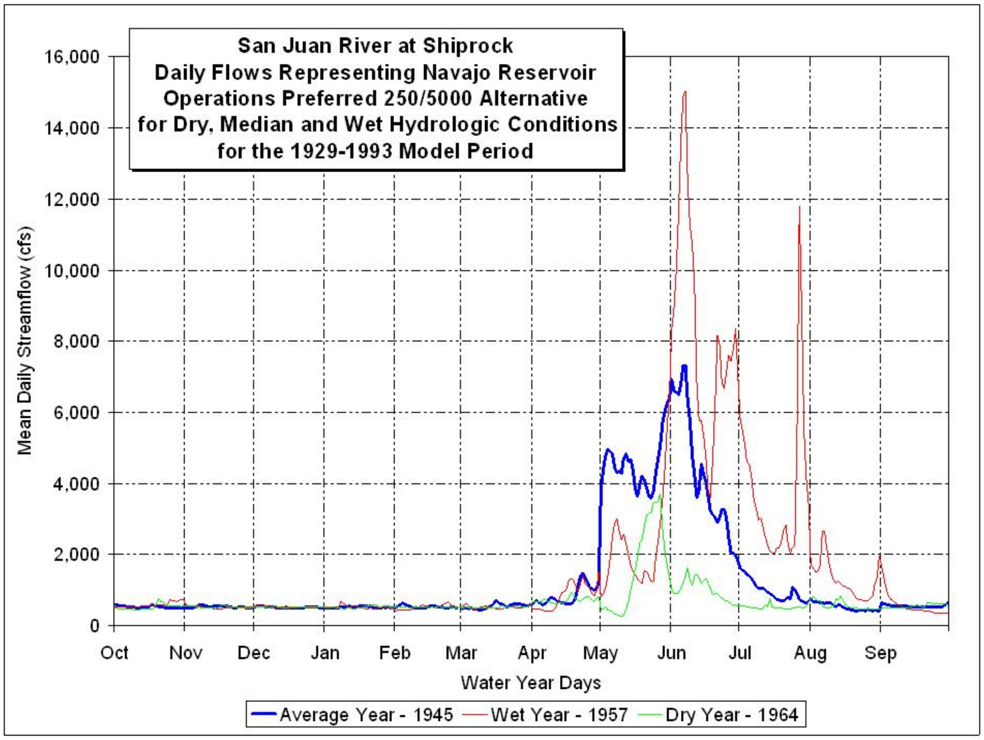


Figure V-2.—Hydrograph of San Juan River at Shiprock.

take and use water. The State Engineer has the primary responsibility for supervision, measurement, appropriation, administration, and recordkeeping. The State courts have primary responsibility with respect to quantifying water rights when there is a general stream adjudication.

Navajo Nation and Jicarilla Apache Nation Uses – For much of its path from Navajo Dam to Lake Powell, the San Juan River either flows through or forms the northern boundary of the Navajo Nation. The Basin has not been fully adjudicated and the Navajo Nation reserved water rights in the Basin have not been quantified. The State of New Mexico and the Navajo Nation have signed a settlement agreement that would settle the Nation's water right claims in the Basin in New Mexico. The proposed project is a cornerstone piece of this settlement. Congress has not yet approved the settlement agreement or authorized the proposed project. Potential impacts of alternatives on Navajo Nation water rights are discussed in the "Indian Trust Assets" section of this chapter.

The Jicarilla Apache Nation's water rights in the Basin under the 1992 Jicarilla Apache Tribe Water Rights Settlement Act and a 1999 Partial Final Decree in the San Juan River adjudication include the right to deplete 25,500 acre-feet per year (AFY) from the Navajo Reservoir water supply or the Navajo River on the Jicarilla Apache Nation Reservation, plus depletions for historic and existing uses with a priority date of September 21, 1880, totaling approximately 2,195 AFY for surface water diversions and approximately 2,187 AFY for evaporation. The Jicarilla Apache Nation also has a right to 6,500 AFY of San Juan-Chama Project water. Potential impacts of alternatives on Jicarilla Apache Nation water rights are also discussed in the "Indian Trust Assets" section.

Water Permits Held by the United States – In the early 1950s, planning for development of the water supply apportioned to New Mexico by the Upper Colorado River Basin Compact was concentrated on several major Federal projects that would put to use the undeveloped water available to New Mexico. The filing on water rights by private entities and subsequent related activities—coupled with the advanced planning for the Federal projects for which no water had been reserved by a water right filing—led the New Mexico Interstate Stream Commission (NMISC) in 1955 to file several notices of intention to appropriate water for use, which were later assigned to Interior. The NMISC filed an additional notice of intention in 1957 for additional water to be provided from Navajo Reservoir. Table V-1 lists the New Mexico permits now held by the United States for water use in the Basin. Water uses by the San Juan-Chama Project and the NIIP, and under other contracts for the Navajo Reservoir supply, must share shortages in the supply in accordance with section 11 of Public Law (P.L.) 87-483.

Table V-1.—New Mexico permits held by the United States[1]

Office of State Engineer file numbers	Purpose	Diversion quantity (acre-feet/year)	Priority dates
2847	San Juan-Chama Project	235,000	June 17, 1955
2848	Hammond Project	23,000	June 17, 1955
2849	NIIP	630,000	June 17, 1955
2873	Navajo Reservoir evaporation loss	28,800	January 17, 1956
2883	ALP Project	49,510	May 1, 1956
2917	Irrigation, domestic, industrial, mining, and power purposes – San Juan-Chama Project	225,000	September 16, 1957
3215	Municipal and industrial purposes (*Note*: permit is a direct flow right)	500 cfs	December 16, 1968

[1] The diversion amounts shown reflect the diversion values in permits or notices of intention and do not reflect actual diversions currently taking place. A permit under file Nos. 2847, 2849, 2873, and 2917 combined was issued on March 6, 1958. File No. 3215 is for the diversion and use of tributary or side inflow entering the San Juan River below Navajo Dam to supplement the water supply available for meeting deliveries under Navajo Reservoir water supply contracts for those contract uses diverting below Navajo Dam.

Under contracts with the Secretary of the Interior (Secretary), users of the Navajo Reservoir water supply include the Navajo Nation for use on the NIIP, the Jicarilla Apache Nation pursuant to the Jicarilla Apache Tribe Water Rights Settlement Act, and several small-use contractors. The Jicarilla Apache Nation currently subcontracts portions of its Navajo Reservoir water supply allocation to the Public Service Company of New Mexico for use at the San Juan Generating Station and others.

Other Water Rights Downstream of Navajo Dam – The San Juan River and its tributaries are the source from which New Mexico's entire consumptive use apportioned by the Upper Colorado River Basin Compact can be reasonably supplied. There are numerous water rights in New Mexico on the San Juan River downstream of Navajo Dam. The water is used for municipal and industrial (M&I) purposes and irrigation. Table V-2 shows a listing of the water rights between Navajo Dam and the Public Service Company of New Mexico (PNM) diversion.

Table V-2—Preliminary list of San Juan River water rights between Navajo Dam and the Animas River confluence

User	Priority dates	Diversion right (cfs)
Citizens Ditch		
Bloomfield Irrigation District	1879, 1881, 1900[2], 1907, 1920,[1] 1951, 1954, 10/24/55, 5/1/56[1] (ALP Project)	106
La Pumpa Ditch	1888	10
Jaquez Ditch	1878	12
City of Bloomfield		4
El Paso Natural Gas		2
Others not listed		2
Subtotal		136
Navajo Dam Water Users Association	5/1/56[1] (ALP Project), 1973	2
Turley-Manzanares Ditch	1876	7
Hammond Canal	1944, 1947, 6/17/55 (Reclamation)	90
Giant Refinery	1881, 1907, 1947, 10/24/55, 5/1/56[1]	2
Lee/Hammond Water Plant	1876[1], 1881, 1896[1], 1907, 1920[1], 1930, 1945, 1947, 1953, 10/24/55, 5/1/56[1] (ALP Project)	3
City of Farmington	1907, 1947, 10/24/55/, 5/1/56[1] (ALP Project)	55
Subtotal		295

Notes: Diversion rights and priority dates are preliminary and were obtained from the State of New Mexico, Office of the State Engineer, in letters dated July 6, 2000, and March 13, 2003, respectively. All priority dates are for the San Juan River unless otherwise indicated. The ALP Project water rights listed are under a Reclamation filing.
[1] Animas River priority date.
[2] Pine River priority date.

Colorado – Colorado water law is based on the prior appropriation doctrine, which states that the first appropriator in time has the first priority to take and apply water to beneficial use without waste. The right to divert the unappropriated waters of natural streams to beneficial uses is never to be denied under Colorado's constitution; the Colorado water courts grant decrees to use water and set priorities. The Colorado State Engineer and the Division of Water Resources administer the water rights according to the priorities, measure flows, and record the use of water. Use of Colorado's compact apportionment can be supplied from many river sources, including the San Juan River.

Numerous water rights exist in Colorado on the San Juan River upstream of Navajo Dam and on tributaries to the San Juan River.

Arizona – As stated above, the San Juan River either flows through or forms the northern boundary of the Navajo Nation. The main stem of the San Juan River does not flow through Arizona; however, all tributaries in Arizona to the San Juan River are on Navajo Nation lands. Water rights for the Navajo Nation on the tributaries in Arizona have not been quantified. The Navajo Nation claims sufficient water from these tributaries necessary to create a permanent homeland for the Navajo people.

Arizona is limited to an annual consumptive use of 50,000 acre-feet of water from the Upper Basin pursuant to its apportionment under the Upper Colorado River Basin Compact. In 2000, the total consumptive use of water in the Upper Basin in Arizona was about 38,100 AFY according to Reclamation's *Consumptive Use and Loss Report 1996–2000*.

Utah – In Utah, water law is also based on the prior appropriation doctrine, and water use is managed in a manner similar to that of the State of Colorado.

In Utah, the San Juan River forms the northern boundary of Navajo Nation Reservation lands. The same principle applies here with respect to the Navajo Nation claims for sufficient water to provide a permanent homeland for its people.

A number of non-Indian water rights exist on the north side of the San Juan River and on tributaries that drain into the San Juan River from the north. While the Colorado River Compact makes provisions for flows to be delivered from the Upper Basin to the Lower Basin at Lee Ferry, it does not require that specific amounts of water be contributed to Lee Ferry from the San Juan River or from any other particular Upper Basin tributary. The Glen Canyon National Recreation Area may have an unquantified Federal reserved water right on the San Juan arm of Lake Powell. This right would be junior to that for Navajo Reservoir, and the Navajo Unit has no obligation to bypass water for this right.[5]

[5] Personal communication between the National Park Service and Reclamation, February 6, 2002.

Table V-3 shows the existing and future projects that have valid water rights and environmental clearances (included with the baseline depletion).

Table V-3.—Baseline and current depletion summary within the Basin[1, 2, 3]
(November 2005)

Depletion category	Hydrologic model (AFY)	Estimated current (AFY)	Presently unused (AFY)
New Mexico depletions			
Navajo lands irrigation depletions			
NIIP	[4]280,600	160,330	120,270
Hogback	[5]12,100	9,535	2,565
Fruitland	[5]7,898	6,147	1,751
Cudei	900	715	185
Chaco River off-stream depletion	[6]2,832	[6]2,832	0
Whiskey Creek off-stream depletion	[6]523	[6]523	0
Subtotal	304,853	180,082	124,771
Non-Navajo lands irrigation depletions			
Above Navajo Dam – private	738	575	163
Above Navajo Dam – Jicarilla	[7]2,195	[7]350	[7]1,840
Animas River	36,711	24,878	11,833
La Plata River	9,808	8,470	1,338
Upper San Juan	9,137	6,680	2,457
Hammond Area	10,268	7,507	2,761
Farmers Mutual Ditch	9,532	7,457	2,075
Jewett Valley	3,088	2,379	709
Westwater	110	110	0
Subtotal	81,587	58,406	23,176
Total New Mexico irrigation depletions	386,440	238,488	147,952
Non-irrigation depletions			
Navajo Reservoir evaporation	27,350	29,235	(1,885)
BHP Navajo Coal Company	39,000	31,388	7,612
San Juan Generating Station	[8]16,200	[8]16,200	0
Industrial diversions near Bloomfield	2,500	2,500	0
M&I uses	8,454	7,443	1,011
Scattered rural domestic uses	[6]1,400	[6]1,400	[6]0
Scattered stock ponds and livestock uses	[6]2,200	[6]2,200	[6]0
Fish and wildlife	[6]1,400	[6]1,400	[6]0
Total New Mexico non-irrigation depletions	98,504	91,766	6,738
San Juan-Chama Project exportation	107,514	107,514	0
Unspecified minor depletions	[9,10]4,500	2,500	2,000
Animas-La Plata Project	13,600	0	13,600
Jicarilla Apache Nation Navajo River Water Supply Project	[11]6,570	0	6,570
Total New Mexico depletions	617,128	440,268	176,860

Table V-3.— Baseline and current depletion summary within the Basin [1, 2, 3] (continued)
(November 2005)

Depletion category	Hydrologic model (AFY)	Estimated current (AFY)	Presently unused (AFY)
Colorado depletions			
Upstream of Navajo Reservoir			
Upper San Juan	10,858	9,270	1,588
Navajo-Blanco	7,865	6,972	893
Piedra	8,098	6,892	1,206
Pine River	71,671	69,775	1,896
Subtotal	98,492	92,909	5,583
Downstream of Navajo Reservoir			
Florida	28,607	27,749	858
Animas	25,119	24,099	1,020
La Plata	[12, 13] 13,245	13,049	196
Long Hollow Reservoir Project	[13] 1,339	0	1,339
Mancos	19,532	15,516	4,016
McElmo Basin imports	(11,769)	(11,769)	0
Subtotal	76,073	68,644	7,429
Animas-La Plata Project	43,533	0	43,533
Total Colorado depletions	218,098	161,553	56,545
Colorado and New Mexico combined depletions	835,226	601,821	233,405
Utah depletion	[6, 14] 9,140	[6, 14] 9,140	0
Arizona depletion	[6] 10,010	[6] 10,010	0
Grand total	854,376	620,971	233,405

[1] The State of New Mexico does not necessarily agree with the depletions shown in terms of constituting evidence of actual water use, water rights, or water availability under the Upper Colorado River Basin Compact (Compact). The SJRBRIP Hydrology Committee uses a hydrology model disclaimer that reads in part, “The model data methodologies and assumptions do not under any circumstances constitute evidence of actual water use, water rights, or water availability under Compact apportionments and should not be construed as binding on any party.”

[2] The NMISC and the San Juan Water Commission (SJWC) believe there are inconsistencies in depletion calculations (communications from NMISC and SJWC dated April 1 and March 21, 2002, respectively).

[3] It should be noted that full development of State compact water and Indian trust water is not included in this table. Only existing projects and projects with ESA and National Environmental Policy Act compliance are included in the depletion table.

[4] Includes 10,600 AFY of annual groundwater storage. At equilibrium, the No Action Alternative drops to 133,000 AFY and the action alternatives drop to 270,000 AFY.

[5] Accounts for 16,420 AFY from Hogback, including the Hogback Extension, and Fruitland Projects to NIIP.

[6] Indicates off-stream depletion accounted for in calculated natural gains. The combined figures for the New Mexico portion include 2,185 acre-feet of historic and existing uses of Jicarilla Apache settlement water rights for scattered off-stream depletions on the reservation.

[7] The Jicarilla Apache Nation recognizes this historic depletion as 2,195 acre-feet, but it was modeled as 2,190 acre-feet on average.

[8] Water contract with the Jicarilla Apache Nation for long-term depletions for the San Juan Generating Station.

[9] 1,500 AFY of depletion from minor depletions approved by SJRBRIP in 1992.

[10] Includes an additional 3,000 AFY of depletion from 1999 Intra-Service consultation, a portion of which may be in Colorado. This amount includes 770 acre-feet of water subcontracted by the Jicarilla Apache Nation to “minor contractors” below Navajo Dam.

[11] Jicarilla Apache Nation Navajo River Water Supply Project Biological Opinion lists this depletion as 6,654 acre-feet, but model configuration shows 6,570 acre-feet on average. The model configuration is shown.

[12] Includes the Red Mesa Reservoir enlargement depletion in the amount of 997 acre-feet.

[13] Long Hollow Reservoir Project Biological Opinion lists this depletion as 1,535 acre-feet. Model configuration shows this as 1,339 acre-feet for the Long Hollow Reservoir Project and an additional 198 acre-feet is included in the La Plata category.

[14] 1,705 AFY San Juan River depletion, 7,435 AFY off-stream depletion.

Water Uses and Resources – Methodology

The following measures were used to evaluate the impacts to water rights and uses under the No Action, SJRPNM, and NIIP Amarillo Alternatives.

- Researching the number of water rights and quantifying the amounts of water associated with each water right
- Researching available water diversion records and determining possible impacts due to changes in flows in the San Juan River resulting from operation of the proposed project
- Examining and comparing a hydrologic model output for each construction alternative to the No Action Alternative to determine possible variations in flow from the future operation of the proposed project and the way in which these variations may affect water use
- Observing actual operations of the diversion structures during the Navajo Dam Summer Low Flow Test conducted from July 9 to July 15, 2001 (Reclamation, 2002b)

Water Uses and Resources – Impact Indicators

The following assumptions and conditions were made for the analysis:

(1) An underlying assumption in analysis of the impact to water resources was that New Mexico water law, based on the prior appropriation doctrine, would be maintained. All existing depletions are intended to be represented in the hydrology model used for analysis. Comparing the model depletions with and without the action reveals differences among alternatives.

(2) Future uses with valid water rights and environmental clearances, when necessary, were handled in the same manner as existing water uses using the same impact indicators (e.g., completion of the NIIP was modeled as a depletion for its full water rights acreage).

(3) Navajo Dam would be operated as described in the preferred alternative in the Navajo Dam Operations FEIS to implement Flow Recommendations. In the Navajo Dam Operations FEIS, flow statistics were based on the modeled period of 1929–93 and compared to the Flow Recommendations criteria, and Navajo Dam operations were adjusted until the Flow Recommendations could be met. The inability to implement the SJRBRIP was considered to be an impact to the endangered fish. A Navajo Depletion Guarantee is included as a component of both action alternatives to ensure the proposed project depletions do not result in

exceeding the depletions allowed under the current Flow Recommendations using all projects currently modeled in the ESA baseline at full development. The Navajo Depletion Guarantee is discussed in greater detail in Chapter VI–Environmental Commitments and Mitigation Measures.

(4) It should be considered whether there are any impacts on the following projects: (1) Colorado Ute and Navajo Indian water uses pursuant to the 1988 Colorado Ute Settlement Act and the 2000 Settlement Act amendments (which also authorize the ALP Project and its component Navajo Nation Municipal Pipeline [NNMP]); (2) Jicarilla Apache Nation water uses pursuant to the 1992 Jicarilla Apache Tribe Water Rights Settlement Act; (3) completion of the NIIP; or (4) the exercise of senior Indian water rights for uses without environmental clearances (more detail is provided in the "Indian Trust Assets" section of this chapter).

(5) The Upper Basin States' ability to develop and use their compact apportionment and the use of Upper Basin water in the Lower Basin (Gallup/Window Rock areas) were taken into consideration.

Water Uses and Resources – Impacts Analysis

No Action Alternative.—Reservoir elevations for the No Action Alternative would generally be lower than those under the action alternatives because additional water would not be stored in Navajo Reservoir to meet the demands of the proposed project. A combination of natural flows, bypasses, and releases from Navajo Reservoir would be used to meet existing downstream senior water rights and implement the Flow Recommendations. The spring releases would reach 5,000 cfs when sufficient water is available, and releases would be decreased to as low as 250 cfs when necessary to provide the Recommended Flows through the critical habitat area and to conserve water. A 250-cfs release from Navajo Reservoir during the irrigation season results in low flows from below the Citizens Ditch diversion to the Animas River confluence due to irrigation diversions; however, during the Navajo Dam Summer Low Flow Test, it was determined that a 250-cfs release would meet senior water rights (Reclamation, 2002b). Currently, some flexibility in reservoir releases exists because water committed under present water rights and/or future development is not fully used. This may be a significant amount of water in many, but not all, years. The release of this water will be incorporated into operations to augment the minimum 250 cfs release during the irrigation season with a goal of minimum releases of 350 cfs.

The application of impact indicators (see previous indicators discussion) was used to predict future resource conditions under the No Action Alternative. Release patterns would generally follow the pattern described in the 250/5000 Alternative (Flow Recommendations) as described in the Navajo Reservoir Operations FEIS. Many of the Navajo Nation residents would continue to haul water for domestic uses, and the Navajo Nation and the city of Gallup would continue to use existing permitted groundwater wells. Additional water conservation would be needed to meet current and future water demands. The Jicarilla Apache Nation would need to construct alternate delivery facilities or sources of water for development of the southwestern portion of Jicarilla Apache Reservation lands.

(1) Under the No Action Alternative, future uses with valid water rights and environmental clearances would likely continue assuming that the Flow Recommendations continue to be met.

(2) Navajo Dam would continue to be operated to assist in meeting the Flow Recommendations.

(3) Under the No Action Alternative, the following projects and uses would continue: (1) Colorado Ute and Navajo Indian water uses pursuant to the 1988 Colorado Ute Settlement Act and the 2000 settlement act amendments (which also authorize the ALP Project and its component NNMP); (2) Jicarilla Apache Nation water uses pursuant to the 1992 Jicarilla Apache Nation Water Rights Settlement Act; and (3) completion of the NIIP.

(4) The No Action Alternative would not limit the Upper Basin States' right to develop and use their compact apportionment. Apportionment planned for use in the proposed project may be available for other projects within the Basin. However, by failing to implement the settlement of the Navajo Nation's water rights and forcing the Nation to reinitiate their claims, local water users could potentially be adversely affected.

SJRPNM Alternative.—Navajo Reservoir elevations for the SJRPNM Alternative would generally be higher than those of the No Action Alternative (1.3-foot increase in mean reservoir elevation) because of the increased storage needed, on average, to make releases from Navajo Reservoir meet project demands (table V-4). The proposed project is designed to divert a total of 37,764 AFY from the San Juan River with a resulting depletion of 35,893 acre-feet, based on 2040 projected population with a demand rate of 160 gallons per capita per day (gpcd). A total of 33,119 acre-feet would be diverted from the San Juan River at the PNM diversion (river mile [RM] 166.7), and 4,645 acre-feet would be diverted through the existing NIIP facilities at Navajo Reservoir (RM 225) to Cutter Reservoir via the NIIP Canal system to meet project water demand.

A combination of natural flows, bypasses, and releases from Navajo Reservoir would be used to meet existing downstream senior water rights and the Flow Recommendations. During higher riverflows, natural riverflows would be used to meet the PNM diversion

Table V-4.—Navajo Reservoir content and releases for the alternatives

Alternative	Project depletions from the San Juan River	Mean reservoir elevations	Mean average flows for the San Juan River[1]
No Action	No project depletions	6,057.1 feet	1,444 cfs
SJRPNM	35,893 acre-feet	1.3-foot increase	4.6 cfs increase
NIIP Amarillo	35,893 acre-feet	0.9-foot increase	1.2 cfs decrease

[1] Average of five San Juan River gauges.

portion of the water demand. Mean average flows in the San Juan River would increase by 4.6 cfs to meet the PNM diversion portion of the water demand and to continue to meet Flow Recommendations downstream of the PNM diversion. Under certain low flow conditions, the SJRPNM Alternative would increase river base flows in the San Juan River from Navajo Dam to the PNM diversion (58.3 river miles) by as much as 16 percent, which would benefit other resources dependent on base flows.

The application of evaluation criteria (see previous indicator discussion) disclosed the following potential impacts:

(1) Under the SJRPNM Alternative, there would be no adverse impact to existing active water use in the Basin.

(2) There would be no adverse impacts to future uses with valid water rights and environmental clearances (included in the existing ESA baseline). Future uses were analyzed in the same manner as existing water uses under the same impact indicators (e.g., completion of NIIP was modeled as a depletion for its full water rights acreage).

(3) Navajo Dam would be operated as described in the preferred alternative in the Navajo Reservoir Operations FEIS to meet Flow Recommendations to the extent possible. In the Navajo Reservoir Operations FEIS, flow statistics were based on the modeled period of 1929–93 compared to the Flow Recommendations criteria, and Navajo Dam operations were adjusted until the Flow Recommendations could be met. Not meeting one or more of the flow criteria was considered to be an impact to the endangered fish. Under the SJRPNM Alternative, all but two of the flow criteria are met for the worst-case scenario, and these criteria have been determined by the Biology Committee to be ineffective in accomplishing the

anticipated results (Miller, 2005). The 2,500 cfs criteria are missed by about 12 percent for 3 days in 1 year out of the 65-year period, or 0.01 percent of the time. All other Flow Recommendations are fully met. Not meeting the Flow Recommendations for 0.01 percent of the time under the 2,500 cfs criteria is not considered to be a significant impact.

(4) The following projects and uses would not be adversely impacted by the SJRPNM Alternative: (1) Colorado Ute and Navajo Indian water uses pursuant to the 1988 Colorado Ute Settlement Act and the 2000 Settlement Act amendments (which also authorize the ALP Project and its component NNMP); (2) Jicarilla Apache Nation water uses pursuant to the 1992 Jicarilla Apache Tribe Water Rights Settlement Act; and (3) the completion of the NIIP.

(5) The SJRPNM Alternative is compatible with the Upper Basin States' ability to develop and use their compact apportionment. The use of Upper Basin water in the Lower Basin (Gallup/Window Rock areas) is also considered compatible. Therefore, no impact is predicted.

NIIP Amarillo Alternative.—Navajo Reservoir elevations for the NIIP Amarillo Alternative would generally be lower than those for the SJRPNM Alternative (0.9-foot increase) because of withdrawals made from Navajo Reservoir via the existing NIIP intake structure to meet the full amount of project demands (table V-4). The proposed project is designed to divert a total of 37,764 AFY from the San Juan River with a resulting depletion of 35,893 AFY based on the 2040 project population with a demand rate of 160 gpcd. A total of 37,764 acre-feet would be diverted through the existing NIIP facilities at Navajo Reservoir to Cutter Reservoir and a newly constructed 4,500 acre-foot active storage reservoir via the NIIP Amarillo Canal to meet project water demands.

A combination of natural flows and releases from Navajo Reservoir would be used to meet existing downstream senior water rights and Flow Recommendations. Mean average flows in the San Juan River would decrease by 4.0 cfs to meet project demands.

The application of the evaluations criteria for the NIIP Amarillo Alternative result in the same conclusions as those for the SJRPNM Alternative, with no adverse impacts identified.

Water Uses and Resources – Mitigation Measures

As part of the proposed project, the Navajo Nation provides a depletion guarantee to allow for full project development while not exceeding the existing depletion baseline and ESA limitations (table V-3).

Reclamation would track actual depletions for the NIIP and ALP Project through the 5-year consumptive use and loss reporting. When the sum of depletions for the NIIP and ALP Project reach a 290,000 acre-foot yearly average, more detailed accounting will be required.

Water Resources and Uses – Summary of Impacts

Under the No Action Alternative, existing and future water uses and projects with valid water rights and environmental clearances would continue to be constructed and/or operated and the Flow Recommendations would be fully met. The SJRPNM and NIIP Amarillo Alternatives (including the Navajo Depletion Guarantee[6] of 20,782 acre-feet of the proposed project's total depletions) would minimally impact the Flow Recommendations. However, missing the 2,500 cfs Flow Recommendation criteria 0.01 percent of the time is not predicted to result in a measurable adverse impact to endangered fish. Therefore, the impact is not considered significant. All other Flow Recommendations are fully met under both action alternatives, and all other water rights and uses are not adversely impacted.

Mean reservoir elevations would slightly increase under both action alternatives, but this change is not significant. Mean average San Juan River flows would increase by 4.6 cfs under the SJRPNM Alternative and decrease by 1.2 cfs under the NIIP Amarillo Alternative. The benefits of other resources from increased flows and reservoir elevations are discussed in greater detail for each resource in the sections of this chapter (Aquatic Resources, Vegetation Resources, Recreation Resources, and others).

Indian Trust Assets

This section addresses the potential impacts to ITAs that could result from implementation of the No Action, SJRPNM, and NIIP Amarillo Alternatives.

Issue: How would the No Action and action alternatives affect ITAs?

Overview

Scope

The scope includes ITAs associated with Navajo Reservoir and the San Juan River and on surrounding trust/reservation lands of the Navajo and Jicarilla Apache Nations.

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[6] Language from the Draft Biological Assessment, Navajo-Gallup Water Supply Project (Biological Assessment, 2004).

Impact Indicators

An impact is considered to exist for any action that would:

- Adversely affect the value, use, or enjoyment of an ITA
- Disregard or subordinate the government-to-government relationship that exists between the United States and any affected Tribal Nation

Indian Trust Assets – Affected Environment

Introduction.—The United States has a trust responsibility to protect rights reserved by or granted to Indian Tribes by treaty, statutes, and Executive orders. This trust responsibility requires that Federal agencies such as Reclamation take actions reasonably necessary to protect ITAs. Interior Secretarial Order Number 3215, dated April 28, 2000, further states:

> *The proper discharge of the Secretary's trust responsibility requires, without limitation, that the Trustee, with a high degree of care, skill, and loyalty: Protect and preserve Indian Trust Assets from loss, damage, unlawful alienation, waste, and depletion.*

Reclamation ITA policy states that Reclamation will carry on its activities in a manner that protects ITAs and avoids adverse impacts to ITAs when possible. When Reclamation cannot avoid adverse impacts, it will provide appropriate mitigation or compensation (Reclamation, 1994).

A basic description of ITAs is as follows:

- ITAs are legal interests in assets held in trust by the Federal Government for federally recognized Indian Tribes or Nations.
- Assets are anything owned that has monetary value. The assets need not be owned outright, but could be some other type of property interest, such as a lease or a right to use something. Assets can be real property, physical assets, or intangible property rights.
- A trust has three components: the trustee, the beneficiary, and the trust asset(s). The beneficiary is also sometimes referred to as the beneficial owner of the trust asset. In this trust relationship, title to ITAs is held by the United States (trustee) for the benefit of a Tribal Nation.

- Legal interest means there is a property interest for which a legal remedy, such as compensation or an injunction, may be obtained if there is improper interference.

- ITAs do not include things in which a Tribal Nation has no legal interest (e.g., off-reservation sacred sites in which a Tribe has no legal property interest are generally not considered ITAs).

- ITAs cannot be sold, leased, or otherwise alienated without the United States' approval. While most ITAs are located on the reservation, they also can be located off-reservation. Examples include lands, minerals, water rights, hunting and fishing rights, other natural resources, money, or claims.

Letters requesting identification and consultation on ITA issues were sent to 18 Tribal governments. Potential ITAs have been identified for four federally recognized Tribes within the Basin: the Navajo and Jicarilla Apache Nations, the Ute Mountain Ute Tribe, and the Southern Ute Indian Tribe. Reclamation is in the process of consulting with Tribal governments to identify and address ITA issues and concerns. ITAs potentially affected by the proposed Federal action appear to be limited to water rights and land use (easements, including Trust lands and Tribal allotments, necessary for project construction and operation). The proposed action is not expected to affect any treaty-based fishing, hunting or gathering, or similar rights of access use on traditional Tribal lands.

In *Winters* v. *United States*, the U.S. Supreme Court laid the foundation for Indian water rights that have become known as Winters Doctrine rights. The court held that the establishment of an Indian reservation carries with it an implied amount of water necessary to satisfy the purposes of the reservation. A water right granted to a Tribal Nation under the Winters Doctrine is given a priority date no later than the time when the reservation was established and, unlike water rights permitted, licensed, or adjudicated under State statutes, such rights under the Winters Doctrine cannot be lost through non-use.

Native American Graves Protection and Repatriation Act of 1990 (NAGPRA) cultural items and other cultural property may be considered ITAs by association with land status, treaty, or some other statute, but are not considered ITAs by virtue of NAGPRA alone. Therefore, cultural resource issues and mitigation, including sacred sites and NAGPRA issues, are addressed separately in the "Cultural Resources" section in this chapter.

Approximately 60 percent of the land within the Basin is entrusted to the reservation lands of the Navajo and Jicarilla Apache Nations, Southern Ute Indian Tribe, and Ute Mountain Ute Tribe. Winters Doctrine water right settlements in the San Juan River Basin have been negotiated and finalized for the Jicarilla Apache Nation, Ute Mountain Ute, and Southern Ute Indian Tribes. Reserved water rights under the Winters Doctrine for the Navajo Nation have not been quantified or settled; however, the proposed project is considered a cornerstone of a proposed settlement. Existing and future Tribal uses of San Juan River water are shown in table V-5.

A discussion of the affected environment for each Tribe and Tribal allotments follows.

Navajo Nation.—The affected environment for this analysis includes much of the eastern and northern portions of the Navajo Nation (where adequate domestic water service is lacking); the lands within the NIIP service area; lands served along the Hogback, Fruitland-Cambridge, and Cudei irrigation projects; irrigation along the tributaries to the San Juan River; and 43 Navajo chapters (communities) within the proposed project service area discussed previously in chapter II.

The Navajo Indian Reservation was established by treaty in 1868 (15 Stat. 667) and was expanded by Executive orders and statutes between 1868 and 1934. The Navajo Nation lands total approximately 26,897 square miles and extend into New Mexico, Arizona, and Utah. The San Juan River runs through the original 1868 reservation, is a major source of water for Navajo Nation agricultural and domestic use, and is the only water source in the northern portion of the reservation capable of being readily developed. Basin water also is used for Tribal mineral development such as the Navajo mine and production of coal-bed methane. About one-half of all Navajo Nation lands lie within the Basin.

The Navajo Nation claims substantial water rights in the Basin, based on historical use and reserved water rights (Winters Doctrine rights); however, as mentioned previously, the reserved rights have not been ultimately quantified through settlement or litigation. The Navajo Nation claims a priority date of no later than 1849 for its water rights, based on the treaty with the United States in that year (Interior, 2000a), even though the reservation was not established until 1868. Because significant areas of arable Navajo Nation lands lie within the Basin, the Navajo Nation claims a significant amount of the water in the San Juan River. This is based on the practicably irrigable acreage (PIA) standard enunciated in the Supreme Court case of *Arizona* v. *California*. The ultimate amount of the Navajo Nation's water rights in the Basin in Arizona, New Mexico, and Utah, including diversion and use of water from the San Juan River, may depend either on PIA analyses to be prepared by the BIA and litigation of the Nation's claims in water rights adjudications, or on the negotiation of water rights settlements between the Navajo Nation and each of the States. The proposed San Juan River Basin in New Mexico Navajo Nation Water Rights Settlement Agreement would, if approved by Congress, quantify the Navajo Nation's water rights in the Basin with the State of New Mexico. The proposed project is a key component of the proposed water rights settlement.

Only the NIIP, the three San Juan River projects in New Mexico (Hogback, Fruitland, and Cudei), and a small project near Aneth, Utah, would potentially be affected by the

Table V-5.—Summary of major existing and future Tribal uses of Basin water

Description	Diversion (AFY)	Depletion (AFY)	Included in environmental baseline[1] for recent ESA consultations
Existing Uses – Navajo Nation[2]			
NIIP (Blocks 1–8)[3]		149,420	Yes
Hogback Project		12,100	Yes
Cudei Irrigation Project		900	Yes
Fruitland		7,898	Yes
Existing Uses – Navajo Nation (New Mexico State water rights)			
Shiprock Helium Plant (permit 2472)		1,400	Yes
Kerr McGee (uranium processing) (permit 2875)		700	Yes
Kerr McGee (permit 2807)		500	Yes
Navajo Methodist School (Navajo Academy)		139.5	Yes
Existing Uses – Jicarilla Apache Nation			
Decreed for historic and existing uses, 1880 priority date	5,683	2,195	Yes
Small third party water service contracts	770	[4]770	Yes
Evaporation – Stock ponds and reservoirs		2,187	Yes
Existing Uses – Ute Mountain Ute Tribe			
Dolores Project	25,100		N/A[5]
Existing Uses – Southern Ute Indian Tribe			
Water allocated to the Tribe from the Florida River	2,000		Yes
Pine River 181.7 cfs and 1/6 interest in Vallecito Reservoir			Yes
San Juan River, 5.64 cfs direct diversion rights, 1868 priority date	1,014		Yes
Piedra River, 2.0 cfs direct diversion, 1868 priority	600		Yes

Table V-5.—Summary of major existing and future Tribal uses of Basin water (continued)

Description	Diversion (AFY)	Depletion (AFY)	Included in environmental baseline[1] for recent ESA consultations
Future Uses – Navajo Nation[1]			
Navajo Nation Municipal Pipeline (ALP Project)	4,680	2,340	Yes
NIIP (Blocks 9–11)		120,600	Yes
Navajo-Gallup Water Supply Project (includes 7,500 AFY for the city of Gallup)	37,764	[2]35,893	No
Hogback Project restoration		16,420	No
Future Uses – Jicarilla Apache Nation		1,875	No
PNM Third Party Water Service Contract (pursuant to the 1992 Water Rights Settlement Act)	16,200	16,200	Yes
Water Rights Settlement Act of 1992 (from San Juan-Chama Project)	6,500	6,500	Yes
Jicarilla Apache Nation Navajo River Water Supply Project	[6]12,000	6,654	Yes
Water Rights Settlement Act of 1992 (Remaining from Navajo Reservoir or Navajo River)	[6]4,530	1,876	No
Future Uses – Ute Mountain Ute Tribe (see table I-1, ALP FSEIS for details on Colorado Ute Settlement)			
ALP Project		16,525	Yes
San Juan River, 10 cfs direct diversion rights, 1868 priority date	1,600		No
Mancos River direct diversion rights for 7,200 acres, priority date subordinated to 1985	21,000		No
Navajo Wash, 15 cfs direct diversion rights, priority date subordinated to 1985	4,800		No
Tributary groundwater, domestic and livestock wells		1,850	No

Table V-5.—Summary of major existing and future Tribal uses of Basin water (continued)

Description	Diversion (AFY)	Depletion (AFY)	Included in environmental baseline[1] for recent ESA consultations
Future Uses – Southern Ute Indian Tribe (see table I-1, ALP FSEIS, p. 1-6 for details on Colorado Ute Settlement)			
ALP Project		16,525	Yes
Florida River, 6.81 cfs direct diversion rights, priority date subordinated to 1976	1,090		Yes
Florida River, Project water	563		No
Stollsteimer Creek, 1,850 AFY storage, 2 cfs, 3.5 cfs	1,850+		Yes[7]
Piedra River, 8.9 cfs direct diversion, 1868 priority date	995		No
Devil Creek, irrigation of 81 acres	183		No
San Juan River, 2.86 cfs direct diversion rights, 1868 priority date	516		No
Round Meadow Creek, 5.4 cfs direct diversion rights, 1868 priority date	975		No
Cat Creek, 8 cfs direct diversion, 1868 priority date	1,372		No
Tributary groundwater, domestic and livestock wells	2,000		No

Note: Blank spaces indicate information not readily available.

[1] The U.S. Fish and Wildlife Service's biological opinions contain a baseline of depletions that are considered in recent ESA consultations. This table is not the same as the depletion table derived for this planning report and draft environmental impact statement (table V-3).

[2] The Navajo Nation has existing unquantified uses in the Basin that are not listed in the table, including municipal water uses, irrigation on San Juan River tributaries, livestock uses, evaporation from reservoirs, and stock ponds, etc. These uses are included in the baseline table (table V-3).

[3] Includes 16,420 AFY from Hogback and Hogback extension.

[4] This 770 acre-foot depletion is allowed under the 3,000 acre-foot minor depletion account allowed for through ESA (section 7) consultation under the SJRBRIP.

[5] This 25,100 acre-feet is imported from the Dolores River Basin and consumed in the Basin.

[6] The proposed diversion is a variable amount up to 12,000 AFY. The maximum new diversion will depend on the available water in that year. The Nation, as a member of the Hydrology Committee, will introduce for the Hydrology Committee's consideration, a method to calculate available water. The sum of this diversion and the remaining water settlement act water supply will not exceed 16,530 AFY.

[7] 530.6 acre-feet of the storage right and the 2 cfs and the 3.5 cfs are included in the environmental baseline for recent ESA consultations.

proposed project because of the Navajo Depletion Guarantee. While production of irrigation tracts or projects on-reservation remain important to the Navajo Nation, it is not currently economically practicable to construct pipelines and pump San Juan River water to the many irrigation tracts or projects scattered throughout Navajo Nation lands.

The SJRPNM and NIIP Amarillo Alternatives would be compatible with existing and planned future Navajo Nation water development projects as well as the Navajo Nation reserved water rights that have not been quantified. Descriptions follow for several of the largest existing and planned Indian water development projects in the Basin; however, the Navajo Nation's water development interests are not limited to these projects (Navajo Nation, 2000a).

Navajo Indian Irrigation Project.—Navajo Reservoir is the principal water storage facility for the NIIP. P.L. 87-483, enacted in 1962, authorized the Secretary to construct, operate, and maintain the NIIP for the purpose of furnishing irrigation water to approximately 110,630 acres. The NIIP, at the time of project authorization, was anticipated to require an average annual diversion of up to 508,000 AFY. The Agreement between the United States and the Navajo Tribe of Indians for Delivery of Water from Navajo Reservoir, executed in 1976, repeats the authorization language from P.L. 87-483, Section 2. However, the diversion amount of 508,000 AFY was the design diversion amount for flood irrigation of 110,630 acres, a large portion of which were to be located west of Chaco Wash and from Shiprock to the north to Newcomb in the south. The NIIP was later reconfigured to:

(1) Place all the proposed project acreage east of the Chaco River, which greatly reduced the overall canal length and water conveyance losses

(2) Install pressure sprinkler irrigation, which improved irrigation efficiency

(3) Reduce farm delivery operations

It is estimated that the re-designed NIIP will require a diversion, on average, of between 337,500 AFY and 372,000 AFY to irrigate 110,630 acres each year, depending on the implementation and success of planned water conservation measures. Also, actual irrigation diversions could be less depending upon land fallowing and farm management practices.

The NIIP includes a water storage and delivery system, lands, roads, utilities, and other facilities for irrigation of project lands located south of Farmington, New Mexico. The Navajo Agricultural Products Industry (NAPI) is a Navajo Nation business enterprise formed in 1970 to develop, farm, operate, and manage the NIIP lands. Both the NIIP and the NAPI were established to provide a profit and employment to the Navajo people; they currently provide approximately 250 permanent jobs and 800 seasonal jobs.

The NIIP is being developed in 11 separate blocks of approximately 10,000 acres of irrigable land each. Congress began funding NIIP construction in 1963, and the proposed project began operation in 1976 with the first 10,000-acre block. The proposed project was scheduled for completion in 1986, but funding delays postponed completion. In 2002, facilities to deliver irrigation water to about 65,000 acres in Blocks 1 through 8 were complete. The acreage through Block 8 totals about 76,481 acres. Construction on Blocks 9, 10, and 11 was scheduled to be completed by 2012, with full irrigation acreage to be reached in 2032. This schedule may not be met because of limited congressional funding.

San Juan River Irrigation Projects.—These irrigation projects along the San Juan River were initiated between 1900 and 1937. In 2000, these projects provided irrigation water to about 5,300 acres.

(1) The *Hogback Irrigation Project* supplies water for lands on the north side of the San Juan River, from the Hogback, located about 9 miles east of Shiprock, New Mexico, to about 17 miles northwest of Shiprock. In recent years, the acreage irrigated under the Hogback Irrigation Project has ranged from an estimated 2,580 acres to about 2,830 acres. In 1991, 16,420 AFY of depletion of the inactive portions of the Hogback Irrigation Project was applied to the NIIP for ESA consultation purposes. Construction of NIIP Blocks 1 through 8 was to proceed while research on endangered fish recovery took place.

(2) The *Cudei Project* supplies water for lands on the south side of the San Juan River about 6 miles northwest of Shiprock. In recent years, the acreage irrigated under the Cudei Project has ranged from an estimated 290 acres to 390 acres. The Cudei diversion dam was removed in 2002, and supply to the proposed project was provided via a siphon from the Hogback main canal.

(3) The *Fruitland Irrigation Project* diversion dam and headworks are located 2 miles west of Farmington, New Mexico, on the south bank of the San Juan River. In recent years, the acreage irrigated under the Fruitland Irrigation Project, including Cambridge, has ranged from an estimated 1,950 acres to about 2,140 acres. The Cambridge Irrigation Project is supplied by the Fruitland Irrigation Project, and in 2000, about 60 acres were irrigated in the Cambridge Project area.

NNMP.—The NNMP is authorized as a structural component of the ALP Project under the Colorado Ute Indian Water Rights Settlement to augment a 30-year old pipeline that serves almost 60 percent of the current domestic water uses occurring along the San Juan

River between Farmington and Shiprock. The pipeline will deliver 4,680 AFY of water diverted from the Animas River to supply a depletion of 2,340 AFY (Reclamation, 2000a).

Other Navajo Nation ITAs.—In addition to water rights, the Navajo Nation Reservation land uses would be affected by the proposed project. These ITAs include trust lands necessary for the construction and operation and maintenance (O&M) of the proposed project pipelines and associated facilities. The BIA administers these trust lands for the benefit of the Navajo Nation. Other identified Navajo ITAs include the NTUA Shiprock Public Water System, other NTUA public water systems, and the proposed Desert Rock Power Plant. No adverse impacts have been identified to ITAs.

Land uses potentially affected would include homesites, grazing assignments, leases, and transportation corridors administered by the local Navajo chapter and the BIA. The proposed project has the potential to temporarily affect up to 32,686 acres and permanently affect 249 acres of Navajo Nation Trust Lands (assuming an area of disturbance of 500 feet from the centerline on each side of the proposed pipeline project construction, a 100-foot right-of way needed for O&M of the pipeline and placement of permanent project facilities). These impacts are discussed in greater detail in the "Vegetation Resources" and "Land Use" sections of this chapter.

Jicarilla Apache Nation.—The Jicarilla Apache Indian Reservation was created by a series of Executive orders between 1874 and 1908. The reservation covers about 880,000 acres in north-central New Mexico. The reservation lies in both Rio Arriba and Sandoval Counties and includes 137,150 acres of land purchased by the Apache Nation. About 80 percent of the reservation is on the west side of the Continental Divide in the Basin. The western boundary of the reservation is about 15 miles east of Navajo Reservoir. The Navajo River, which is tributary to the San Juan River, is a perennial stream on the reservation. The San Juan-Chama Project[7] diverts approximately 50 percent of the average annual flow of the Navajo River upstream of the Jicarilla Apache Reservation. Downstream from the reservation, Navajo Reservoir impounds the water. The Jicarilla Apache Nation was not included initially as a beneficiary of either of these Federal water resource development projects.

Settlement negotiations between the Jicarilla Apache Nation and the United States began in 1985. Central to the negotiation effort was an updated hydrology study that resulted in the Secretary submitting to Congress a 1988 Hydrologic Determination for the Upper

[7] For a full description of the San Juan-Chama Project, see the "Connected, Cumulative, and Related Actions" section of this chapter.

Colorado River Basin. According to the hydrologic determination, water was available within New Mexico's Upper Basin apportionment for development and settlement of the Jicarilla Apache Nation's Federal reserved water right claims.

In October 1992, the Jicarilla Apache Tribe Water Rights Settlement Act became law (160 Stat. 2237). The water delivery provisions for future uses in the settlement act mandated certain requirements to be fulfilled before water could be made available for Tribal use. All of these requirements were met, and on February 23, 1999, the Jicarilla Apache Nation water rights in the San Juan River were adjudicated in District Court, San Juan County, New Mexico.

As part of the Jicarilla Apache Nation water rights settlement, Congress approved a settlement contract between the Nation and the Secretary to provide for the diversion by the Nation of 33,500 AFY, with a corresponding depletion of 25,500 AFY, from the Navajo Reservoir water supply at or above the reservoir, and to provide for the delivery to the Nation of 6,500 AFY at Heron Reservoir through the San Juan-Chama Project as part of the proposed project's yield. Water to be supplied under the contract with the Secretary is the same priority as the water rights for Navajo Reservoir and the NIIP and must share shortages with other contractors of the Navajo Reservoir supply, including the NIIP. The settlement act also allows the Jicarilla Apache Nation to market its Navajo Reservoir supply and San Juan-Chama Project water through third-party contracts, consistent with Federal and State laws. Consistent with the settlement act, Interior works with the Jicarilla Apache Nation to facilitate use of water pursuant to the settlement contract and subcontracts between the Jicarilla Apache Nation and third parties that have been approved by the Secretary.

Under the partial final decree in the San Juan River adjudication, the Jicarilla Apache Nation has a reserved water right for historic and existing uses not to exceed an annual diversion of 5,683 AFY or the quantity necessary to supply a depletion of 2,195 acre-feet, whichever is less, and a net evaporation of 2,187 acre-feet. These water rights retain a priority date of 1880.

A variety of development options for these water rights is being pursued by the Jicarilla Apache Nation, including third-party water leases and on-reservation water use. The Jicarilla Apache Nation has leased water to several small contractors and to the PNM. In 2006, the PNM third-party subcontract began putting to beneficial consumptive use up to 16,200 AFY of the Jicarilla Apache Nation's Navajo Reservoir supply contract water. The Jicarilla Apache Nation is also pursuing use of its remaining portion of the 25,500 AFY of depletion from the Navajo Reservoir water supply, including possible implementation of the Jicarilla Apache Nation Navajo River Water Supply Project (JANNRWSP) that would result in a consumptive use of up to 6,654 AFY. For this analysis, it was assumed that the Jicarilla Apache Nation would not use its Navajo Reservoir supply contract to implement the JANNRWSP and that the Nation would instead make available 8,530 AFY of depletion from its Navajo Reservoir supply contract water and 170 AFY of depletion from some of its historic use reserved rights that currently are not used to supply the uses of water to be made under the proposed project by both the Jicarilla Apache Nation (1,200 AFY) and the city of Gallup (7,500 AFY). For purposes of this analysis, it is assumed that the JANNRWSP would divert no future use water, 2,020 AFY of depletion of the historical water right would be used for other purposes, and 8,700 acre-feet would be delivered to this project (6,570 acre-feet previously committed to JANNRWSP plus 1,960 acre-feet of additional future use water and 170 acre-feet of other water) to meet the full demands anticipated from the Jicarilla Apache Nation water rights.

Colorado Ute Indian Tribes.—The original Ute Indian Reservations were carved out of the historical Ute homelands in 1868. The present lands of the Ute Mountain Ute and Southern Ute Indian Tribes are in southwestern Colorado and northwestern New Mexico. The Ute Mountain Ute lands include 890 square miles in Colorado and New Mexico. Southern Ute Indian Trust Lands include 470 square miles within the Tribe's 1,250 square miles of checkerboard reservation. Seven rivers in southwestern Colorado flow through the Southern Ute and Ute Mountain Ute Reservations. The Colorado Ute Indian Water Rights Final Settlement Agreement was signed on December 10, 1986, and quantified the Colorado Ute Tribes' water rights in the San Juan and Dolores River Basins in the State of Colorado.

A large portion of the Colorado Ute Indian Water Rights Settlement Act is being implemented by the Ute Mountain Ute Tribe through the participation in the Dolores Project and by the Ute Mountain Ute and Southern Ute Indian Tribes' participating in the ALP Project; however, these two projects do not fully implement the act. The Tribes also have water rights in other rivers that do not involve the Dolores or ALP Projects; they are presently using the other rights or have plans to use them. (Future use water rights granted under the act were provided in table V-5). Collectively, the Colorado Ute Tribes have approximately up to 36,104 acre-feet of future use direct diversion and groundwater that may not be included in the existing ESA baseline. Additional section 7 consultations may be necessary if a Federal nexus exists for the development of these water rights.

Tribal Allotments.—In 1887, Congress passed the General Allotment Act (24 Stat. 388, ch. 119, 25 USCA 331). The allotment act was applied to reservations by the President whenever, in his opinion, it was advantageous for particular Indian Tribes. Members of the selected Tribe or reservation were given permission to select pieces of land—usually around 40 to 160 acres in size—for themselves and their children. If the amount of reservation land exceeded the amount for allotment, the Federal Government could negotiate to purchase the land from the Tribes and then sell it to non-Tribal settlers. Sixty million acres were either ceded outright or sold to non-Indian homesteaders and corporations as "surplus lands." Under the General Allotment Act, Indians had only partial ownership because the United States considered itself to have legal title to the land.

In 1934, the Howard-Wheeler Act, also known as the Indian Reorganization Act (48 Stat. 984), prohibited further allotment of Indian lands; extended periods of trust and restrictions on allotted lands; authorized the Secretary to restore Tribal ownership to the remaining surplus lands of an Indian reservation; prohibited transfers of restricted Indian land, individually owned or otherwise, except to an Indian Tribe; and authorized the acquisition of lands, water rights, surface rights, and interested by the U.S. Government for Indians and declares that purchased lands be tax exempt.

Indian Trust Assets – Methodology

Much of the ITA analysis was based on the review of documents concerning potentially impacted ITAs, with a focus on water rights. These documents include the 1992 Jicarilla Apache Tribe Water Rights Settlement Act; Colorado Ute Indian Water Rights Settlement Act of 1988 (P.L. 100-585), as amended; Secretarial Orders 3175 and 3206; various Interior and Reclamation guidelines and procedures; and available economic development, water development, and natural resource management plans for the Navajo and Jicarilla Apache Nations; Act of June 13, 1962, authorizing the construction and O&M of the NIIP and the initial stage of the San-Juan Chama Project as Colorado River Storage Project (CRSP) participating projects; the 2000 Final Supplement to the Environmental Impact Statement for the ALP Project; and the Navajo Reservoir Operations FEIS (Reclamation, 2006) for Navajo Reservoir Operations. Correspondence between the Tribal Nations and Reclamation concerning ITAs were also reviewed.

In addition, Reclamation held meetings with Tribal representatives to obtain their interpretations and assessments of ITAs that could be affected by the proposed Federal action. The Navajo and Jicarilla Apache Nations and BIA are active members of the project planning report's Steering Committee and are cooperating agencies in the development of this planning report and draft environmental impact statement (PR/DEIS). Information about project issues was obtained from the Navajo Nation's Department of Water Resources, Navajo Fish and Wildlife Department (NFWD), Jicarilla Apache Nation's Water Commission, and the Jicarilla Apache Department of Natural Resources.

Indian Trust Assets – Impacts Analysis

Reclamation sent letters to 18 Tribal governments requesting assistance in identifying potentially affected ITAs. Consultations with potentially affected Indian Tribes are currently under way. Results of these consultations will be incorporated into the final document.

SJRPNM Alternative.—Depletions associated with the SJRPNM Alternative exceed the existing ESA baseline depletions (table V-3). The Navajo Nation developed a Navajo Depletion Guarantee that would keep the proposed project from exceeding the existing ESA baseline and allow the proposed project to use undeveloped water in the existing ESA baseline until developed. With the Navajo Depletion Guarantee, the proposed project meets the critical elements of the Flow Recommendations.

The Navajo Nation depletion of 27,193 AFY would be allocated between New Mexico and Arizona. Water rights settlement negotiations are underway in both New Mexico and Arizona to determine the quantity of water available for the proposed project among other uses. The proposed San Juan River Basin in New Mexico Navajo Nation Water Rights Settlement Agreement would, if approved by Congress, provide the Navajo Nation the right to consumptively use up to 20,782 acre-feet in any year for its uses under the proposed project with the State of New Mexico, and it is anticipated that water rights in Arizona will be made available to permit the Navajo Nation to consumptively use up to 6,411 acre-feet in any year for its uses under the proposed project within the State of Arizona and within the allocations of water made to the State of Arizona by compact or decree. Separate Navajo Reservoir water supply contracts with the Secretary will be needed for the delivery of water from Navajo Reservoir and the San Juan River to the Navajo Nation's project uses in New Mexico and Arizona.

Navajo Nation vegetation and land use resources associated with the SJRPNM Alternative are discussed in greater detail under the appropriate resource.

Easements for pipelines through Tribal allotments would be acquired through the BIA and negotiated on an individual basis.

The 1,200 acre-foot demand for the Jicarilla Apache Nation would be met by delivery of a portion of their 25,500 acre-foot contract allocation from the Navajo Reservoir water supply as a result of the Jicarilla Apache Nation Water Rights Settlement Act and/or a portion of their unused historical rights. Contingent upon successful negotiation of a subcontract between the Jicarilla Apache Nation and the city of Gallup, the 7,500 acre-foot demand for the city would be met from deliveries from the Navajo Reservoir water supply under the Jicarilla Apache Nation water settlement contract. The Secretary would need to approve the subcontract.

The SJRPNM Alternative would use the remaining depletions available according to the Flow Recommendations. Approximately 36,104 acre-feet of future use water may not be included in the existing environmental baseline. Additional depletions over and above the proposed project may result in violations of critical elements of the Flow Recommendations. Tribal water developments that include a Federal nexus would require additional ESA section 7 consultation. The SJRBRIP is intended to serve as the reasonable and prudent alternative (RPA) for actions that may cause jeopardy to the endangered fish. Additional information on the SJRBRIP is provided in chapter I.

NIIP Amarillo Alternative.—Impacts to ITAs under the NIIP Amarillo Alternative would be similar to those described for the SJRPNM Alternative. Vegetation and land use impacts associated with the NIIP Amarillo Alternative are discussed in greater detail under the appropriate resource.

Indian Trust Assets – Mitigation Measures

No mitigation measures are proposed at this time. After consultations with affected Tribes are completed, mitigation measures may be developed and incorporated into the final document.

Indian Trust Assets – Summary of Impacts

The SJRPNM and NIIP Amarillo Alternatives would provide needed domestic water supplies for both the Navajo and Jicarilla Apache Nations. Implementation of these alternatives may make it more difficult for the Colorado Ute Tribes to obtain non-jeopardy biological opinions to develop future use water rights not in the current existing ESA baseline (see table V-3). The SJRBRIP is intended to serve as the RPA to avoid jeopardy for future water development.

Water Quality

This section discusses the potential impacts to water quality that could result from operation of the alternatives considered and associated operation of Navajo Dam and Reservoir.

Issue: How would the No Action and action alternatives affect water quality and the attainment of water quality standards?

Overview

Scope

Navajo Reservoir and the San Juan River to Lake Powell.

Impact Indicators

Exceedences of Federal, State, and Tribal water quality standards were considered an adverse impact.

Water Quality – Affected Environment

The San Juan River is characterized by good water quality when flows are released from Navajo Dam, but water quality progressively degrades downstream due to natural and induced bank erosion, diversions, agricultural and municipal use, and tributary contributions. The State of New Mexico has listed reaches of the San Juan River where water quality does not meet intended uses. Turbidity, fecal coliform, and bottom sediments impact the designated uses of the river most often. Several trace elements (selenium, aluminum, arsenic, mercury, copper, and zinc) have occasionally exceeded State standards from Navajo Dam to Farmington, New Mexico (Reclamation, 2000a).

San Juan River water quality generally declines to Shiprock, New Mexico, with the stretch of the river between Farmington and Shiprock having the highest number of water quality standard exceedences. At the Four Corners gauge/sampling site, water quality improves and the number of exceedences decreases, but water quality declines again from Four Corners to Mexican Hat, Utah (Reclamation, 2000a).

The State of New Mexico has issued fish consumption advisories because of elevated mercury concentrations in fish from Navajo Reservoir and the San Juan River from Hammond diversion to the mouth of the Mancos River.

A number of facilities (city waste water treatment plants and powerplants) have National Pollution Discharge Elimination System (NPDES) discharge permits along the San Juan River. These permits are based on critical low-flow values determined from flow in the river where they discharge.

Previous Water Quality Studies[8].—Studies used in analyzing water quality impacts included extensive water quality studies that have been conducted on the San Juan River and its tributaries within the last 10 years. The U.S. Geological Survey (USGS)

[8] The discussion is a brief summary of the detailed results produced by the studies in question. The summaries are general in nature, and the reports should be read for detailed analysis of the findings.

has conducted studies under Interior's National Irrigation Water Quality Project (Blanchard et al., 1993; Thomas et al., 1998). The SJRBRIP was initiated in October 1991 and has been collecting data on water quality on the San Juan River ever since. In addition, water quality data were collected and analyzed as part of the NIIP environmental studies on the San Juan River main stem as well as on tributaries, seeps, springs, ponds, and wells on the proposed project lands. Table V-6 is a summary of historical water quality data collected on the San Juan River at the USGS gauging stations.

Early USGS investigations (Blanchard et al., 1993) were reconnaissance-level studies to identify whether irrigation drainage (1) has caused or had the potential to cause adverse harmful effects to human health, fish, and wildlife or (2) may adversely affect the suitability of water for other beneficial uses in the Basin. It concluded that selenium was the major trace element of concern in all sampled media (water, bottom sediments, and biota). The USGS performed a detailed study of selenium and selected constituents in water, bottom sediments, soil, and biota associated with irrigation drainage in the San Juan River area (Thomas et al., 1998). Selenium was much less concentrated in water at irrigation-drainage sites and ponds on irrigated land; and least concentrated at irrigation-supply sites, backwater, and San Juan River sites. Other elevated trace elements in water, bottom sediments, soils, or biota included lead, molybdenum, strontium, zinc, vanadium, barium, cadmium, chromium, iron, mercury, and aluminum.

Selenium was much less concentrated in water samples than in bottom sediment, soil, or biota samples. Mean selenium concentrations in water samples were greatest from seeps and tributaries draining irrigated lands. The NIIP biological assessment (BIA, 1999) assessed the impacts from full development of the NIIP. The "Water Quality Impacts Analysis" section concluded that the proposed project will increase arsenic, copper, selenium, and zinc levels in the San Juan River. It was concluded that levels of arsenic and zinc concentrations would be below levels of concern for the two endangered fish species. Conclusions on copper were less certain but are not expected to impact the two endangered fish species.

Selenium received a low hazard potential, but uncertainty about actual levels in biota downstream from the proposed project and chronic toxicity to the razorback sucker leaves the possibility of some impact to the recovery of the species. The Navajo Nation developed water quality regulations in 1999.[9] The predicted arsenic, copper, selenium, and zinc levels in the biological assessment are below the Navajo Nation water quality standards. The predicted dissolved selenium level is 1.9 micrograms per liter (μg/L),

[9] The Navajo Nation water quality standards are awaiting Environmental Protection Agency approval.

Table V-6.—Historical (1950–98) water quality measurements on the San Juan River

	Farmington		Shiprock		Four Corners		Bluff	
Parameter	**n**	**Mean**	**n**	**Mean**	**n**	**Mean**	**n**	**Mean**
Alkalinity total (mg/L as $CaCO_3$)	607	114	646	119	59	121	2,333	147
Aluminum dissolved (µg/L as Al)	34	34.4	138	58.5	40	63.9	174	64.1
Aluminum total (µg/L as Al)	30	5,283	83	15,636	30	11,373	134	20,500
Arsenic dissolved (µg/L as As)	76	1.9	267	2.3	78	1.8	345	1.9
Arsenic total (µg/L as As)	78	2.8	224	4.4	72	3.8	309	4.3
Boron dissolved (µg/L as B)	315	49.5	678	103.9	45	126.0	1,720	68.7
Cadmium dissolved (µg/L as Cd)	11	0.8	71	0.9	15	1.2	56	1.0
Cadmium total (µg/L as Cd)	12	5.7	29	3.6	7	3.7	15	3.7
Calcium dissolved (mg/L as Ca)	859	61.6	1,178	72.4	135	65.6	2,627	93.8
Calcium total (mg/L as Ca)	5	71.5	12	70.8	6	78.8	23	88.8
Chloride total in water (mg/L)	830	9.8	1,084	16.9	104	13.5	2,568	20.6
Chromium dissolved (µg/L as Cr)	4	11.3	53	3.2	4	2.9	48	2.5
Chromium total (µg/L as Cr)	9	51.8	25	22.5	5	17.0	17	52.1
Cobalt dissolved (µg/L as Co)	9	1.5	67	1.4	10	1.6	53	1.5
Cobalt total (µg/L as Co)	13	44.4	29	22.9	7	10.6	21	41.7
Copper dissolved (µg/L as Cu)	45	3.8	165	4.2	48	5.0	203	4.9
Copper total (µg/L as Cu)	45	29.5	121	35.5	42	20.8	163	35.8
Fecal coliform (counts/100 mL)	93	10,588	162	1,040	23	256	72	185
Hardness calc. (mg/L as $CaCO_3$)	859	189	1,154	237	123	222	2589	326
Hardness total (mg/L as $CaCO_3$)	824	189	969	245	45	224	2423	336
Iron dissolved (µg/L as Fe)	164	47.2	251	31.2	42	22.0	69	30.5
Iron total (µg/L as Fe)	15	25,691	39	30,449	13	13,405	201	4,809
Lead dissolved (µg/L as Pb)	67	0.7	256	1.5	70	0.8	343	1.0
Lead total (µg/L as Pb)	79	30.3	222	27.6	71	23.6	305	26.1
Magnesium dissolved (mg/L as Mg)	859	8.4	1,176	13.4	135	14.4	2,628	25.0
Magnesium total (mg/L as Mg)	5	11.9	12	14.0	6	17.4	23	27.1
Manganese dissolved (µg/L as Mn)	26	22.3	110	45.0	30	6.3	86	6.1

Table V-6.—Historical (1950–98) water quality measurements on the San Juan River (continued)

	Farmington		Shiprock		Four Corners		Bluff	
Parameter	**n**	**Mean**	**n**	**Mean**	**n**	**Mean**	**n**	**Mean**
Manganese total (µg/L as Mn)	20	852	56	978	27	449	39	1,109
Mercury dissolved (µg/L as Hg)	70	0.12	254	0.13	75	0.10	338	0.11
Mercury total (µg/L as Hg)	78	0.14	225	0.15	71	0.13	309	0.14
Nickel dissolved (µg/L as Ni)	28	6.1	146	4.6	36	5.2	184	4.6
Nickel total (µg/L as Ni)	28	6.8	105	12.1	39	9.7	144	15.5
Nitrite + nitrate total (mg/L as N)	47	0.27	98	0.39	27	0.74	55	0.78
Oxygen dissolved (mg/L)	251	9.5	455	9.8	159	9.5	478	9.2
pH lab (standard units)	879	7.81	1,097	7.89	107	8.25	1,357	7.78
pH field (standard units)	60	8.13	190	8.26	60	8.25	285	8.20
Phosphorus total (mg/L as P)	59	0.27	164	0.32	31	0.37	95	0.58
Residue total filtrable (dried at 180 °C) (mg/L)	374	382	667	498	102	422	1,313	656
Selenium dissolved (µg/L as Se)	81	0.6	277	1.0	78	1.3	349	1.1
Selenium total (µg/L as Se)	76	0.7	227	0.9	71	1.6	309	1.4
Selenium total recoverable (µg/L as Se)	10	0.5	29	1.0	10	0.9	47	0.8
Silver dissolved (µg/L as Ag)	2	0.75	51	0.56	n/a	n/a	45	0.56
Silver total (µg/L as Ag)	2	0.75	10	1.10	n/a	n/a	9	2.06
Sodium dissolved (mg/L as Na)	836	44.7	951	64.6	112	49.3	2,047	79.2
Sodium total (mg/L as Na)	5	37.7	12	38.5	6	43.8	23	58.2
Solids susp.-residue on evaporation at 180 °C (mg/L)	59	242	191	956	60	663	283	934
Specific conductance (µmhos/cm at 25 °C)	905	550	1136	716	112	644	2,020	931
Sulfate total (mg/L as SO_4)	827	154	1,083	225	104	193	2,568	329
Turbidity (NTU, FTU, JTU)	117	158	142	527	104	406	92	503
Water temperature (°C)	60	10.6	227	12.2	79	12.4	343	12.6
Zinc dissolved (µg/L as Zn)	80	9.2	268	9.2	77	7.8	346	15.7
Zinc total (µg/L as Zn)	75	92.9	224	114.1	71	204.0	306	109.6

Source: Final Supplemental Environmental Impact Statement, Animas-La Plata Project, Technical Appendices, Water Quality Analysis (, 2000a).

while the standard for total selenium is 2.0 μg/L in the San Juan River. The NIIP biological assessment assumed that the minimum release rate from Navajo Reservoir would be 250 cfs in the future.

The SJRBRIP study on environmental contaminants in aquatic plants, invertebrates, and fishes of the San Juan River main stem was completed in 1999. The trace elements evaluated included aluminum, arsenic, copper, selenium, and zinc. Aluminum appeared to be related to sediment geochemistry, and most life forms associated with sediment had elevated levels. Arsenic levels showed no consistent pattern for any river reach or site. Elevated arsenic levels were found in most plants and some invertebrates and fish. Elevated copper levels were found in the trout from upstream coldwater river reaches. Generally, copper concentrations in plants, invertebrates, and fish increased downstream from the coldwater areas. Selenium concentrations were clearly elevated in all biota above ambient background concentrations. Zinc concentrations in plants, invertebrates, and fish below Farmington to the "mixer area" (RM 135)[10] were generally higher than in the rest of the river, and it appears the source may be the Animas River. The study found no consistent correlation between contaminant concentrations and river discharges.

According to the Final Supplemental Environmental Impact Statement (FSEIS), ALP Project (Reclamation, 2000a), a number of water quality standards are periodically exceeded in the San Juan River in New Mexico and Utah, Above Farmington, New Mexico, there are a few historical exceedences in the San Juan River for aluminum, mercury, selenium, cadmium, and lead. The number of exceedences increases between Farmington and Shiprock, New Mexico, including several for copper and zinc. At Four Corners, New Mexico, the number of exceedences decreases and then increases again at Mexican Hat, Utah. According to Utah regulations, there are exceedences in nutrients and total dissolved solids (TDS).

The ALP Project FSEIS also reports that these historic values could be slightly affected by the operation of Navajo Dam for endangered fish and the increase in spring runoff flows will result in improvement of water quality during the runoff period, but the lower flows during the rest of the year will provide less dilution and may impact the water quality of the San Juan River.

Water Quality – Methodology

Impacts were evaluated by the following measures:

[10] The "mixer area" is a suspected Colorado pikeminnow spawning site.

- Researching the existing water quality standards from New Mexico and Utah, and the Navajo Nation and identifying differences among them for reservoir and river segments of the San Juan River
- Researching available water quality reports and assessments to determine possible impacts to the San Juan River from changes in the operation of Navajo Reservoir
- Examining and comparing the hydrologic model output for each alternative to operations described in the Navajo Reservoir Operations FEIS 250/5000 Alternative to determine possible variations in flow from the future operation of Navajo Reservoir
- Evaluating the expected impacts on water quality against the water quality standards

Water Quality Standards.—State and Tribal water quality standards have been developed and applied to the San Juan River from the States of New Mexico and Utah and the Navajo Nation. The States and Tribes have developed numeric and narrative standards for streams, rivers, and lakes within their boundaries. The Ute Mountain Ute Tribe is in the process of developing draft water quality standards and getting approval by the Environmental Protection Agency (EPA). The Navajo Nation adopted water quality standards for their reservation in 1999.

Regulators usually assess impacts to the surface water quality by looking at the exceedences of numeric standards. For the most part, fishery aquatic standards are divided into chronic and acute standards based on exposure time that the aquatic organisms experience. There are also narrative standards that have no numeric values, which regulate some physical attributes (i.e., color, odor, taste of fish, etc.). The chronic standard is often expressed as a 4-day average and the acute standard as a 1-hour average or single sample. Few water quality measurements are done this way. Most data are collected as a single sample and entered into a database as such. Exceedences for this PR/DEIS are based on comparing the single sample result to the chronic and acute standards as was done in the ALP Project FSEIS (Reclamation, 2000a). Violations of the water quality chronic standards are based on exceedences over a period of time (most standards have one violation in 3 years). Some States and Tribes/Tribal Nations allow an average of one violation every 3 years for a long period of record. Acute standards should never be exceeded.

State and Tribal.—States are required under the Clean Water Act (CWA) to report to the EPA on the condition of the streams, rivers, and lakes within their boundaries. One of these reports is a list of impaired (does not meet its intended use) stream or river segments (referred to as a Section 303(d) list). This list generally indicates the water body segment, a probable source of pollutant(s), uses not supported, and specific pollutant(s). The agency must develop a plan to improve the condition of the water body and meet its intended use. The present status of listing is:

- The Tribes are encouraged but not required to report impaired water bodies to the EPA.

- Based on the latest State of New Mexico Section 303(d) listing, the San Juan River designated uses are not supported on the following segments: (1) San Juan River from Canyon Largo to Navajo Dam (turbidity and stream bottom deposits), (2) from Animas River confluence to Canyon Largo (stream bottom sediments and fecal coliform), and (3) from the Navajo Nation boundary at the Hogback to Animas River confluence (stream bottom deposits).

Water Quality – Impacts Analysis

No Action Alternative.—Under the No Action Alternative, spring releases from Navajo Reservoir would be maintained at 5,000 cfs, but releases during the rest of the year could be lowered to 250 cfs. A 250-cfs release from Navajo Reservoir during the irrigation season would probably result in low flows (in the range of approximately 60–150 cfs) from Citizens Ditch (RM 217) diversion to Farmington (RM 181) due to irrigation demands. During the Summer Low Flow Test (Reclamation, 2002), several water quality parameters (temperature, aluminum, fecal coliform, total organic carbon, and conductivity) exceeded the State standards for this reach. Exceedences of water quality standards would probably continue at these lower flows over the long term.

Low releases after the spring runoff under the No Action Alternative would result in possible continued exceedences of water quality standards. If the exceedences occurred more than once in 3 years, a violation of the State or Tribal standards would occur. Short-duration low flow tests indicated some parameters exceeded the State's standards from Navajo Dam to the Animas River confluence.

The New Mexico State Department of Environment is scheduled to complete total maximum daily load (TMDL) studies on several segments of the San Juan River within the next several years. The TMDLs will identify Best Management Practices (BMPs) that might be implemented to reduce nonpoint source pollutant loads into the San Juan

River. BMPs taken to prevent violations of the State water quality standards would improve water quality in the river. Water quality parameter exceedences in the San Juan River from Farmington to Lake Powell would continue, but significant increases in exceedences would probably not occur due to maintenance of the 500 cfs minimum flows in the critical habitat sections.

Under the No Action Alternative, regular springtime snowmelt-runoff period peak releases of up to 5,000 cfs would result in cleaning of the San Juan River channel bottom of substantial amounts of suffocating sediment contributed by erosion of tributary drainages. Scouring of such sediment is periodically necessary to restore and maintain spawning gravel bars for endangered fish species and productive backwaters and side channels used by endangered fish for rearing habitat. Restoring such scouring is to restore the natural, pre-dam function to the river.

SJRPNM Alternative.—Construction of the PNM intake structure, water treatment facility, piping crossing the San Juan River, or other project facilities could temporarily increase the suspended sediment loads in the San Juan River. The implementation of mitigation measures to minimize construction-related impacts is described towards the end of this resource section.

During operation of the proposed project, a few exceedences might continue under the SJRPNM Alternative at the Four Corners and Bluff USGS gauges. Increases in exceedences at Shiprock might occur in fecal coliform, temperature, turbidity, and mercury. The exceedences in mercury probably occur because of the Navajo Nation coldwater habitat water use assigned to the San Juan River.[11] The coldwater habitat standards are lower than the other Navajo Nation water use standards, and other regulatory agencies have the San Juan River designated as a warmwater fishery.

Facilities with NPDES permits above the PNM diversion could benefit from increased flows in the river associated with the proposed project. The facility most affected by the change in flows would be the Bloomfield waste water treatment plant where the critical low flow of approximately 373 cfs is much higher than would occur under the No Action Alternative. During the Summer Low Flow Test, flows in the vicinity of the Bloomfield waste water treatment plant were 130 cfs, significantly lower than the critical low flow loading requirements for the permit. Other facilities with NPDES permits would not be affected on the San Juan River.

[11] Since the detection limit for mercury is higher than the standard, it is unknown if the standard is exceeded, and, for this analysis, it is assumed that the standard is exceeded because it is so low.

Under the SJRPNM Alternative, the critical elements of the Flow Recommendations would be met and regular springtime snowmelt-runoff period peak releases of up to 5,000 cfs would result in cleaning of the San Juan River channel bottom as described in the No Action Alternative.

NIIP Amarillo Alternative.—Potential construction-related impacts associated with the NIIP Amarillo Alternative would be less than the SJRPNM Alternative because all water is delivered through the existing NIIP facilities and there are no new facilities constructed on the San Juan River. Implementation of the proposed mitigation measures described below would reduce construction-related impacts to an insignificant level. Operation of the NIIP Amarillo Alternative would result in no predicted change to water quality when compared to the No Action Alternative because all project water is delivered through the NIIP facilities with no additional releases downstream from Navajo Dam.

Under the NIIP Amarillo Alternative, the critical elements of the Flow Recommendations would also be met and regular springtime snowmelt-runoff period peak releases of up to 5,000 cfs would result in cleaning of the San Juan River channel bottom as described in the No Action Alternative.

Water Quality – Mitigation Measures

The significance of construction-related water quality impacts would be reduced to less than significant through the following measures:

- Reclamation or the contractor would be required to obtain discharge permits from the appropriate regulatory agency. A storm water permit would also be obtained.

- BMPs and construction schedule techniques could be implemented to minimize adverse water quality impacts.

- Measures could be implemented to time construction activities to coincide with periods of low flow, and measures to capture sediment could be employed.

- The duration of placement of fill materials could be minimized to shorten the period of time to reduce the duration of turbidity.

- Temporary cofferdams/berms could be used to contain fine materials and placement of fill material during periods of low flows in the San Juan River.

- The San Juan River pipeline crossing for the SJRPNM Alternative could be directionally drilled to minimize the use of cofferdams.

- Stockpiles of fill materials could be placed above the ordinary high water marks and protected by measures to prevent erosion of those materials into the waters of the United States.

- Silt screens or other appropriate methods could be used in the San Juan River and at intermittent stream crossings to confine suspended particulates and turbidity to small areas where settling or removal could occur.

- Reclamation would comply with applicable New Mexico and Navajo Nation water quality standards. Permits would be obtained as appropriate under sections 401 (water quality certification), 402 (dewatering), and 404 (dredge and fill) of the CWA.

Water Quality – Summary of Impacts

Under the No Action and NIIP Amarillo Alternatives, existing trends of water quality degradation would be expected to continue in the San Juan River below Navajo Dam.

Under the SJRPNM Alternative, increased releases from Navajo Dam would lower concentrations of contaminants in the San Juan River because of dilution; however, these effects may be insignificant and difficult to measure. The NPDES Bloomfield waste water treatment plant above the PNM diversion could also benefit from increased flows in the river associated with the proposed project.

Vegetation Resources

This section discusses the potential impacts to vegetation resources that could result from actions associated with the No Action Alternative and the action alternatives considered.

Issue: How will the No Action Alternative and action alternatives affect upland and riparian vegetation resources?

Overview

Scope

The analysis includes vegetation resources associated with Navajo Reservoir, the San Juan River from Navajo Dam to Lake Powell, and all vegetation within 500 feet of the proposed pipeline alignments under the action alternatives. Areas of vegetation to be removed for the placement of permanent project features are specifically noted. Protected plant species (Federal and Navajo listed species) are discussed in the "Special Status Species" section of this chapter.

Impact Indicators

Defined standards, determined by government regulatory agencies and accepted professional opinion, provide the necessary criteria to assess potential impact significance on vegetation resources for the proposed project. In accordance with these standards, potential outcomes in this analysis were considered significant if they resulted in the following:

(1) Substantial reduction in the cover of native vegetation or native plant species

(2) A change in the diversity of plant species or the introduction of new species

For specifically determining the effects of the proposed project on wetlands and riparian vegetation, outcomes were considered significant if they resulted in:

(1) Conversion of wetland/riparian vegetation to upland vegetation

(2) A net loss of wetland or riparian vegetation

Vegetation Resources – Affected Environment

Vegetation Classifications.—This section describes vegetation resource communities potentially affected by the proposed project. The project area consists of semiarid terrain with an average annual precipitation of 6 to 11 inches (U.S. Department of Commerce, 1965, 1976). Vegetation is sparse in areas, and soils are often rocky. Three separate vegetation surveys have been conducted along portions of the proposed pipeline routes (Gallup Environmental Assessment completed in 1981, the NIIP Plant Survey completed in May 1991, and an Ecosystem Research Institute [ESRI] field survey [2003a] completed in 2000 and 2002). Vegetation communities within the project area are shown in figure V-3. Eleven of the 20 vegetation classification types occur within

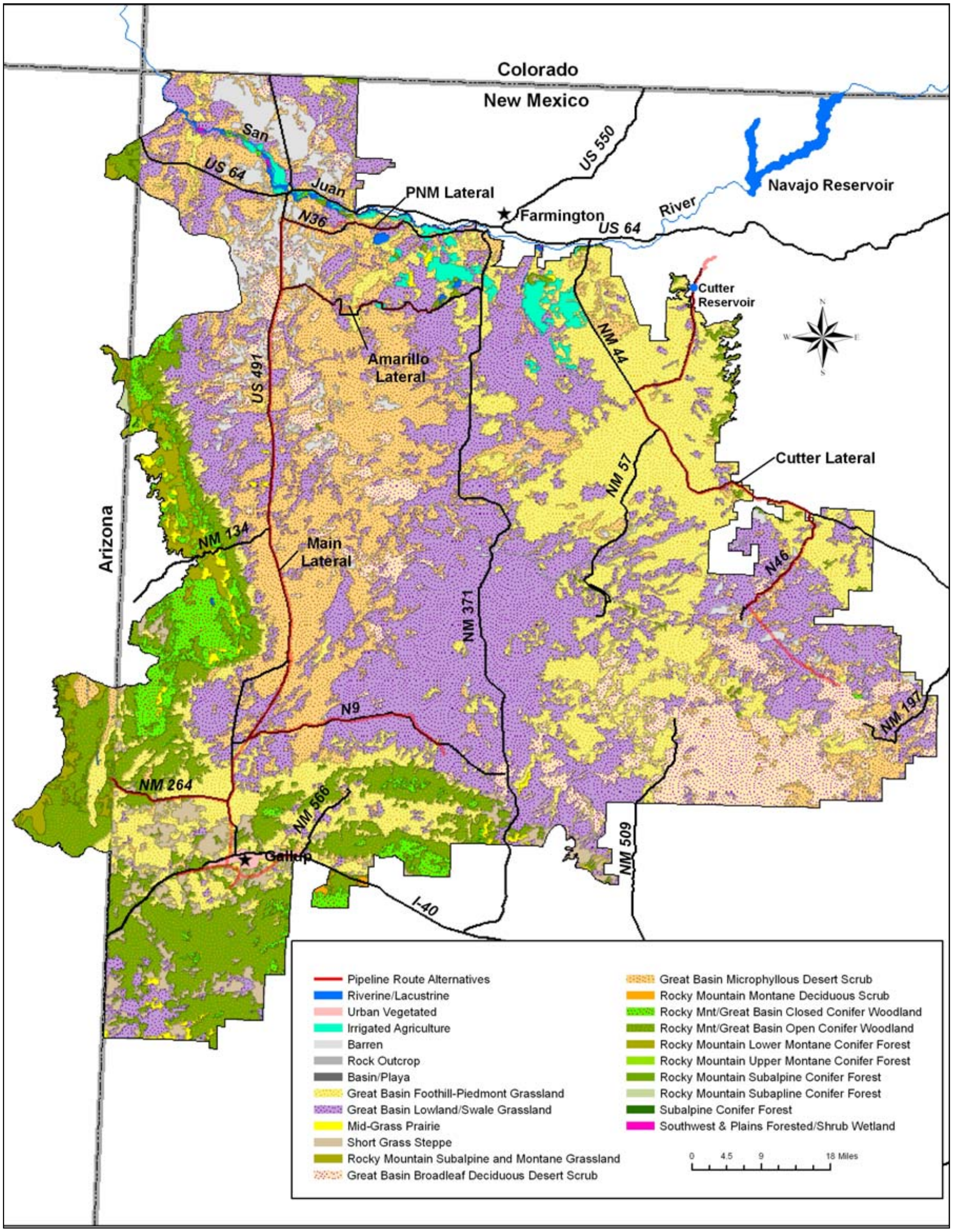

Figure V-3.—Gap Analysis vegetation classification within the project service area.

the pipeline corridors and are described in greater detail in attachment H. This attachment contains a list of plant species found in the proposed project vicinity.

Riparian.—Riparian shrub communities were not included as a separate category with the geographic information system (GIS) analysis and are described here for the San Juan River downstream of Navajo Dam. Six types of riparian cover are recognized along the San Juan River, including Russian olive/tamarisk stands, willow thickets, riparian shrub habitat, riparian grass and forb habitat, and emergent wetlands (Reclamation, 2000). Since the impoundment of the San Juan River by Navajo Dam, flooding has decreased, and dense shrub thickets have become more common. Introduced Russian olive and tamarisk are dominant species within 98 feet of the San Juan River (37 and 30 percent of total vegetation, respectively) (Bliesner and Lamarra, 2000). Fremont cottonwood (P*opulus fremontii*) occurs infrequently (7 percent) and reaches its highest density above RM 155. Native willows are common below RM 130. These riparian areas support a greater diversity of both vegetation and wildlife than the surrounding upland areas.

Wetlands.—The U.S. Army Corps of Engineers (Federal Register, 1982) and the EPA (Federal Register, 1980) jointly define wetlands as those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. Wetlands within the proposed project area are generally associated with the San Juan River, Cutter Reservoir, intermittent streams and arroyos, or irrigation.

Special Status Plants.—Plant species of concern include two federally endangered and two federally threatened species as well as seven Federal species of concern. The Navajo Nation considers 13 plants as endangered. Plant species of concern are discussed within the "Special Status Species" section of this chapter.

Vegetation Resources – Methodology

This section describes the methods used to measure the effects of the No Action, SJRPNM, and NIIP Amarillo Alternatives. The significance of such effects is evaluated based on the impact indicators outlined in the overview.

Twenty vegetation classifications were identified by the New Mexico Natural Heritage Program (NMNHP) and Arizona Natural Heritage Program within the proposed project area (attachment H). The GIS was used to quantify each of the habitat classification types within 500 feet of the SJRPNM and NIIP Amarillo pipeline routes. The Gap Analysis[12] data have a 98-foot resolution, such that areas of habitat smaller than 98 feet may not be included in this analysis.

Specific vegetation classifications developed by the NMNHP (Muldavin et al., 1996) were used to classify vegetation within the 500 feet of the proposed pipeline routes. Gap Analysis data were used to quantify plant communities in accordance with the NMNHP classifications. The 1,000-foot pipeline corridor represents the areas of vegetation potentially disturbed during placement of the pipeline and accessory features. The estimate is conservative, and in most cases, a smaller area of vegetation will be affected.

Design drawings were used to enumerate the area of vegetation permanently removed for water development structures and to consider the extent and location of vegetation (volume II, appendix B). The same methods were used to evaluate project effects on wetland and riparian vegetation. Site visits were used to describe the general nature of riparian vegetation.

Wetland delineations were conducted to identify and describe wetlands that may be affected during construction of the action alternatives. Potentially affected wetlands were identified and mapped to provide pertinent information to determine jurisdictional and permitting requirements under section 404 of the CWA. Wetland delineations targeted the north side of the San Juan River immediately east of the PNM diversion dam and the outlet and base of Cutter Dam (ESRI, 2005).

Vegetation Resources – Impacts Analysis

This section describes the effects of the No Action, SJRPNM, and NIIP Alternatives on vegetation within the proposed project area. Mitigation measures are described and the net effects of each alternative, following mitigation, are evaluated. The significance of each effect is determined based on the impact indicators presented in the overview.

No Action Alternative.—Water conservation may alter urban landscaping and agricultural uses, and changes in irrigation water use could reduce wetlands associated with irrigation.

SJRPNM Alternative.—Under the SJRPNM Alternative, up to 31,686 acres of vegetation may be temporarily disturbed (table V-7) during construction of project facilities. The

[12] A comparison of the distribution of elements of biodiversity with that of areas managed for their long-term viability to identify elements with inadequate representation.

Table V-7.—Acres of affected vegetation within the proposed project area

Vegetation classification type	Total project area	Affected by SJRPNM Alternative		Affected by NIIP Amarillo Alternative	
	Acres	Acres	Percent	Acres	Percent
Barren	156,356	761	0.0049	7,560	0.0048
Great Basin broadleaf deciduous desert scrub	466,412	1,270	0.0027	1,399	0.0030
Great Basin foothill-piedmont grassland	1,124,489	10,507	0.0093	10,586	0.0094
Great Basin lowland swale grassland	1,481,846	8,290	0.0056	8,518	0.0057
Great Basin microphyllous desert scrub	852,050	7,477	0.0088	8,518	0.0100
Irrigated agriculture	50,926	124	0.0024	109	0.0021
Riverine/lacustrine	10,037	42	0.0042	0	0
Rocky Mountain/Great Basin open conifer woodland	527,845	1,371	0.0026	1,371	0.0026
Rocky Mountain montane deciduous scrub	3,148	121	0.0384	121	0.0384
Short grass steppe	124,028	1,065	0.0086	1,065	0.0086
Urban vegetated	8,827	657	0.0744	657	0.0744
Total acres of vegetation classified within the proposed project area	4,668,243	31,686	0.0063	31,841	0.0063

largest components of vegetation include 10,057 acres of Great Basin foothill-piedmont grassland, 8,290 acres of Great Basin lowland/swale grassland, and 7,477 acres of Great Basin microphyllous desert scrub. Impacts to vegetation would be less than 0.01 percent for each of the 12 vegetation classification types affected.

Up to 43 acres of vegetation would be removed for placement of a river pumping plant, 2 water treatment facilities, 17 forebay tanks and pumping plants, 4 regulating tanks, and 20 community storage tanks. Twenty-six acres of vegetation removed for placement of permanent project features would be native upland vegetation.

Seventeen acres of exotic riparian vegetation occur within 500 feet of the proposed alignment. Riparian vegetation in this area is composed primarily of Russian olive and tamarisk (ESRI, 2002). A limited amount of this vegetation may be disturbed during construction. The SJRPNM Alternative would remove 18 acres of vegetation in the immediate vicinity of the San Juan River for pumping and water treatment facilities. A small area (0.09 acre) of non-native shrub cover would be removed to place the pump. The remaining acres are fallow agricultural land and would be removed for the water treatment facilities. However, releases made from Navajo Reservoir to meet project demands may help maintain existing riparian vegetation downstream of Navajo Dam to the PNM diversion structure.

Wetland delineations identified three separate wetlands within the San Juan River site: (1) 12.86 acres of palustrine shrub-scrub wetland, (2) 11.39 acres of persistent emergent palustrine wetland, and (3) 1.54 acres of persistent, palustrine emergent wetland. In addition, wetland delineations below Cutter Dam identified two persistent, palustrine emergent wetlands totaling 0.51 acre. Under the SJRPNM Alternative, 3.6 acres would be temporarily disturbed and 1.1 acres of palustrine wetlands would be permanently removed during the construction of project features. Wetlands permanently removed include 1.0 acre along the San Juan River and 0.1 acre below Cutter Dam.

Other waters of the United States that are protected under the CWA occur within and adjacent to the proposed project boundaries. These include the San Juan River and Cutter Reservoir adjacent to the wetland sites discussed above. Potential jurisdictional wetlands and/or other waters of the United States associated with crossing of intermittent streams may occur along the proposed SJRPNM Alternative's pipeline route. The boundaries of these sites will be determined based on the presence of wetland vegetation, the ordinary high water mark as distinguished by a lack of terrestrial vegetation, and/or the accumulation of litter and debris on the shore.

Mitigation measures described below could reduce impacts associated with pipeline construction and replace riparian and wetland habitats lost or impacted during the construction of project facilities.

NIIP Amarillo Alternative.—Under the NIIP Amarillo Alternative, up to 31,484 acres of vegetation may be disturbed. The largest component of vegetation includes 10,586 acres of Great Basin foothill-piedmont grassland, 8,518 acres of Great Basin lowland/swale grassland, and 7,260 acres of Great Basin microphyllous desert scrub (see table V-7). Impacts to vegetation would be less than 0.01 percent for each of the 12 vegetation classification types affected. In addition, a total of 249 acres of vegetation would be removed for placement of 2 water treatment facilities, 17 forebay tanks and pumping plants, 6 regulating tanks, 20 community storage tanks, and one 226-acre holding pond.

No riparian cover types were detected within one-half mile of the proposed NIIP Amarillo alignment; therefore, the NIIP Amarillo alignment is predicted to have no effect on existing riparian vegetation. There would be no benefit to riparian habitat downstream of Navajo Reservoir as described in the SJRPNM Alternative because all project demands would be delivered through the existing NIIP system with no additional releases downstream of Navajo Dam.

Wetland impacts would be limited to 0.1 acre permanently removed for project facilities below Cutter Dam. Other waters of the United States that are protected under the CWA occur within and adjacent to the proposed project boundaries, including Cutter Reservoir adjacent to the wetland sites discussed above. Potential jurisdictional wetlands and/or other waters of the United States associated with crossing of intermittent streams may occur along the proposed NIIP Amarillo Alternative's pipeline route. The boundaries of these sites will be determined based on the presence of wetland vegetation, the ordinary high water mark as distinguished by a lack of terrestrial vegetation, and/or the accumulation of litter and debris on the shore.

Mitigation measures would be similar to those described under the SJRPNM Alternative.

Vegetation Resources – Mitigation Measures

General mitigation procedures could include:

Upland Sites

- Use accepted erosion control measures during construction
- Minimize pipeline and accessory components' footprints
- Seed disturbed areas with a mixture of local-source, native grasses
- Supplement grass seeding with native shrub seeds in areas where shrub cover is diminished due to pipeline disturbance
- Monitor plantings to ensure establishment of native cover equivalent to pre-construction disturbance levels
- Control noxious weeds in disturbed areas (i.e., herbicide applications)

Riparian and Wetland Sites

- Re-plant disturbed areas with native riparian/wetland shrubs, including coyote willow (*Salix exigua*) immediately following construction
- Clear tamarisk and Russian olive within 300 feet of project features and re-plant such areas with native riparian shrubs
- Monitor plantings to ensure establishment of native cover equivalent to pre-construction disturbance levels

- Replace removed riparian and wetland habitat with creation of acre-per-acre replacement or the enhancement of 3 acres for each acre lost. The CWA has statutory requirements that require mitigation for impacts to jurisdictional wetlands. In addition, Executive Order 11990 requires Federal agencies to "*. . .take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities for (1) acquiring, managing, and disposing of Federal lands and facilities; (2) providing federally undertaken, financed, or assisted construction and improvements; and (3) conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities."*

Vegetation Resources – Summary of Impacts

Under the No Action Alternative, water conservation may alter urban landscaping and agricultural uses, and changes in irrigation water use could reduce wetlands associated with irrigation.

Construction of the SJRPNM Alternative would temporarily remove up to 31,686 acres of vegetation for pipeline construction assuming up to a 500-foot disturbance area on either side of the pipeline. Of the vegetation temporarily removed, 17 acres of exotic Russian olive and tamarisk would be replaced with native riparian vegetation within the San Juan River corridor. In addition, 3.6 acres of wetlands within the San Juan River corridor would be temporarily impacted during pipeline construction. Native grasses and shrubs comprise the largest vegetation resource affected.

Approximately 43 acres would be permanently removed for project features under the SJRPNM Alternative, including 0.09 acre of riparian shrub vegetation and 1.1 acres of wetland vegetation. Re-vegetation and restoration of upland areas and habitat enhancement in riparian zones would minimize project effects.

Construction of the NIIP Amarillo Alternative would disturb up to 31,841 acres of vegetation. In addition, 249 acres would be permanently removed for project features, including 1.1 acres of wetland vegetation. Riparian vegetation would not be impacted during construction activities.

Implementation of mitigation measures to re-vegetate and restore upland areas, enhance habitat in riparian zones, and provide compensatory wetland mitigation as proposed would minimize project effects.

Wildlife Resources

This section addresses the present status of and project-related impacts to wildlife resources in the proposed project area.

Issue: How would the No Action, SJRPNM, and NIIP Amarillo Alternatives affect wildlife resources?

Overview

Scope

The scope of this analysis includes terrestrial wildlife resources found within one-half mile of the SJRPNM and NIIP Amarillo proposed pipeline alignments and all wildlife habitat found within 500 feet of these alignments. Fisheries and aquatic wildlife are discussed in the “Aquatic Resources” section of this chapter. Federal and Navajo Nation listed and candidate species are discussed in the “Special Status Species” section of this chapter.

Impact Indicators

Defined standards, determined by government regulatory agencies and accepted professional opinion, provide the necessary criteria to assess potential impact significance on aquatic resources for the proposed project. In accordance with these standards, potential outcomes in this analysis were considered significant if they resulted in the following:

(1) Substantially diminished habitat for wildlife

(2) A deterioration of existing wildlife habitat

(3) A permanent loss of key wildlife habitat (e.g., wintering grounds, wetlands)

(4) Disturbance to wildlife key critical stages (e.g., nesting, breeding)

Wildlife Resources – Affected Environment

This section describes wildlife habitat and common wildlife species that may be affected by the SJRPNM and NIIP Amarillo Alternatives. Descriptions include common wildlife and habitat within 500 feet of the proposed pipeline alignments. Federal and Navajo Nation threatened, endangered, candidate, and species of concern are discussed in the “Special Status Species” section of this chapter.

Wildlife Habitat.—Wildlife habitat can be broken into three main categories in the proposed project area: (1) bottomland riparian/wetland habitat, (2) irrigated agriculture and urban habitat, and (3) arid upland habitat. Wildlife investigations conducted in 1983 (Reclamation, 1983) within a portion of the proposed project area and Gap Analysis data show that habitat within the 1983 study area and the proposed project area are proportioned similarly. A list of wildlife species and habitat associations that may occur in the proposed project area is presented in attachment I.

Bottomland, riparian, and wetland habitat within the proposed project area include the San Juan River and Chaco Rivers and numerous arroyos. Both cover and forage are provided by this habitat for the following:

- Nine of the 11 amphibian species found in the area depend on this habitat.

- Fifteen of the 34 reptile species found in the proposed project area use bottomlands, and 3 use these habitat types exclusively (Reclamation, 1983).

- A broad variety of birds use riparian habitat as wintering, resting, and nesting areas (these bottomland areas are considered essential to maintaining avian diversity in the area).

- Large and small mammals and reptiles also rely on these types of habitat. Over one-half of the 84 mammals found in the proposed project area use riparian/wetland habitat (Reclamation, 1983).

Irrigated agriculture and urban habitat provide important wildlife habitat in the arid project landscape. These habitat types are located along the San Juan River corridor as well as in and around the NIIP near Farmington, New Mexico. The interspersion of crops, fencerows, ditchbanks, orchards, and plentiful water create high-value wildlife habitat. The highest abundance of birds in the proposed project area is found within agricultural fencerow habitat. Large and small mammals, birds, amphibians, and reptiles use these habitat types.

Vegetation and associated wildlife are sparse within the upland habitat due to low precipitation and extensive grazing. According to a 1981 report by the U.S. Fish and Wildlife Service (Service), "In certain areas there is virtually no vegetation. Most of these lands are open to livestock grazing, primarily sheep. The heavy grazing pressure along with the lack of regular water supply greatly limits both the plant and wildlife diversity." Of 105 avian species commonly found in the proposed project area, 43 were associated with upland grass habitat (Reclamation, 1983). Of the 50 mammal species using upland habitat, 4 were exclusively associated with arid shrub/grassland habitat. Amphibians and reptiles show the same trend, with 5 species linked to grassland/shrub communities out of the 45 species potentially present in the proposed project area.

Common Wildlife Species.—Eighty-four mammal, 11 amphibian, 34 reptile, and 150 avian species have been recorded within habitat types that occur within the proposed project area (attachment H; Reclamation, 1983). Recent information on wildlife in the proposed project vicinity is limited to censuses of elk and mule deer. Mid-winter 2002 aerial surveys of State lands in Game Management Unit 7 adjacent to the Navajo Nation estimate four elk per square mile and fewer than one mule deer per square mile in (the western and central portion) of the proposed project. Estimates in Game Management Unit 2B (northeastern portion of San Juan County, New Mexico) include approximately 5,100 deer and 1,350 elk (ESRI, 2003a).

San Juan and McKinley Counties in New Mexico exhibit relatively high trapping rates for fur-bearing mammals including coyote, gray fox, bobcat, red fox, kit fox, badger, raccoon, ringtail, spotted skunk, striped skunk, weasel, muskrat, and beaver. Trapping records show a declining trend for kit fox and muskrat and an increasing trend for bobcat (New Mexico Department of Game and Fish [NMDGF], 2000).

Common species observed during field surveys included Gunnison's prairie dog, kangaroo rat, deer mice, chipmunk, coyote, badger, bobcat, red-tailed hawk, ferruginous hawk, packrat, red fox, and golden eagle (ESRI, 2002). Ferruginous hawk and golden eagle are Navajo Nation listed species and discussed in greater detail in the "Special Status Species" section of this chapter.

Wildlife Resources – Methodology

This section describes the methods used to measure the effects of the SJRPNM and NIIP Amarillo Alternatives relative to the No Action Alternative. The significance of such effects is evaluated based on the impact indicators outline in the overview. Reports from the NMDGF, Navajo Department of Fish and Wildlife, the Service, Bureau of Land Management (BLM), and Reclamation were reviewed to compile a description of wildlife in the proposed project area. In addition, field surveys were conducted on approximately 290 miles of the proposed pipeline alignments. The route was walked in increments along the centerline and wildlife observations made to both sides. Binoculars and close visual inspections were used throughout the survey. Sandstone cliffs, large trees, and utility structures within one-quarter mile of the proposed routes were visually inspected for raptor nests, and perching and roosting sites. Both direct sightings and indirect evidence (tracks, droppings, burrows, and others) were used to document wildlife presence in the proposed project area (ESRI, 2003a).

Wildlife Resources – Impacts Analysis

This section describes the effects of the No Action, SJRPNM, and NIIP Amarillo Alternatives on wildlife within the proposed project area. Implementation of the

SJRPNM or NIIP Amarillo Alternatives would alter or remove areas of wildlife habitat. In addition, construction activities might disturb animals using the proposed project area. Maintenance of project facilities might create long-term disturbance, and powerlines associated with pumping plants and project facilities might pose a hazard to raptors and other birds.

No Action Alternative.—The No Action Alternative would have no effect on wildlife habitat or wildlife resources within the proposed project area. The proposed project would not be constructed and no ground-disturbing activities would impact wildlife habitat or wildlife resources.

SJRPNM Alternative.—Temporary disturbance during construction may be the largest impact to wildlife under the SJRPNM Alternative. Because many desert species are nocturnal, direct interaction may not occur. However, small mammal and reptile burrows may be disturbed and their occupants dispersed during construction. Interference during the nesting season may cause nest failures for birds along the pipeline routes. Long-term disturbance to wildlife from maintenance activities would be minimal because the pipeline route mainly follows existing roads. Therefore, wildlife should be habituated to human presence in these areas.

The SJRPNM Alternative would temporarily disturb up to 31,686 acres of wildlife habitat. Key habitat within this alignment includes: (1) potential raptor nesting along the Defiance Monocline near Window Rock, Arizona; (2) raptor nesting along the Nutria Monocline northeast of Gallup, New Mexico; (3) raptor hunting areas southwest of Nageezi, New Mexico, and east of Sheep Springs, New Mexico; (4) riparian vegetation and wetlands along the San Juan River; and (5) raptor nesting areas in Blanco and Cutter Canyons.

Because project construction is proposed in phases (possibly a 10-year period or more) and the pipeline corridors are proposed to be re-vegetated concurrently with construction, wildlife habitat loss would be minimal. Key habitat that would temporarily be removed during pipeline construction consists of 17 acres of riparian habitat and 3.6 acres of wetlands. In addition, 3.26 acres of raptor cliff nesting habitat may be impacted. The riparian habitat, composed primarily of exotic Russian olive and tamarisk, could be re-vegetated with native riparian species. Following vegetation restoration, increased riparian wildlife habitat value is anticipated.

Other project features would permanently displace approximately 43 acres of habitat and result in the loss of 1.19 acres within key wildlife habitat. Construction of the water treatment facility and river pump along the San Juan River would result in the permanent loss of 1.9 acres of key habitat (0.09 acre of riparian shrub and 1.0 acre of wetland habitat). An additional 0.1 acres of wetlands would be permanently removed for construction of the Cutter water treatment plant.

Power transmission lines and substations pose an additional threat to birds in the proposed project area. Hazards associated with powerlines include the risk of electrocution to perching raptors and a risk of avian collision. The SJRPNM Alternative includes approximately 107 miles of transmission line. The barren nature of the proposed project area creates a relatively high electrocution risk to raptors, as they may select utility structures from which to perch and hunt. Electrocution occurs when two or more conductors are contacted simultaneously. Thus, large-winged raptors are at greater risk than smaller birds (Bevanger, 1994).

Project effects on small mammals and reptiles would be temporary, but should not be significant because the effects would be temporary, and suitable habitat is available outside disturbed areas. Large, mobile animals may avoid areas during construction, but these impacts would be temporary.

San Juan River habitat is used for both nesting and migration for many bird species. Restricting San Juan River pipeline crossing construction activities to low flow periods would provide adequate protection to nesting birds along the San Juan River. Adjacent areas for project facilities (siltation ponds and pumping plants) would occur in disturbed areas with non-native vegetation. In addition, these features would be adjacent to the PNM diversion dam and near the highway where existing wildlife have become habituated to these disturbances. Construction and maintenance activities along river habitat may disturb wildlife during critical periods; however, this is not considered a significant impact.

Implementation of proposed mitigation measures would minimize or avoid impacts to wildlife.

NIIP Amarillo Alternative.—The NIIP Amarillo Alternative would temporarily disturb up to 31,841 acres of wildlife habitat. Project structures would permanently displace up to 249 acres of upland habitat. In addition, 0.1 acre of wetlands considered to be a key wildlife habitat would be removed.

Under the NIIP Amarillo Alternative, no riparian habitats would be affected. Other disturbances to wildlife would be similar to those caused by the SJRPNM Alternative; however, additional upland habitat would be inundated for the storage reservoir.

Implementation of proposed mitigation measures would minimize or avoid impacts to wildlife.

Wildlife Resources – Mitigation Measures

The following proposed mitigation measures would minimize project effects on wildlife. Habitat disturbance caused by the placement of pipeline would be temporary because of the restoration planned for disturbed vegetation.

- To minimize disturbance of raptors, activities along the Nutria and Defiance Monoclines, Cutter Canyon, Blanco Canyon, and the corridor from Cutter to Largo Canyons could be restricted during the nesting season (January 15 to July 15). If that is not possible, extensive nest searches could be made up to three-quarters of a mile of proposed activities immediately prior to construction and active nests avoided. Raptor perch guards or raptor-safe configurations could be incorporated for all transmission structures.

- Transmission lines that pose a high collision risk could be marked with spiral vibration dampers or bird flight diverters.

- To comply with the Migratory Bird Treaty Act, removal of riparian and wetland vegetation that has the potential to impact nesting birds or active nests would be restricted from March 15 to August 15.

- Construction of the pipeline river crossing could be restricted to low water periods to minimize construction dewatering costs and to reduce potential risks of flooding. This restriction would prevent construction within the San Juan River during the normal nesting season for most migratory bird species that occur along the San Juan River.

- Trenching and burying pipeline concurrently could be implemented to minimize trapping of small wildlife. Escape ramps could also be built for trenches left open overnight.

- The mitigation measures proposed in the "Vegetation Resources" section of this chapter could also minimize impacts to wildlife.

Wildlife Resources – Summary of Impacts

Temporary disturbance during construction would be the largest impact to wildlife under the action alternatives. The alternatives could temporarily disturb large areas of wildlife habitat (31,686 acres,—SJRPNM and 31,841 acres—NIIP Amarillo) during pipeline construction. Construction of project facilities would result in the permanent loss of wildlife habitat (43 acres—SJRPNM and 249 acres—NIIP Amarillo). Temporary impacts to key habitat would occur under both alternatives (23.86 acres—SJRPNM and 3.26 acres—NIIP Amarillo). Permanent loss of key habitats would occur under both alternatives (1.19 acres—SJRPNM and 0.1 acre—NIIP Amarillo).

Both action alternatives would construct 19.2 miles of pipeline through raptor cliff nesting habitat and could temporarily affect 3.26 acres within raptor cliff nesting habitat. The 19.2 acres of transmission line also may pose an avian collision risk. Implementation of proposed mitigation measures could minimize or avoid impacts to wildlife and wildlife habitat.

Aquatic Resources

This section addresses the present status of and project-related impacts to aquatic resources in the proposed project area, including fish inhabiting both Navajo Reservoir and those downstream of the dam in the San Juan River to Lake Powell.

Issue: How do changes in reservoir levels affect the reservoir fishery, and how do changes in flow regimes affect the downstream aquatic ecosystem?

Overview

Scope

Non-native (game and nongame fish) and native fish and other aquatic wildlife in both Navajo Reservoir and in the San Juan River from Navajo Dam to Lake Powell. Threatened and endangered species are discussed in the "Special Status Species" section of this chapter.

Impact Indicators

Potential outcomes in this analysis were considered significant if they resulted in:

(1) Adverse effects on hydrology in the San Juan River

(2) An undesirable change in the composition of the native fish community.

(3) Deterioration of trout habitat from Navajo Dam to Blanco, New Mexico

(4) An undesirable change in the composition of the Navajo Reservoir fish community.

Aquatic Resources – Affected Environment

This section describes fish, amphibians, and macroinvertebrates associated with Navajo Reservoir and the San Juan River downstream of Navajo Dam. Characteristics of the river environment are included. Table V-8 shows the fisheries resources that occur in Navajo Reservoir and the San Juan River from Navajo Dam downstream to Lake Powell.

Navajo Reservoir.—Navajo Reservoir began filling in 1963 with the completion of Navajo Dam. The reservoir extends 35 miles up the San Juan River, 13 miles up the Pine River, and 4 miles up the Piedra River. It has a maximum surface area of 15,610 acres and a storage capacity of 1,709,000 acre-feet (Reclamation, 2006). Releases from the reservoir maintain target flow levels for endangered fish in the San Juan River and support a tailwater trout fishery. In addition, the reservoir provides recreation opportunities, including angling for northern pike, catfish, smallmouth bass, rainbow trout, and kokanee salmon (Reclamation, 2006).

San Juan River.—The San Juan River originates in the San Juan Mountains of southwestern Colorado. Its course extends south into New Mexico and then turns west to its confluence with Lake Powell in Utah. Along its 354-mile length, the San Juan River drains 38,300 square miles in Colorado, Arizona, New Mexico, and Utah. Since the closure of Glen Canyon Dam, the lower 54 miles of the San Juan River have been inundated by Lake Powell. Currently, there are 223 miles of river between Navajo Dam and Lake Powell.

Prior to the completion of Navajo Dam, the San Juan River showed an extremely variable hydrograph characterized by peak spring flows associated with snowmelt and by low summer and winter base flows; late summer and fall storms caused dramatic spikes in flow. Over the period of record (1929–61), unregulated median daily peak flows averaged 10,500 cfs at Bluff, Utah (range 3,810–33,800 cfs) during spring runoff, and 73 percent of yearly flows occurred between March 1 and July 31 (Bliesner and Lamarra, 2000). Although spring flows accounted for the majority of discharge, storms often created spikes in the hydrograph larger than those recorded during spring runoff. Such short-duration peaks moved sediment and restructured habitat. In contrast to a maximum daily flow of 42,500 cfs, base flows often approached zero prior to regulation by Navajo Dam. Regulated flows dropped below 50 cfs during 29 percent of the years studied (Bliesner and Lamarra, 2000). Flash flooding from tributaries and erodible soils along the river created high sediment loads. Thus, native vertebrate and invertebrate species within the San Juan River are adapted to high-velocity, turbid conditions.

Table V-8.—Fishes documented in the Basin

Common name	Scientific name	Documented occurrence	
		Navajo Reservoir	San Juan River
Native			
Bluehead sucker	*Catostomus discobolus*	Yes	Yes
Colorado pikeminnow	*Ptychocheilus lucius*	No	Yes
Flannelmouth sucker	*Catostomus latipinnis*	Yes	Yes
Razorback sucker	*Xyrauchen texanus*	No	Yes
Roundtail chub	*Gila robusta*	Yes	Yes
Mottled sculpin	*Cottus bairdi*	No	Yes
Speckled dace	*Rhinichthys osculus*	No	Yes
Non-native			
Black bullhead	*Ictalurus melas*	Yes	Yes
Black crappie	*Pomoxis negromaculatus*	Yes	No
Bluegill	*Lepomis macrochirus*	Yes	Yes
Brown trout	*Salmo trutta*	Yes	Yes
Channel catfish	*Ictalurus punctatus*	Yes	Yes
Common carp	*Cyprinus carpio*	Yes	Yes
Fathead minnow	*Pimephales promelas*	No	Yes
Grass carp	*Ctenopharyngodon idella*	No	Yes
Green sunfish	*Lepomis cyanellus*	Yes	Yes
Kokanee salmon	*Onchorhynchus nerka*	Yes	No
Largemouth bass	*Micropterus salmoides*	Yes	Yes
Western mosquitofish	*Gambusia afinnis*	No	Yes
Northern pike	*Esox lucius*	Yes	No
Plains killifish	*Fundulus zebrinnus*	No	Yes
Rainbow trout	*Onchoryhnchus mykiss*	Yes	Yes
Red shiner	*Cyprinella lutrensis*	No	Yes
Smallmouth bass	*Micropterus dolomieu*	Yes	Yes
Striped bass[1]	*Morone saxatilis*	No	Yes
Threadfin shad	*Dorosoma petenense*		Yes
Walleye[1]	*Stizostedion vitreum*	No	Yes
White sucker	*Catostomus commersoni*	Yes	Yes
Yellow perch	*Perca flavescens*	Yes	No
Hybrid			
Bluehead x flannelmouth	*Catostomus discobolus x latipinnis*	No	Yes
White sucker x bluehead	*Catostomus commersoni x discobolus*	No	Yes
White sucker x flannelmouth	*Catostomus commersoni x latipinnis*	No	Yes

[1] Found in the lower reach of the San Juan River near Lake Powell.

After Navajo Dam was completed, peak flows were created by late winter releases designed to increase available reservoir storage prior to snowmelt. The magnitude of such peaks was reduced relative to pre-dam conditions, whereas base flows increased.

Median monthly base flows for August through February averaged 168 percent of original base flows. Near-zero-flow conditions were eliminated, and minimum average monthly flows increased from 65 cfs to 250 cfs (Bliesner and Lamarra, 2000). Since 1991, Navajo Dam has been operated to more closely mimic the San Juan River's natural hydrograph (Holden, 1999). This re-operation is designed to improve habitat and conditions for federally protected fish. Peak flows are timed to coincide with those from the Animas River during spring runoff. The magnitude of flows is based on snowpack. Various flow parameters are set to mimic natural variability in the system (Holden, 1999) as described in the Flow Recommendations.

The San Juan River between Navajo Dam and Lake Powell has been partitioned into eight reaches based on geomorphology and other channel characteristics. A brief description of each reach, taken from Bliesner and Lamarra (2000), is shown in figure V-4 and presented below.

- *Reach 1* (RM 0 to 16) is a low-gradient, sand-bottomed reach created by backwater from Lake Powell.

- *Reach 2* (RM 17 to 67) is canyon-bound but is located above the influence of Lake Powell, with higher gradient, dominated by riffle-type habitat.

- *Reach 3* (RM 68 to 105) is characterized by higher sinuosity and lower gradient (second lowest) than the other reaches, a broad flood plain, multiple channels, high island count, and high percentage of sand substrate. Backwaters are more abundant, but are easily perturbed by summer stormflows.

- *Reach 4* (RM 106 to 130) is a transition reach between the upper cobble-dominated reaches and the lower sand-dominated reaches with relatively low abundance of backwaters and little clean cobble.

- *Reach 5* (RM 131 to 154) is predominately multichanneled. Backwaters and spawning bars in this reach are much less subject to perturbation during summer and fall storm events than the lower reaches.

- *Reach 6* (RM 155 to 180) is predominately a single channel. Cobble and gravel substrates dominate, and cobble bars with clean interstitial space are more abundant in this reach than in any other. Four diversion dams limit upstream movement of fish.

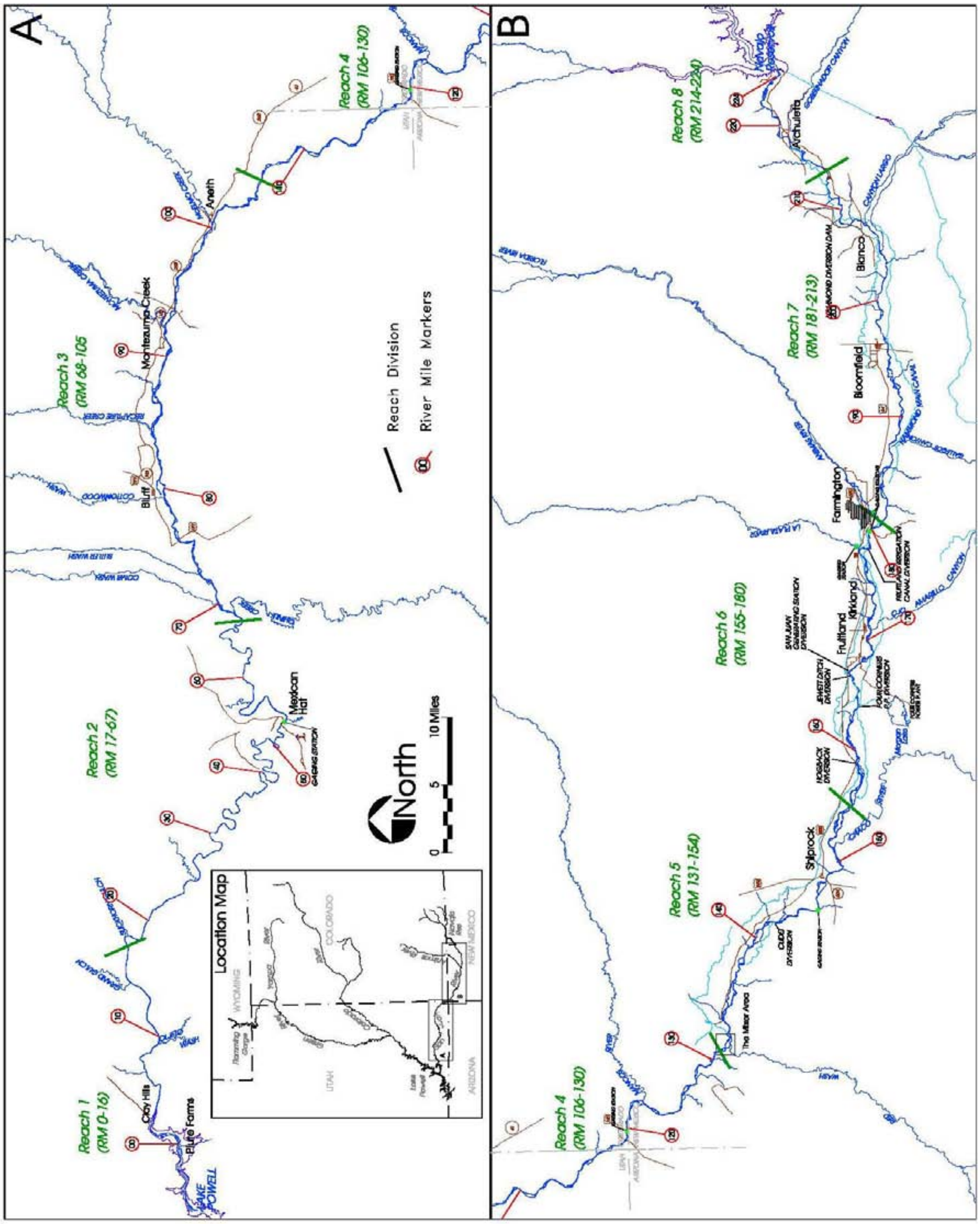

Figure V-4.—San Juan RM locations.

- *Reach 7* (RM 181 to 213) is similar to Reach 6 in terms of channel morphology. The river channel is very stable, consisting primarily of embedded cobble substrate as a result of controlled releases from Navajo Dam, and much of the river bank has been stabilized and/or diked.

- *Reach 8* (RM 214 to 224) is the most directly influenced by Navajo Dam, which is situated at its uppermost end (RM 224). This reach is predominately a single channel with cobble substrate and clean, cold water as a result of Navajo Dam.

Along with streamflow, channel morphology and geology are the primary factors influencing aquatic habitat. Unless otherwise noted, the following information on channel morphology, geology, and riparian habitat is taken from analyses conducted by Bliesner and Lamarra (2000).

The San Juan River valley ranges from less than 655 feet to more than 2 miles across. After an initial canyon-bound reach below Navajo Dam, the river valley widens beyond RM 208 to over 1.86 miles across near Shiprock, New Mexico. From there, the river valley narrows to a width of about 3,280 feet until it becomes canyon-bound below RM 68. The San Juan River reaches its maximum gradient near RM 18. The slope generally decreases to RM 140 and then steepens from RM 68 as it enters the canyon. Channel sinuosity is lowest in the canyon reaches and highest in the reach immediately below Navajo Dam. Sinuosity values range from 1.000 to 1.195. The river channel appears most stable between RM 119 and RM 135 based on the area of cutbanks along both sides. Sand is the primary source material found in cutbanks along the river (64 percent), with cobble and gravel also common (22 and 14 percent, respectively). Riparian vegetation within 98 feet of the channel is dominated by non-native Russian olive (37 percent) and tamarisk (30 percent). Cottonwood (7 percent) and willow (6 percent) are also present.

From Navajo Dam to Lake Powell, runs are the most common aquatic habitat at low, medium, and high flows (80 to 84 percent total wetted area). Riffles and shoals are the second most common habitat (3 to 9 percent total wetted area depending on flows) except during high flows when inundated vegetation becomes a common habitat (5.6 percent total wetted area) (Bliesner and Lamarra, 2000). Low-velocity habitat makes up a small portion of the total wetted area (approximately 3.5 percent), and backwaters comprise less than 1 percent of the wetted area.

Aquatic Invertebrate Community.—The aquatic invertebrate community is comparatively simple with the majority of the biomass composed of caddisflies, bloodworms, midges, and gnats (*Hydropsyche* species and *Chironomidae*). These species are indicative of sediment-laden river systems. The San Juan River reaches its highest productivity in upstream Reaches 6, 7, and 8 (Bliesner and Lamarra, 2000). The lowest densities of aquatic macroinvertebrates are found in Reach 2.

Fish.—The San Juan River fish community is characterized as highly endemic with species adapted to harsh, turbid conditions. Twenty-six fish species are found in the San Juan River, including 8 native, 19 non-native, and 3 hybrid sucker species (Ryden, 2000a). However, six of these species—three native and three introduced—comprise 99 percent of the fish found in the river. The most abundant native fish include the flannelmouth sucker (*Catostomus latipinnis*), bluehead sucker (*Catostomus discobolus*), and speckled dace (*Rhinichthys osculus*). Abundant non-native fish include the channel catfish (*Ictalurus punctatus*), common carp (*Cyprinus carpio*), and red shiner (*Richardsonius balteatus*). Roundtail chub (*Gila robusta*) collected in the San Juan River appear to be from resident populations in the Animas, La Plata, and Mancos Rivers and do not seem to be established within the main stem of the San Juan River.

In general, the density of native fish species increases upstream to near Farmington, New Mexico (RM 180). This longitudinal increase in density is driven primarily by flannelmouth and bluehead suckers, which exhibit high abundances in Reaches 5 and 6 (Ryden, 2000a). Above RM 180, hypolimnetic releases from Navajo Dam cool the San Juan River and favor an introduced trout fishery. Beginning in 1995, walleye, striped bass, and threadfin shad (non-native fish species) were accidentally introduced to the San Juan River fish community when a waterfall restricting movement of Lake Powell fishes into the San Juan River at RM 0.0 was inundated (Ryden, 2000a).

Threadfin shad remained in the lower reaches of the river, whereas the predacious striped bass and walleye have been collected upstream to RM 91 and 108, respectively (Ryden, 2000a).

Native Fishes.— Seven native fish species occur in the San Juan River and make up 74.6 percent of the community as measured by main channel electrofishing (Ryden, 2000a and 2000b). The most abundant native fish is the flannelmouth sucker, followed by the bluehead sucker (58.1 and 12.7 percent, respectively). Four native species are described briefly here. Five rare or endangered native species—Colorado pikeminnow, razorback sucker, roundtail chub, bluehead sucker, and mottled sculpin—are described in more detail in the "Special Status Species" section of this chapter. Emphasis is placed on species distribution and habitat within Reach 6 because this is the area where the withdrawal facilities for the SJRPNM Alternative would be located.

Flannelmouth Sucker – The flannelmouth sucker is endemic to the Colorado River system of the Western United States and northern New Mexico. Flannelmouth sucker prefer pools and low-gradient reaches and are absent from impoundments. These suckers are benthic feeders and consume detritus, algae, periphyton, plants, and insects. They spawn over gravel areas during late spring and early summer.

In the San Juan River, the flannelmouth sucker is found in very limited numbers above RM 205 near Blanco, New Mexico, and occur more abundantly downstream of RM 180 near Farmington, New Mexico (Wethington, 2002; Ryden, 2000a). Spawning flannelmouth sucker appear to use cobbles within Reaches 5 and 6 (see figure V-4), although other areas are likely also used (Holden, 1999). Reach 6 has higher numbers of large juvenile and adult fish than the river downstream and is an important spawning area for the flannelmouth sucker (Holden, 1999). The number of large flannelmouth sucker present here may also provide an important prey base for Colorado pikeminnow.

Speckled Dace – The speckled dace is found in many drainages west of the Continental Divide. The species reaches its highest abundance in small- to medium-sized rivers and prefers shallow, slow-moving waters. Speckled dace are bottom feeders and consume aquatic insects, plant material, and zooplankton. They broadcast spawn over gravel areas. Speckled dace spawn principally during the spring, but may also spawn during late summer in the San Juan River (Platania et al., 2000).

Seine sampling in the San Juan River in low velocity habitat, targeted at small-bodied fish, found speckled dace to be the most common native fish (Propst et al., 2003). Speckled dace are found in very limited numbers upstream of RM 205 near Blanco, New Mexico, where introduced trout are the dominant species (Wethington, 2002). The highest concentrations of speckled dace in the San Juan River occur in Reaches 4, 5, and 6 (figure V-4) and are rare below RM 68 (Ryden, 2000a; Propst et al., 2003). No speckled dace have been caught below RM 13 (Ryden, 2000a).

Non-Native Fishes.—Twenty-one non-native fish species occur in the San Juan River. During main channel electrofishing from Lake Powell to Farmington, New Mexico (RM 3 to RM 180), non-native fish accounted for 25.4 percent of the catch (Ryden, 2000a and 2000b). Thirteen of these non-native species are either known or potential predators of native fish. Dietary overlap among species suggests that non-natives may also place competitive pressure on native San Juan River fish. Furthermore, 12 non-native species are spiny-rayed and pose a documented choking hazard to Colorado pikeminnow (Ryden, 2000b). Channel catfish, common carp, and red shiner are the most abundant non-native fish.

Tailwater Trout Fishery.—Navajo Dam tailwater is a unique environment characterized by cobble substrate and cool deep water releases. The NMDGF manages the tailwater as a trout fishery from the base of Navajo Dam 17 miles downstream to Blanco, New Mexico.

Annual NMDGF electrofishing surveys from 1997–2001 found an increasing percentage of brown trout in the special trout water and regular regulation reaches. Increases in brown trout numbers may be due to improved spawning success associated with high spring releases from Navajo Dam. The average length of rainbow trout from the special regulation waters was 15 inches, and on average, 18 percent of the rainbow trout were over 18 inches. In contrast, less than 2 percent of trout in the regular regulation waters were over 18 inches; trout in regular regulation waters averaged 9 inches. Since then, NMDGF has managed the effects of whirling disease by stocking only fish 4 inches or larger (Wethington, 2002).

The fishery in the lower 10-mile reach is maintained primarily through natural reproduction of brown trout. In 1992, the fish composition within this reach included 62 percent native species (flannelmouth sucker, bluehead sucker, and mottled sculpin). By 1998, this number had declined to less than 1 percent. Higher releases from Navajo Dam associated with the 1991–97 Navajo Dam test flows may be causing this shift (Wethington, 2002).

Aquatic Wildlife.—The San Juan River and its associated riparian and marsh habitat support the greatest diversity of wildlife in the proposed project area. Five aquatic mammals known from the proposed project area occur only in the San Juan River and its flood plain—river otter (*Lytra Canadensis*), beaver (*Castor Canadensis*), meadow vole (*Microtus pennsylvanicus*), muskrat (*Ondata zibethica*), and mink (*Mustella vison*).

Waterfowl are common along the river, and populations have increased since the closure of Navajo Dam and development of the Square-B Ranch near Farmington as a waterfowl and wildlife preserve. Twenty-nine waterfowl species are found in the proposed project area, and 26.5 percent of avian species found in the proposed project area are restricted to breeding in riparian habitat (Reclamation, 1983).

Several amphibian species are tied to the San Juan River and tributaries in the proposed project area—tiger salamander (*Ambystoma tigrinum*), western spadefoot (*Scaphiopus hammondi*), plains spadefoot (*Scaphiopus bombifrons*), red-spotted toad (*Bufo punctatus*), Woodhouse's toad (*Bufo woodhousei*), great plains toad (*Bufo cognatus*), chorus frog (*Pseudacris triseriata*), bullfrog (*Rana catesbeiana*), and northern leopard frog (*Rana pipiens*). Of these, the native northern leopard frog and the introduced bullfrog are found only in habitat within the San Juan River flood plain. The northern leopard frog is discussed in greater detail in the "Special Status Species" section of this chapter.

In addition, the smooth green snake (*Opheodrys vernalis*), common garter snake (*Thamnophis sirtalis*), and black-necked garter snake (*Thamnophis crytopsis*) are found only along the river (Reclamation, 1983).

Aquatic Resources – Methodology

This section describes the methods used to measure the effects of the No Action, SJRPNM, and NIIP Amarillo Alternatives on aquatic resources. The methods are presented here relative to five significance criteria used to assess effects.

(1) ***Effects on hydrology in the San Juan River***

Modeling was used to evaluate effects of alternatives on hydrology in the San Juan River. Keller-Bliesner Engineering, LLC, modeled the No Action, SJRPNM, and NIIP Amarillo Alternatives using RiverWare[13] (Bliesner, 2003). The San Juan River Basin Hydrologic Model[14] was used as a starting point to configure the proposed project alternatives. Alternatives were modeled from water year 1929 to 1993. All alternatives considered include depletions for the ALP Project. The results of modeling were compared against Flow Recommendation criteria and are discussed in greater detail in the "Special Status Species" section of this chapter.

(2) ***An undesirable change in the composition of the native fish community***

Effects on the native fish community were approximated based on the effects that each alternative would have on individual species. Bluehead sucker, flannelmouth sucker, and speckled dace were identified as native species vulnerable to entrainment (Platania et al., 2000; Ryden, 2000a). Estimates of entrainment were based on each species' distribution and the fraction of the flows diverted at the time of peak drift.

This analysis assumes that the portion of drifting larvae exiting a reach is directly related to the proportion of a species' population occupying that reach. This assumption provides a conservative estimate of the fraction of drift originating upstream of the proposed diversion for two reasons. First, a greater

[13] RiverWare is the software that runs the hydrologic model.
[14] The San Juan River Basin Hydrologic Model was developed for the SJRBRIP for use in assessing impacts that water development would have on the endangered fish (Flow Recommendations).

proportion of adult and large-sized native suckers are found within Reach 6 (RM 158.6–180) than are found within the downstream reaches (Ryden, 2000a). Adult fish comprise the spawning portion of the population and larger fish show greater fecundity. Thus, fish found in the reach above the proposed intake likely produce more larvae than an equivalent number of fish downstream. Second, abundant clean cobble substrates within Reach 6 provide more suitable spawning habitat than do embedded substrates found within downstream reaches (Bliesner and Lamarra, 2000). Thus, a greater proportion of spawning likely occurs above the proposed diversion.

This analysis also assumes that drifting larvae are evenly distributed in the water column. The size parameters used to determine drift for this analysis are from Platania et al. (2000) and refer to individuals with minimal or no control over their longitudinal movement. Such larvae are not sufficiently developed to actively move out of the current and into a low-velocity habitat. Thus, the drifting larvae are likely to be distributed randomly within the water column.

(3) ***Deterioration of trout habitat from Navajo Dam to Blanco, New Mexico***

Effects on the tailrace trout fishery were determined based on hydrology modeling and Reclamation design drawings.

Aquatic Resources – Impacts Analysis

This section describes the effects of the No Action, SJRPNM, and NIIP Amarillo Alternatives on aquatic resources. Mitigation plans are described, and each alternative's net effects are evaluated based on significance criteria.

No Action Alternative.—The No Action Alternative assumes that Navajo Reservoir is operated to meet the Flow Recommendations, as previously described. There is flexibility in summer releases from Navajo Dam that may delay changes in the San Juan River during an interim period; however, future conditions discussed below are expected to occur in the long term. The model configuration used for the No Action Alternative is identical to the Navajo Reservoir Operations FEIS model used by the SJRBRIP and includes no project water use.

SJRPNM Alternative.—The SJRPNM Alternative was modeled by taking the diversion/ depletion of 33,118/31,247 acre-feet at the PNM diversion (table V-9). Return flow of 1,871 acre-feet is returned to the San Juan River downstream of Shiprock, New Mexico. An additional project depletion of 4,645 acre-feet is taken at the NIIP diversion above

Table V-9.—Summary of flow statistics for the SJRPNM Alternative

Parameter	Pre-dam (1929–61)	Post-dam (1962–93)	No Action Alternative[1]	SJRPNM Alternative[2]	Flow target parameters
Average peak daily runoff (cfs)	12,409	6,749	8,791	8,793	
Average March–July runoff (acre-feet)	1,263,89	891,712	833,416	830,316	
>10,000 cfs for 5 days – frequency	39%	13%	27.7%	27.7%	20%
>8,000 cfs for 10 days – frequency	45%	17%	38.5%	38.5%	33%
>5,000 cfs for 21 days – frequency	64%	37%	50.8%	55.4%	50%
>2,500 cfs for 10 days – frequency	100%	83%	80%	78.5%	80%
Maximum years between flow events for minimum duration					
10,000 cfs – 5 days	4	14	10	10	10
8,000 cfs – 10 days	4	7	6	6	6
5,000 cfs – 21 days	4	7	4	4	4
2,500 cfs – 10 days	0	1	2	2	2
Average date of peak	May 31	June 1	June 1	June 4	
Average days for modeling period greater than indicated flow rate					
Days >10,000cfs	14	3	4	4	
Days >8,000 cfs	23	8	11	11	
Days >5,000 cfs	46	28	31	31	
Days >2,500 cfs	82	67	54	54	
Meets Flow Recommendations	Yes	No	Yes	Yes	

Source: Keller-Bliesner, 2005.
[1] As simulated for baseline depletion conditions and Navajo Dam operated to meet Flow Recommendations.
[2] Baseline depletions plus project depletion of 35,892 acre-feet. NIIP depletions reduced from 280,600 to 247,000 acre-feet. Navajo Dam operated to meet the Flow Recommendations.

Navajo Dam. NIIP depletion is reduced to 250,000 acre-feet with groundwater accumulation of 7,000 acre-feet. All critical elements of the Flow Recommendations are met. All but two flow criteria are met under worst-case scenario, and these criteria have been determined by the SJRBRIP to be ineffective in accomplishing the anticipated effect (Miller, 2005). The 2,500 cfs criteria are missed by about 12 percent for 3 days in 1 year out of the 65-year analysis period. Over the full model period, the Flow Recommendations are met 99.99 percent of the time.

The SJRPNM Alternative would affect aquatic resources by diverting water, disturbing riparian and aquatic invertebrate habitat, and entraining native fish. This alternative would divert 33,118 acre-feet of water from the San Juan River at RM 167 via a pump with an intake of 60 cfs. An additional 4,645 acre-feet would be diverted from Navajo Reservoir via the existing NIIP facilities to Cutter Reservoir to supply the eastern pipeline. A portion of this water (1,871 acre-feet) would be returned downstream of Shiprock, New Mexico. Mean average flows in the river would be increased by 4.6 cfs to meet project demands; minimum flows would decrease by 1.6 cfs, and maximum flows would increase by 25.2 cfs (Bliesner, 2003). The intake pump would be constructed adjacent to the San Juan River, and the pipeline would cross the river. Aquatic invertebrate habitat might be temporarily affected by substrate disturbance associated with construction. Mean reservoir elevations would increase by 1.3 feet under the SJRPNM Alternative but are predicted to result in no measurable effect on the fish community in Navajo Reservoir.

A portion of the native fish population would be vulnerable to entrainment and impingement with intake facilities associated with the SJRPNM Alternative. An estimated 8.3 percent of flannelmouth sucker and 10 percent of speckled dace in the San Juan River are found upstream of the proposed intake structure (Propst et al., 2003). The fraction of these fish subject to entrainment depends on screening and the location of the intake. In the process of recovery, Colorado pikeminnow, razorback sucker, and bluehead sucker may also become entrained within project facilities, as is discussed in the "Special Status Species" section of this chapter.

Under the SJRPNM Alternative, the intake pump would be screen at 3/32 inch to minimize fish entrainment. (This screen size is already a standard on all Upper Colorado River Basin diversions and is designed to exclude 20–30 millimeter larval fish). To avoid impingement, screens would be designed such that approach velocities do not exceed 0.5 foot per second.

The SJRPNM Alternative has the potential to affect the composition of the native fish community through entrainment of flannelmouth sucker and speckled dace. Based on electrofishing population estimates from 1991–2002, 8.3 percent of the flannelmouth sucker population is located upstream of the proposed intake. Both native suckers spawn during the late spring and early summer (May–June). Average flows at Farmington during 1993–2003 were 5,011 cfs (USGS, 2003). The proposed SJRPNM Alternative would withdraw 60 cfs or 1.2 percent of San Juan River flows during the period of peak drift. Bluehead sucker exit the drift at 15 millimeters, and flannelmouth sucker exit the drift at 20 millimeters. Thus, all drifting larvae would be vulnerable to entrainment. Based on flows, 1.2 percent of the drift produced upstream of the proposed diversion would be entrained. This amounts to 0.10 percent of flannelmouth sucker larvae produced in the San Juan River between Navajo Dam and Lake Powell.

Based on seine sampling from 1998–2001, 10 percent of the speckled dace population in the San Juan River is located upstream of the proposed intake (Propost et al., 2003). Speckled dace primarily spawn during the late spring and early summer (May–June), although limited, late-season spawning has also been documented on the San Juan River (Platania et al., 2000). Average early summer flows at Farmington during 1993–2002 were 5,011 cfs (USGS, 2003). The proposed SJRPNM intake would withdraw 60 cfs or 1.2 percent of San Juan River flows during the period of peak speckled dace drift. Speckled dace exit the drift at 12 millimeters; thus, all drifting larvae would be vulnerable to entrainment. Based on flows, 1.2 percent of the drift produced upstream of the proposed diversion would be entrained. This amounts to 0.12 percent of the speckled dace larvae produced in the San Juan River between Navajo Dam and Lake Powell. When late-season spawning occurs, a greater portion of these larvae would be entrained because the proposed diversion comprises a greater fraction of flows during the late summer.

The entrainment losses of 0.10 percent flannelmouth sucker larvae and 0.12 percent speckled dace larvae under the SJRPNM Alternative are not considered significant and are not predicted to result in significant changes in the native fish community.

The SJRPNM Alternative has no foreseeable adverse effects on trout habitat below Navajo Dam. This alternative would not disturb any benthic or riparian habitat within the designated sport fishery. Slight increases in flows associated with project demands are not expected to adversely affect trout and may be beneficial, especially during extreme low-flow conditions.

NIIP Amarillo Alternative.—The NIIP Amarillo Alternative was modeled by taking a diversion/depletion of 37,763/35,892 acre-feet at the NIIP diversion on Navajo Reservoir. Flows of 1,871 acre-feet would be returned downstream of Shiprock, New Mexico. The NIIP depletion was reduced to 242,000 acre-feet to ensure that the Flow Recommendations are satisfied. An additional 6,300 acre-feet of NIIP groundwater accumulation was included.

The NIIP Amarillo Alternative would impact the Flow Recommendations more than the SJRPNM Alternative. Less water would be available in Navajo Reservoir to meet the Flow Recommendations because all project water would come from Navajo Reservoir.

The NIIP Amarillo Alternative includes no new intake structures and poses no entrainment risk to native fish. Changes in flow and mean reservoir elevation (0.9-foot increase) would be imperceptible and would not be expected to affect aquatic conditions or result in changes in the composition of the native fish community or the fish community in Navajo Reservoir.

The NIIP Amarillo Alternative when compared to the No Action Alternative would have no effect on the native fish community or trout habitat below Navajo Dam. This alternative is not predicted to disturb trout, aquatic invertebrates, or aquatic habitat on the San Juan River, although slight decreases in flows may occur.

Aquatic Resources – Mitigation Measures

Proposed mitigation measures include monitoring and reporting total depletions in the Basin as monitored by the SJRBRIP. Also, mitigation measures that incorporate BMPs as previously described in the "Water Quality" section, could also be used to avoid or minimize project impacts to aquatic resources.

Aquatic Resources – Summary of Impacts

Both the SJRPNM and NIIP Amarillo Alternatives meet the critical elements of the Flow Recommendations. Under the SJRPNM Alternative, the Flow Recommendations are met 99.99 percent of the time. All but two flow criteria are met under the worst-case scenario, and these criteria have been determined by the SJRBRIP to be ineffective in accomplishing the anticipated effect (Miller, 2005). The 2,500 cfs criteria are missed by about 12 percent for 3 days in 1 year out of the 65-year analysis period. The NIIP Amarillo Alternative meets the Flow Recommendations slightly less often. Both alternatives are predicted to result in no measurable change to the fish community in Navajo Reservoir.

The SJRPNM Alternative has potential benefits to the downstream native and tailwater trout fisheries with increases in average monthly flows of 4.6 cfs (average over five gauging stations (Bliesner, 2003). Entrainment losses of 0.48 percent bluehead sucker larvae, 0.10 percent flannelmouth sucker larvae, and 0.12 percent speckled dace larvae under the SJRPNM Alternative may occur but are not considered significant and not predicted to result in significant changes in the native fish community.

Withdrawals for the NIIP Amarillo Alternative would decrease mean monthly flows in the San Juan River by 4 cfs (average over five gauging stations (Bliesner, 2003). When compared to the No Action Alternative, the NIIP Amarillo Alternative would have no impact on native or tailwater trout fisheries.

Changes in flows would generally be imperceptible under both the SJRPNM and NIIP Amarillo Alternatives because of the 10-percent margin of error at the gauges.

Special Status Species

This section addresses the potential impacts to threatened and endangered species and species of concern (or special status species) that could result from actions associated with the alternatives considered.

Issue: How do the No Action, SJRPNM, and NIIP Amarillo Alternatives affect special status species?

Overview

Scope

The scope of analysis includes the area along the San Juan River corridor to near Lake Powell, south to the city of Gallup, east to the Star Lake area, and north from there to the Navajo Dam and Reservoir area.

Impact Indicators

The indicators applicable to the special status species parameter are whether the proposed action would cause impacts to threatened or endangered species and species of concern or their habitats.

Special Status Species – Affected Environment

Special status species include threatened or endangered species listed and protected under the ESA of 1973 or the Navajo Nation Endangered Species Act (NESA) and species of concern for which further information is needed to determine their conservation status.

The Service identified 6 endangered, 4 threatened, 2 candidate[15] species, and 22 species of concern[16] that could exist within the proposed project area (letter from the Service to Bliesner, November 24, 2003) (table V-10). Threatened or endangered species are listed as such under section 7 of the ESA.

The Navajo Natural Heritage Program (NNHP) (2003) also provided a list of species that may occur within the proposed project area and that are protected under the NESA.[17] The NFWD will actively seek information on these species to determine if they warrant inclusion in a different group or removal from the list.

[15] Candidates are species for which the Service has sufficient information on their biological status and potential threats to propose them as endangered or threatened, but the species have yet to be formally listed.

[16] Species of concern are suspected by the Service to be vulnerable, but require further study to determine their conservation status.

[17] Species listed under Group 1 of the NESA are those species or subspecies that no longer occur on the Navajo Nation. The NESA Group 2 listed species are any species or subspecies that is in danger of being eliminated from all or a significant portion of its range on the Navajo Nation. The NESA Group 3 listed species are any species or subspecies likely to become an endangered species, within the foreseeable future, throughout all or a significant portion of its range on the Navajo Nation. The NESA Group 4 listed species are any species or subspecies for which the NFWD does not currently have sufficient information to support their being listed in Group 2 or Group 3 but has reason to consider them.

Table V-10.—Threatened or endangered species (section 7)

Common name	Scientific name	Species status		Potentially adversely affected by alternative		
		Federal[1]	Navajo[2]	No Action	SJRPNM	NIIP Amarillo
Wildlife						
American peregrine falcon[3]	*Falco peregrinus anatum*	SC	Group 4	No	No	No
Arctic peregrine falcon[3]	*Falco peregrinus tundrius*	SC	Group 4	No	No	No
Black-footed ferret[3]	*Mustela nigripes*	E	Group 2	No	No	No
Baird's sparrow[3]	*Ammondramus baidrii*	SC		No	No	No
Bald eagle	*Hailiaeetus leucocephalus*	T		No	Yes	No
Black tern[3]	*Chlidonias niger*	SC		No	No	No
Canada lynx[3]	*Lynx canadensis*	T		No	No	No
Ferruginous hawk	*Buteo regalis*	MBTA	Group 3	No	Yes	Yes
Golden eagle	*Aquila chrysaetos*	EPA	Group 3	No	Yes	Yes
Kit fox	*Vulpes macrotis*		Group 4	No	Yes	Yes
Mexican spotted owl[3]	*Strix occidentalis lucida*	T	Group 3	No	No	No
Mountain plover	*Charadrius montanus*	SC		No	No	No
Mule deer	*Odocoileus hemionus*		SCES	No	Yes	Yes
Northern goshawk[3]	*Accipiter gentilis*	SC		No	No	No
Northern leopard frog[3]	*Rana pipiens*		Group 2	No	No	No
Pronghorn	*Antiocapra americana*		Group 3	No	Yes	Yes
Rocky Mountain elk	*Cervus elaphus nelsoni*		SES	No	No	No
Sora[3]	*Porzana carolina*		Group 2	No	No	No
Southwestern willow flycatcher	*Empidonax traillii extimus*	E	Group 2	No	Yes	No
Townsend's big-eared bat[3]	*Corynorhinus townsendii*	SC		No	No	No
Western burrowing owl	*Athene cunicularia hypugea*	SC		No	Yes	Yes
Yellow-billed cuckoo[3]	*Coccyzus americanus*	CS		No	No	No
Fishes						
Bluehead sucker	*Catostomas discobolus*		Group 4	No	Yes	No
Colorado pikeminnow	*Ptychocheilus lucius*	E	Group 2	No	Yes	No
Mottled sculpin	*Cottus bairdi*		Group 4	No	Yes	No
Razorback sucker	*Xyrauchen texanus*	E	Group 2	No	Yes	No
Roundtail chub	*Gila robusta*	SC	Group 2	No	No	No
Zuni bluehead sucker[3]	*Catostomus discobolus*	CS	Group 4	No	No	No
Insects						
New Mexico silverspot butterfly[3]	*Speyeria nokomis nitocris*	SC		No	No	No
San Juan checkerspot butterfly	*Euphydryas anicia chuskae*	SC		No	No	No

Table V-10.—Threatened or endangered species (section 7) (continued)

Common name	Scientific name	Species status		Potentially adversely affected by alternative		
		Federal[1]	Navajo[2]	No Action	SJRPNM	NIIP Amarillo
Vegetation						
Acoma fleabane[3]	*Erigeron acomanus*	SC		No	No	No
Beautiful gilia	*Gilia formosa*	SC		No	Yes	Yes
Bisti fleabane[3]	*Erigeron bistinensis*	SC		No	No	No
Brack hardwall cactus[3]	*Sclerocactus cloveriae ssp. brackii*	SC		No	No	No
Gooding's onion[3]	*Allium gooddingii*	CS		No	No	No
Knowlton cactus[3]	*Pediocacus knowltonii*	E		No	No	No
Mancos milkvetch[3]	*Astragalus humillimus*	E	Group 2	No	No	No
Mesa Verde cactus	*Sclerocactus mesae-verdae*	E	Group 3	No	Yes	Yes
Naturita milkvetch[3]	*Astragalus naturitensis*		Group 4	No	No	No
Parish's alkali grass[3]	*Puccinellia parishii*	CS*		No	No	No
Santa Fe cholla[3]	*Opuntia viridiflora*	SC		No	No	No
Sivinski's fleabane[3]	*Erigeron sivinskii*	SC		No	No	No
Zuni fleabane[3]	*Erigeron rhizomatus*	T	Group 2	No	No	No

[1] Federal: CS = candidate species, CS* = candidate species (proposed endangered), E = endangered, EPA = Eagle Protection Act, MBTA = Migratory Bird Treaty Act, SC = species of concern, T = threatened.
[2] Navajo: Group 2 = in danger of being eliminated, Group 3 = likely to become an endangered species, Group 4 = does not has sufficient information to support their being listed in Group 2 or Group 3.
[3] The areas affected by the proposed project lack suitable habitat for these species.

Special Status Wildlife Species.—The proposed project lacks suitable habitat for peregrine falcon, black-footed ferret, Baird's sparrow, black tern, Canada lynx, Mexican spotted owl, Northern goshawk, Northern leopard frog, and Townsend's big-eared bat; therefore, all alternatives are predicted to have no effect on these species. Species potentially impacted by the project alternatives are discussed below. Species' occurrences are shown in figure V-5.

Bald Eagle.—The bald eagle (*Halieaeetus leucocephalus*) is listed as a federally threatened species and protected under the Bald Eagle Protection Act of 1940, as amended.[18] This large raptor catches fish principally, but also feeds on carrion, waterfowl, and rabbits. Bald eagles are found primarily near seacoasts, rivers, reservoirs, and lakes.

[18] 16 U.S.C. §§ 668-668d, June 8, 1940, as amended 1959, 1962, 1972, and 1978.

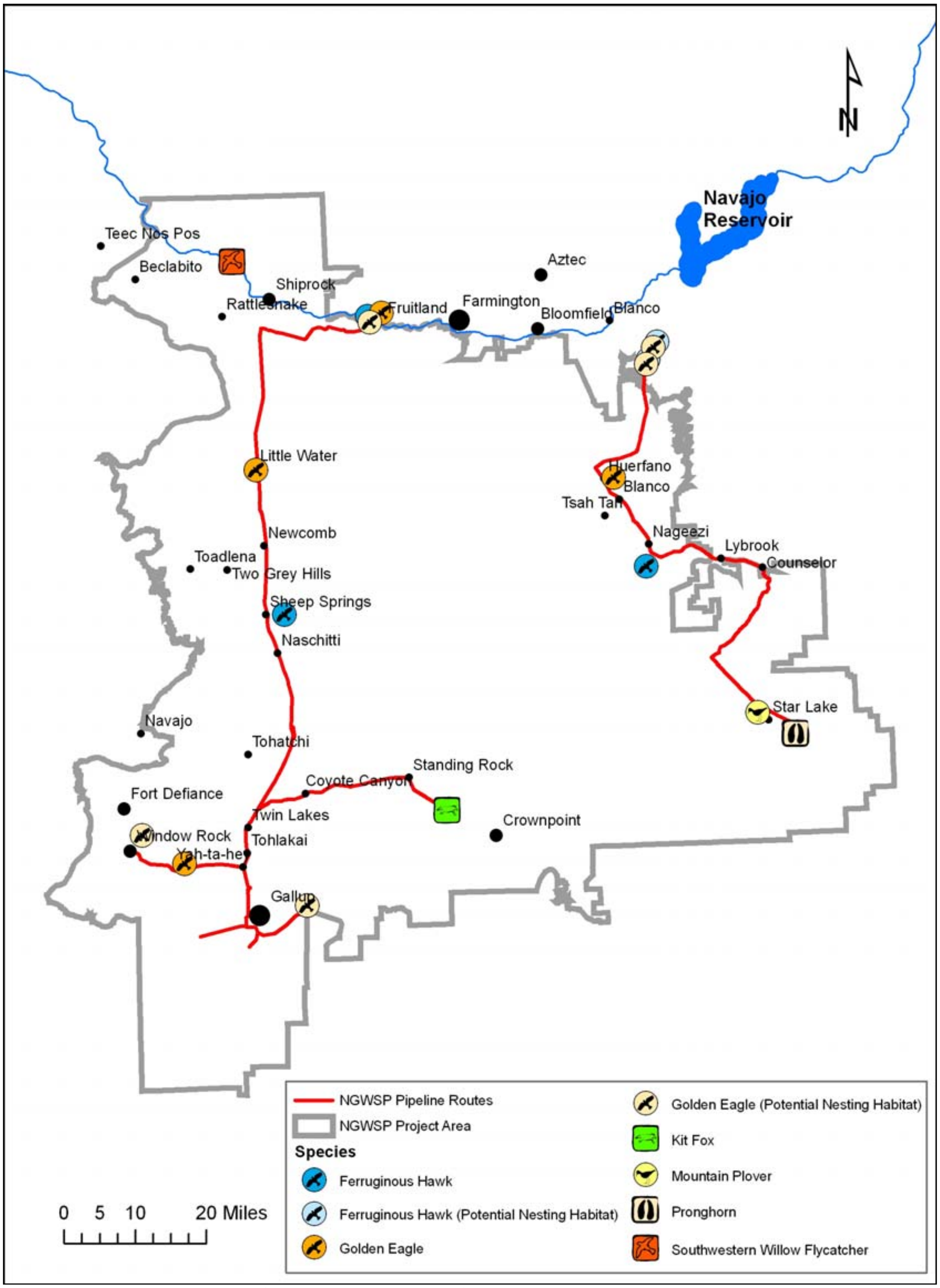

Figure V-5.—Special status wildlife within the proposed project area.

Ferruginous Hawk.—The ferruginous hawk (*Buteo regalis*) is a Navajo Nation endangered species (Group 3). Ferruginous hawks are found on semiarid plains and in arid steep habitats and favor relatively unbroken terrain. They prefer tall trees for nesting, but will use a variety of structures including mounds, short cliffs, cutbanks, low hills, haystacks, and human structures. Ferruginous hawks feed on ground squirrels, rabbits, pocket gophers, kangaroo rats, mice, voles, lizards, and snakes. Populations are adversely influenced by agricultural activities (DeGraaf et al., 1991).

The ferruginous hawk occurs in low numbers in the northwest corner of New Mexico. Two ferruginous hawks were observed during field surveys for the proposed project (ESRI, 2002). One was seen hovering over the sagebrush flats southwest of Nageezi, New Mexico, and another was observed over the plains east of Sheep Springs, New Mexico. No nests were observed, although suitable areas may occur several miles east-southeast of Sheep Springs and along cliffs in Blanco and Cutter Canyons. NNHP records ferruginous hawks within 3 miles of the proposed project pumping and water treatment facilities and within 1 mile of the Cutter Lateral pipeline route (NNHP, 2003).

Golden Eagle.—The golden eagle (*Aquila chrysaetos*) is a Navajo Nation endangered species (Group 3) and is also protected under the Bald Eagle Protection Act. Golden eagles are found in mountainous areas, canyons, grasslands, and shrublands and reside primarily in shrub-steepe habitats during the winter. They nest in large trees and on cliffs. Breeding success is often highly dependent on prey densities. Primary prey includes jackrabbits, larger rodents, birds, and reptiles (DeGraaf et al., 1991).

One golden eagle nest is known historically from the ridge of the Nutria Monocline about 0.3 mile north of the proposed project pipeline. During recent surveys, a golden eagle was observed in flight along the San Juan River north of the San Juan Chapter and several were spotted along the SJRPNM pipeline route (ESRI, 2002). Although no active nests were detected during recent surveys, several areas of suitable nesting habitat are found in the proposed project vicinity. Large cottonwood trees near the SJRPNM's Hogback-San Juan River pipeline crossing may provide nesting habitat. The Defiance Monocline near Window Rock, Arizona, and the Nutria Monocline east of Gallup, New Mexico, may provide cliff-nesting habitat. NNHP records show golden eagles within 1 mile of the proposed pipeline along the western lateral near Little Water, New Mexico, the eastern Cutter Lateral near Huerfano, New Mexico, and the distribution lateral to Window Rock (NNHP, 2003).

Kit Fox.—The kit fox (*Vulpes macrotis*) is a Navajo Nation Group 4 species. Recent taxonomic studies include the kit fox as a subspecies of the swift fox (*Vulpes velox macrotis*). This subspecies inhabits arid grass and scrubland primarily, but may use woodland habitats. NNHP records show kit fox within 1 mile of the distribution lateral to Crownpoint, New Mexico. No signs of kit fox or fox were observed during surveys of the proposed project area (ESRI, 2002). Potential habitat occurs throughout much of the proposed project area wherever soils are adequate for denning and small mammals are abundant (NNHP, 2003).

Mountain Plover.—The mountain plover (*Charadrius montanus*) is a Federal species of concern and a Navajo Nation Group 4 species. The mountain plover breeds in northeastern New Mexico and is only an incidental visitor in western New Mexico (BISON-M, 2002), although sightings have been documented within 1 mile of the proposed pipeline in the Star Lake, New Mexico, area (NNHP, 2003).

Mule Deer.—The mule deer (*Odocoileus hemionus*) is listed by the Navajo Nation as an economically and culturally significant species and is found within the proposed project area.

Pronghorn.—Pronghorn (*Antilocapra Americana*) are listed by the Navajo Nation as a Group 3 species. They are known from within 3 miles of the southern tip of the Cutter Lateral, and suitable habitat is found along the southern portions of the Cutter and Main Laterals (NNHP, 2003).

Rocky Mountain Elk.—The Rocky Mountain elk (*Cervus elaphus nelsoni*) is economically significant to the Navajo Nation. Although once found over much of North America, elk now range primarily through the Rocky Mountains from northern Alberta to New Mexico and Arizona (Whitaker, 1980).

Southwestern Willow Flycatcher.—The Southwestern willow flycatcher (*Empidonax traillii extimus*) is listed as federally endangered and listed by the Navajo Nation as a Group 2 species. The flycatcher's range includes the Basin, but designated critical habitat does not include this drainage, nor was critical habitat proposed for the drainage (Service, 1993).

Within the San Juan River drainage, populations of breeding flycatcher appear to have been quite small for many years. Woodsbury (1961) lists the flycatcher as a summer resident based on a single observation of a singing and feeding individual along the Piedra River in early July 1960. Schmitt (1976) lists the species as "occasional" at Kirtland, but overlooked and/or misidentified and thought to breed. Ecosphere, Inc. (2001) conducted presence-absence surveys along the San Juan River from Navajo Dam downstream to the confluence with Red Wash at about RM 132 in 1997, 1998, and 1999. One nesting pair producing one fledgling was identified in the flood plain along the San Juan River near the mouth of Malpais Arroyo (RM 142) in 1997. In addition, 14 undifferentiated flycatchers were identified on 12 of 24 sites surveyed.

In 1998, four nests were found in the same location, with four flycatchers fledged from three of the nests. An additional 18 undifferentiated flycatchers were identified in 10 of

27 sites. In 1999, no nesting pairs and no fledglings were found, although 31 flycatchers were found in 10 of 21 sites surveyed. In 3 years of surveying, 57 percent of the sites detected flycatcher at some time during the year, although only one site demonstrated nesting. Further, flycatchers were detected in exotic as well as native riparian habitat, although nesting was only detected in high quality, native willow habitat (Ecosphere, 2001). The bulk of these birds may be using the riparian corridor as a temporary stopover to replace resources spent during migration. Similar use of larger rivers as important refueling sites for flycatcher as they migrate between breeding grounds and wintering grounds has been described along the middle Rio Grande River (Yong and Finch, 1997).

Southwestern willow flycatchers are not necessarily restricted to willow/cottonwood complexes along larger rivers. They may also utilize suitable willow habitat away from these large rivers. Within the proposed project area, however, there is no suitable willow flycatcher habitat, nor has there historically been such habitat. This subspecies is not expected to use the proposed project service area.

Western Burrowing Owl.—The Western burrowing owl is listed as a Federal species of concern. No records of Western burrowing owl are known from the proposed project area. Crop production limits the suitability of some project habitats for Western burrowing owl; other open habitats may be used, depending on the availability of burrows.

Special Status Fish.— Species potentially impacted by the proposed project alternatives are discussed below. Species' occurrences were shown in figure V-5.

Zuni Bluehead Sucker – The Zuni bluehead sucker (*Catostomas discobolus yarrowi*) is a Federal candidate species and listed as a Navajo Nation Group 4 species. The historical range of the Zuni bluehead sucker, a subspecies of the bluehead sucker, is limited to the headwaters of the Little Colorado River and does not occur within the proposed project area.

Colorado Pikeminnow – The Colorado pikeminnow (*Ptychocheilus lucius*) is protected as both federally endangered and a Navajo Nation Group 2 species. Colorado pikeminnow spawn from early July through mid-August. Preferred spawning sites are riffles with gravel to cobble substrates (Lamarra et al., 1985). The Colorado pikeminnow is endemic to the Colorado River Basin and historically inhabited the main river channels. It is now found in small numbers only in limited portions of the upper Colorado River Basin in Colorado, Utah, and New Mexico, occupying about 25 percent of its former range. Within the San Juan River, the Colorado pikeminnow has been collected from RM 0 to RM 177.1 (see figure V-5) (Ryden, 2000a and 2000b).

Critical habitat for the Colorado pikeminnow is designated as the 100-year flood plain of the San Juan River from Neskahai Canyon in Lake Powell to the confluence of the San Juan and Animas Rivers (see figure V-4). Several factors have contributed to the decline of Colorado pikeminnow in the San Juan River. Water development, in particular the construction of Navajo and Glen Canyon Dams, has limited access to important habitats and altered the hydrology to which the Colorado pikeminnow is adapted. Competition with and predation by non-native species may also play a role. Historical chemical eradication of native species in favor of non-native game fish may have affected the population locally.

Mark recapture[19] estimates place 19 wild adult Colorado pikeminnow in the San Juan River from RM 136.6 to RM 119.2 (Ryden, 2000a). Radio-tagged adults appear to have relatively small home ranges and primarily use habitats from RM 109 to RM 142. The exception to this trend was one fish that consistently used habitats immediately downstream of Bluff, Utah, at RM 80 (Ryden, 2000a). Spawning has been documented in a region of high channel complexity characterized by shifting gravel bars from RM 133.4 to RM 129.8 (Ryden, 2000a). Additional suitable spawning habitat has been identified at RM 178.7 and RM 168.4 (Bliesner, 2003). Prior to spawning, some adults have staged at the mouth of the Mancos River. Spawning dates range from July 8 to August 12 (Platania et al., 2000). Larval and juvenile Colorado pikeminnow have been collected from low-velocity shoreline and pocketwater habitats downstream of RM 130 (Ryden, 2000a).

Stocking of Colorado pikeminnow in the San Juan River began in 1996. In the San Juan River at RM 147.9 and RM 53, 827,000 larval Colorado pikeminnow were stocked. Overwinter survival was high (62.5–6.27 percent), and survival between Age-1 and Age-2 based on recapture rates neared 100 percent (Kimball et al., 2000). As a result of this initial success, an augmentation plan began in 2002 and called for stocking and monitoring 300,000 Age-0 Colorado pikeminnow at RM 180.2 and RM 158.6 for 7 years (Ryden and McAda, 2003). In addition to augmentation, ongoing recovery efforts include adult and larval fish monitoring, habitat and water quality monitoring, and control of non-native species.

In 2003, the fish passage at the PNM weir was finished and put into operation. During the summer of 2003, nine Colorado pikeminnow used the fish passage (Lapahie, 2004). In 2004 and 2005, four and nine Colorado pikeminnow, respectively, used the PNM fish passage (Lapahie, unpublished data). One of the goals of the SJRBRIP is the expansion of the range of Colorado pikeminnow and removal of barriers to migration (SJRBRIP, 1995). The removal of the Cudei diversion dam and construction of a fish passage at the Hogback diversion dam in 2001 and the documented use of the fish passage at the PNM weir has provided opportunity for and documented use of this upper portion of the San Juan River by Colorado pikeminnow, an important step toward recovery.

[19] Mark recapture estimates are population estimates based on the number of fish that are marked or tagged and recaptured over a series of samplings.

In 2005, 287 Colorado pikeminnow were collected during nonnative fish control activities in the lower San Juan River (Jackson, 2006). Population estimates ranged from 536–696 individuals. Captures of adult Colorado pikeminnow have diminished since the non-native fish control project began in 2002, and no adult Colorado pikeminnow were collected in 2005.

Based on spawning dates in the San Juan River, larvae typically enter the drift from mid-July to mid-August (Platania et al., 2000) and are passive in the drift for 3 to 6 days after emergence (Dudley and Platania, 2000). Therefore, larval Colorado pikeminnow spawned above the diversion would be subject to entrainment for about 35 to 40 days. Flows during this period average about 1,500 cfs at the Farmington gauge (1993–2003; USGS, 2003). The proposed San Juan River intake would divert about 4 percent (59 cfs) of the total river during peak Colorado pikeminnow drift. Colorado pikeminnow exit the drift at 0.55 inch and would not be excluded by a 3/32 inch screen (Platania et al., 2000). Thus, it is estimated that about 4 percent of the larvae spawned above the intake would be subject to entrainment. Since only 25 percent or less of the spawn is expected above the proposed diversion, the net loss is expected to be less than 1 percent of all Colorado pikeminnow larvae produced in the San Juan River.

Razorback Sucker – The razorback sucker (*Xyrauchen texanus*) is listed as federally endangered and as a Navajo Nation Group 2 species. Critical habitat for this species is designated as the San Juan River and its 100-year flood plain from Neskahai Canyon in Lake Powell to the Hogback diversion dam. The razorback sucker's range is limited to the Colorado River drainage. Currently, it occurs in portions of the Green River in Utah and the upper Colorado River in Colorado. The largest remaining wild population is in Lake Mohave, Arizona-Nevada. Beginning in 1994, razorback sucker were re-introduced in the San Juan River. This population is reproducing and larval/juvenile razorback sucker have been recaptured from RM 0 to RM 135 (Brandenburg et al., 2002). Stocked razorback sucker use a variety of habitats seasonally. During the cold, winter months they select areas of high habitat diversity. During June, when inundated vegetation is available, razorback sucker use these areas. From August through October, razorback sucker inhabit fast run habitats. Razorback sucker have been documented spawning near Aneth, Utah, at RM 152.2. Reproduction has been documented by the capture of larval razorback sucker since 1999, with substantial increases in capture rates since 1994 (Brandenburg et al., 2002).

Augmentation through stocking is the current focus of razorback sucker recovery efforts on the San Juan River. During the aforementioned 5-year stocking period, fewer fish were available than were called for in the augmentation plan (Ryden and McAda, 2003). Thus, the augmentation plan has been extended to include 11,400 Age-2 razorback suckers per year through 2011. The goal of this augmentation is to establish an adult population of 5,800 razorback suckers. Several grow-out ponds have been established, and more are being developed, to meet the demand of this stocking effort. Additional recovery efforts include mimicry of a natural hydrograph, larval razorback sucker monitoring, control of non-native fish, habitat monitoring, and removal of barriers to fish passage.

Removal of the Cudei diversion and construction of fish passage structures at the Hogback and PNM diversion provide access above the upper end of the razorback sucker's designated critical habitat. Razorback sucker have been documented at the PNM fish passage in 2003 (Lapahie, 2004), indicating the use of the river above designated critical habitat and above the PNM diversion.

Roundtail Chub – The roundtail chub (*Gila robusta*) is listed as a Federal species of concern and by the Navajo Nation as a Group 2 species. It is found in the larger streams of the Colorado Basin from California and Wyoming south to Arizona, New Mexico, and Mexico.

Bluehead Sucker – The bluehead sucker is listed as a Navajo Nation Group 4 species. It is widespread throughout the Colorado River Basin and is also found in Idaho, Wyoming, Nevada, and Utah in the upper Snake, Bear, Walker, and Weber River drainages (BISON-M 2002; Valdez, 1990). This sucker inhabits small streams to large rivers and prefers fast-moving water over rocky substrates and relatively cool, clear conditions (Woodling, 1985; McAda, 1977; Holden and Stalnaker, 1975).

Bluehead sucker are the second most abundant native species and the third most abundant fish overall in the San Juan River from RM 53 to RM 180 (Ryden, 2000a). The bluehead sucker is found in very limited numbers upstream of RM 205, where introduced trout are the dominant species (Wethington, 2002). The highest catch rates for bluehead sucker occur within Reaches 5 and 6; downstream of this area the catch-per-unit effort (CPUE) declines dramatically with each consecutive reach, and no bluehead sucker have been caught below RM 17 (Ryden, 2000a). Large juvenile and adult fish are most common within Reach 6. Downstream of Reach 6, juveniles make up more of the CPUE, although there is no longitudinal trend in size class (K. Lawrence, personal communication, 2003).

During the period of test flows from 1991–97 from Navajo Dam to more closely mimic a natural hydrograph, bluehead sucker CPUE decreased throughout most of the San Juan River. This trend was reversed in 1998 and 1999; the catch of bluehead sucker increased (Ryden, 2000b). Decreasing trends did not occur within Reach 6. CPUE of bluehead sucker increased from 1991 through 1999. At times, over one-half the total catch of bluehead sucker occurred within Reach 6 (Ryden, 2000a). Reach 6 appears to be an important spawning area, and the number of large bluehead sucker present here may provide an important prey base for Colorado pikeminnow (Holden, 1999).

Mottled Sculpin – The mottled sculpin is listed as a Navajo Nation Group 4 species. Mottled sculpin within the Colorado River drainage are considered a unique subspecies.

This species is infrequently collected in the San Juan River in part because most surveys have focused on the middle and lower portions of the river and boat electrofishing does not effectively sample this small, benthic species (K. Lawrence, personal observation). Even so, the mottled sculpin is probably not abundant in the San Juan River, and most specimens have been collected upstream of Hogback diversion (Ryden, unpublished data).

Special Status Plants.—The proposed project area lacks suitable habitat for the Federal and Navajo Nation sensitive species including the Acoma fleabane, bisti fleabane, Brack hardwall cactus, Gooding's onion, Knowlton's cactus, Mancos milkvetch, Naturita milkvetch, Parish's alkali grass, Santa Fe cholla, Sivinski's fleabane, and Zuni fleabane. Therefore, these species are not discussed in any detail in this section.

This section focuses on Federal and Navajo Nation sensitive plant species that may be adversely affected by the proposed project (figure V-6).

Beautiful Gilia – Beautiful gilia (*Gilia formosa)* is a Federal species of concern and is found only in San Juan County on soils derived from the Nacimiento Formation. Beautiful gilia is also known as Aztec gilia. It grows in association with desert salt scrub communities at elevations from 5000 to 6000 feet (New Mexico Rare Plant Technical Council [NMRPTC], 1999).

Mesa Verde Cactus – The Mesa Verde cactus (*Sclerocactus mesa-verdae*) is listed as a federally threatened species and as a Navajo Nation Group 3 species. It is found in San Juan County, New Mexico, and Montezuma County, Colorado (NMRPTC, 1999). Mesa Verde cacti grow in highly alkaline, gypsiferous soils on low, rolling hills formed by the Mancos and Fruitland shale formations at 4900 to 5500 feet. The growth of Shiprock, New Mexico, oil and gas development, and off-road vehicle use threaten populations of the Mesa Verde cactus (NMRPTC, 1999).

NNHP records indicate populations of Mesa Verde cactus within 1 mile of the proposed project main lateral (NNHP, 2003). During field surveys along the main pipeline lateral route adjacent to Route 491, fewer than 100 individual Mesa Verde cactus were documented in one population. The population is located south-southeast of the junction of Route 491 and Navajo Route N36 and is within the boundary of the proposed pipeline alignment. Three additional areas of potential habitat were documented: (1) south of the junction of Route 491 and Navajo Route N36 for approximately 15 miles to the vicinity of Little Water, New Mexico; (2) north of Route 491 and west of the Hogback; and (3) immediately east of the Hogback from the Amarillo Canal to Route 491. During the spring and early summer of 2002, additional surveys were conducted in these areas (ESRI, 2002). Approximately 150 acres were surveyed. No Mesa Verde cacti were

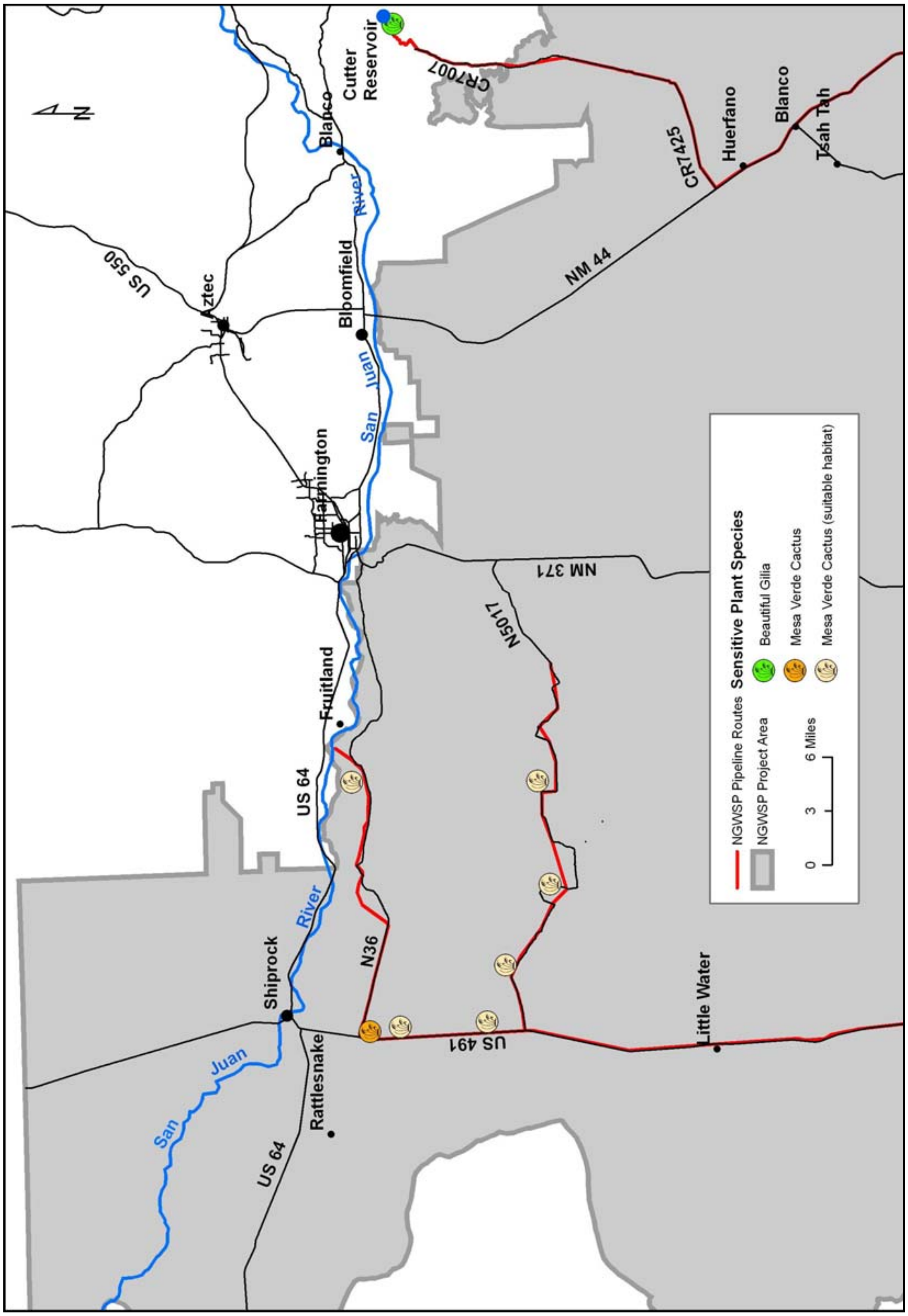

Figure V-6.—Special status plant species within the proposed project area.

observed; however, the area experienced a prolonged drought. During drought conditions, cacti recede into the ground and become very difficult to distinguish.

Special Status Species – Methodology

Special Status Wildlife.—Reports from the NMDGF, NNHP, and BISON-M were reviewed to compile descriptions of sensitive wildlife in the proposed project area. In addition, field surveys were conducted on approximately 290 miles of the proposed pipeline alignments. Each alignment was walked in increments along the centerline and wildlife observations were made on both sides. Binoculars and close visual inspections were used throughout the survey. All potential habitats for threatened and endangered wildlife were examined. Furthermore, sandstone cliffs, large trees, and utility structures within one-quarter mile of the proposed pipeline alignments were visually checked for raptor nests, perching, and roosting sites.

Both direct sightings and indirect evidence (tracks, dropping, burrows, and others) were used to document wildlife presence in the proposed project area (ESRI, 2002).

Special Status Fish.—Data previously collected by the SJRBRIP were used to evaluate impacts to special status fish. No field surveys were conducted.

Special Status Plants.—Reports from the NMGFD, NNHP, and BISON-M were reviewed to compile descriptions of sensitive plants in the proposed project area. In addition, field surveys were conducted on approximately 290 miles of the proposed pipeline alignment (for more information, see the description for "Special Status Wildlife" under "Special Status Species Methodology," above).

Special Status Species – Impacts Analysis

The alternatives would have no potential impacts to the following special status species: mule deer, pronghorn, Rocky Mountain elk, mountain plover, and roundtail chub.[20] There are potential impacts to the following special status species for both action alternatives:

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[20] Habitats are generally poor in the project area for Rocky Mountain elk, so they are expected to avoid these areas and any adverse impacts during construction activity. Although a limited number of roundtail chub have been documented above the proposed PNM intake, the roundtail chub is not expected to be impacted.

- Ferruginous hawk
- Golden eagle
- Kit fox
- Western burrowing owl
- Colorado pikeminnow
- Razorback sucker
- Beautiful gilia
- Mesa Verde cactus

No Action Alternative.—The No Action Alternative would have no impact on special status species in the proposed project area.

SJRPNM Alternative.— The SJRPNM Alternative would potentially impact three additional special status species—bald eagle, Southwestern willow flycatcher, and bluehead sucker. These species are briefly discussed below; additional detail is presented in Appendix C, Part III—Biological Assessment.

Bald Eagle – Under the SJRPNM Alternative, wintering eagles that feed in the San Juan River may be temporarily displaced by construction activity near the PNM diversion. These eagles would likely use other areas of the river and the proposed project area when equipment is idle.

Ferruginous Hawk – The SJRPNM and NIIP Amarillo Alternatives have the potential to affect ferruginous hawks. This species is known to nest within 1 mile of the proposed Cutter Lateral pipeline route, which is a common feature to both alternatives (NNHP, 2003). Construction activities in these areas may disrupt nesting and could lead to nest failures. Project operation is not expected to adversely affect the ferruginous hawk, and no nesting habitats will be damaged by the proposed project; thus, long-term effects are not anticipated.

Golden Eagle – The SJRPNM and NIIP Amarillo Alternatives have the potential to adversely affect the golden eagle. Golden eagles are known to nest within 1 mile of the proposed pipeline route (NNHP, 2003).

Kit Fox – The SJRPNM and NIIP Amarillo Alternatives have the potential to cause local effects on the kit fox. This species has been documented within 1 mile of the proposed pipeline alignment for the SJRPNM and NIIP Amarillo Alternatives.

Southwestern Willow Flycatcher.—Under the SJRPNM Alternative, construction activities at the PNM diversion may affect the Southwestern willow flycatcher. The impact area was surveyed in 1999 with no flycatchers found, although the habitat determination was "good" (Ecosphere, 2001). However, much of the vegetation in the area rated as "good" was removed during the construction of the PNM fish ladder. Most of the remaining habitat is "marginal." The SJRPNM Alternative may affect, but is not likely to adversely affect, the Southwestern willow flycatcher. This species is rare along the San Juan River. Less than an acre of exotic riparian shrub habitat would be removed for project structures, and approximately 17 acres of the same tamarisk habitat may be disturbed during construction. Monotypic tamarisk stands typically provide marginal habitat for the flycatcher, and it is unlikely that this species would be affected by project activities.

During higher flow periods when the Navajo Dam release is at its minimum, the flow below the PNM diversion would be slightly reduced (less than 0.5 percent on average) with negligible effect on potential habitat. Upstream of Navajo Dam, the average reservoir level would be slightly higher (about 2 feet) under project operation compared to baseline, with no difference in change between high and low flow levels each year. Further, inflow would be slightly higher as a result of the transfer of water from the JANNRWSP to the proposed project, so no impacts to Southwestern willow flycatchers above the reservoir are expected.

Western Burrowing Owl – The SJRPNM and NIIP Amarillo Alternatives have the potential to affect Western burrowing owl by project-related ground disturbance. This species was not observed during general wildlife surveys in the proposed project area; however, suitable habitat may be found along the proposed pipeline routes. Any Western burrowing owl nesting along the proposed alignments would be displaced by construction activity. Protective measures include conducting burrowing owl surveys within potential habitat prior to ground-disturbance activities. If active nests were found in the construction area, an appropriate mitigation plan would be developed.

Colorado Pikeminnow – Under the SJRPNM and NIIPAmarillo Alternatives, the critical elements of the Flow Recommendations would be met, as shown in table V-9 and as previously discussed in the "Aquatic Resources" Section. All but two of the flow criteria are met for the worst-case scenario, and these criteria have been determined by the SJRBRIP to be ineffective in accomplishing the anticipated results (Miller, 2005). Under the SJRPNM Alternative, the Flow Recommendations are met 99.99 percent of the time.

Although the SJRPNM Alternative meets the critical elements of the Flow Recommendations, it has the potential to adversely affect Colorado pikeminnow because entrainment of Colorado pikeminnow at the PNM intake might occur. Entrainment of adult and subadult Colorado pikeminnow is limited because of the incorporation of a 3/32-inch fish screen in the proposed project designs, but larval Colorado pikeminnow may still become entrained. While no spawning sites have been documented above this diversion, the quality of gravel bars suggests spawning potential between the PNM diversion and Farmington, New Mexico (Bliesner, 2003). Given the known range of spawning and the availability of spawning habitat above the diversion, up to 1 percent of Colorado pikeminnow spawning may become entrained at the proposed San Juan River intake under the SJRPNM Alternative. While this impact is adverse, it is also negligible.

The San Juan River intake structure, pump, and pipeline would be constructed within designated critical habitat for Colorado pikeminnow, but no adverse modification of critical habitat is predicted. Flows upstream of the PNM weir would actually be greater with the proposed project than current baseline conditions, and water quality risks would remain low.

*Razorback Sucke*r – Under the SJRPNM Alternative, the razorback sucker may also be adversely affected by the possible entrainment of larval fish during spawning. Spawning typically occurs on the ascending limb of the hydrograph during May (Brandenburg et al., 2002). With an assumed potential spawning range from Aneth, Utah, to Farmington, New Mexico (RM 100 to 180), and a uniform distribution of spawning adults in the future, about 16 percent of the larval drift may occur above the proposed PNM diversion. During May, the flow averages about 4,300 cfs, of which 59 cfs (1.4 percent) would enter the proposed project's PNM diversion under the SJRPNM Alternative. Not more than 0.2 percent of the nonretained drifting larvae are predicted to become entrained in the diversion. While this impact is adverse, it is also negligible.

Bluehead Sucker.—Under the SJRPNM Alternative, a portion of the bluehead sucker population would also be vulnerable to entrainment and impingement with intake facilities. Forty percent of Age-1+ bluehead sucker in the San Juan River are found upstream of the proposed intake structure (Propst et al., 2003). Up to 0.4 percent of drifting larval bluehead sucker in the San Juan River may be subject to entrainment. The predicted loss is also negligible.

Beautiful Gilia.—The SJRPNM Alternative has the potential to adversely affect beautiful gilia. Approximately 100 plants are documented east of the proposed pipeline route centerline about 1,000 feet south of Cutter Dam (ESRI, 2002). These plants may be disturbed or displaced by the water treatment facility planned for the base of Cutter Dam. The pipeline exiting Cutter Dam may also disturb this population. Beautiful gilia populations on disturbed sites appear to recover over time (NMRPTC, 1999).

Mesa Verde Cactus.— The SJRPNM and NIIP Amarillo Alternatives have the potential to adversely affect the Mesa Verde cactus. The single population documented within the boundary of the main lateral and an associated pumping plant would be impacted. Additional habitat is found along the main lateral, and several populations are found within a mile of the main lateral alignment (NNHP, 2003).

NIIP Amarillo Alternative.—With the exception of sensitive fish and riparian-dependent species previously discussed, all other sensitive species effects would be similar to those described under the SJRPNM Alternative.

Because all project water would be delivered via the NIIP intake in Navajo Reservoir, there is no potential for entrainment of Colorado pikeminnow, razorback sucker, or bluehead sucker. No Southwestern willow flycatcher or bald eagle habitat would be affected under the NIIP Amarillo Alternative. Critical elements of the Flow Recommendations would be met, as previously discussed in the SJRPNM Alternative.

Special Status Species – Mitigation Measures

Potential mitigation measures to avoid or minimize impacts to affected sensitive species are discussed below. Reasonable and prudent measures (RPM) are not included. (RPMs are measures to reduce incidental take of threatened or endangered species defined in the biological opinion as terms and conditions. The terms and conditions are nondiscretionary actions required by the action agency and are not included as mitigation measures).

- Proposed measures for ferruginous hawk and bald eagle include conducting surveys of the proposed construction areas 1 year in advance of construction for pipeline routes and construction sites that are not adjacent to highways, well-traveled roads, or areas of regular human activities. If active nests are found as a result of the surveys, appropriate protective measures could be developed to avoid or minimize nest disturbance.

- Construction could be managed to avoid intentional disturbance of dens for kit fox, as construction activities may discourage or disrupt denning activities.

- Proposed mitigation measures for Southwestern willow flycatcher include surveying prior to construction within ¼ mile of the disturbed area and avoiding activity during the nesting period (March 15 to August 15) if the species is found. Any riparian vegetation removed may be replaced with appropriate native species, either on-site if the disturbance is temporary, or at an alternative location if the disturbance is permanent, as described in the "Vegetation Resources" section.

- Mitigation measures for beautiful gilia should include delineating and avoiding plants where possible.

- Proposed mitigation measures to protect existing populations of Mesa Verde cactus include:

(1) Where possible, refine the pipeline alignment to avoid individual cacti and populations as a whole.

(2) Select an alternate site for the pumping plant currently planned for the intersection of Route 491 and Navajo Route N36.

(3) Mark cacti with protective cones when construction activity occurs in their vicinity.

(4) Where conflicts are unavoidable, prior to disturbing areas where cacti are growing, dig up susceptible plants, place in a safe area, and re-plant these cacti without delay once construction in the area is complete.

(5) Consult with a qualified botanist during marking and/or transplant of cacti.

Special Status Species – Summary of Impacts

Both action alternatives have the potential to affect Colorado pikeminnow, razorback sucker, ferruginous hawk, golden eagle, kit fox, Western burrowing owl, beautiful gilia, and Mesa Verde cactus. However, implementation of proposed mitigation measures would avoid or reduce impacts for most sensitive species. Both alternatives meet the critical elements of the Flow Recommendations, and the Flow Recommendations are met 99.99 percent of the time. All but two of the flow criteria are met for the worst-case scenario, and these criteria have been determined by the SJRBRIP to be ineffective in accomplishing the anticipated result (Miller, 2005).

The SJRPNM Alternative has the potential to affect three additional species: bald eagle, Southwestern willow flycatcher, and bluehead sucker. Incidental take of Colorado pikeminnow, razorback sucker, and bluehead sucker larvae at the PNM intake structure might also occur under the SJRPNM Alternative.

Recreation

This section addresses the potential impacts to recreation that could result from actions associated with the proposed project under the alternatives considered.

Issue: How would the No Action, SJRPNM, and NIIP Amarillo Alternatives affect recreation?

Overview

Scope

The recreation analysis includes Navajo Reservoir and the San Juan River corridor from Navajo Dam to the Clay Hills rafting take-out area near Lake Powell in the Glen Canyon National Recreation Area.

Impact Indicators

Impacts were measured using various indicators, including changes in:

(1) Visitor recreation experience
(2) Traditional uses (e.g., fishing, camping, hunting, and rafting)
(3) Fishery habitat
(4) Riverflow levels

Recreation – Affected Environment

The study area is analyzed in four river segments and two general recreation areas (figure V-7): (1) Navajo Reservoir; (2) San Juan River corridor from Navajo Dam to Blanco, New Mexico; (3) San Juan River corridor from Blanco, New Mexico, to Montezuma Creek; (4) San Juan River corridor from Montezuma Creek to Clay Hills, Utah; (5) general recreation on the Navajo Nation lands within the proposed project area; and (6) general recreation on the Jicarilla Apache lands within the proposed project area.

Navajo Reservoir.—About 80 percent of Navajo Reservoir and its associated lands are located in New Mexico and approximately 20 percent in Colorado. The reservoir and lands that immediately surround it offer a variety of water-based recreation opportunities, at least one-half of which center on abundant fishing opportunities for a variety of fish, including bass, trout, crappie, northern pike, and kokanee salmon. As the lake waters warm in the summer, usage shifts to water-based sports such as water skiing. In recent years, there has been a noticeable increase in the number of family groups on summer vacation from Colorado visiting the reservoir. Other popular activities are boating, swimming, picnicking, camping, and, to a lesser degree, hiking, wildlife viewing, and hunting.

While the United States owns the reservoir and lands within the reservoir boundary, recreational uses are administered primarily by the Colorado Division of Parks and Outdoor Recreation and the New Mexico Department of Parks and Recreation (NMDPR). The parks are open year round, with seasonal closures in some areas to conserve natural and park resources.

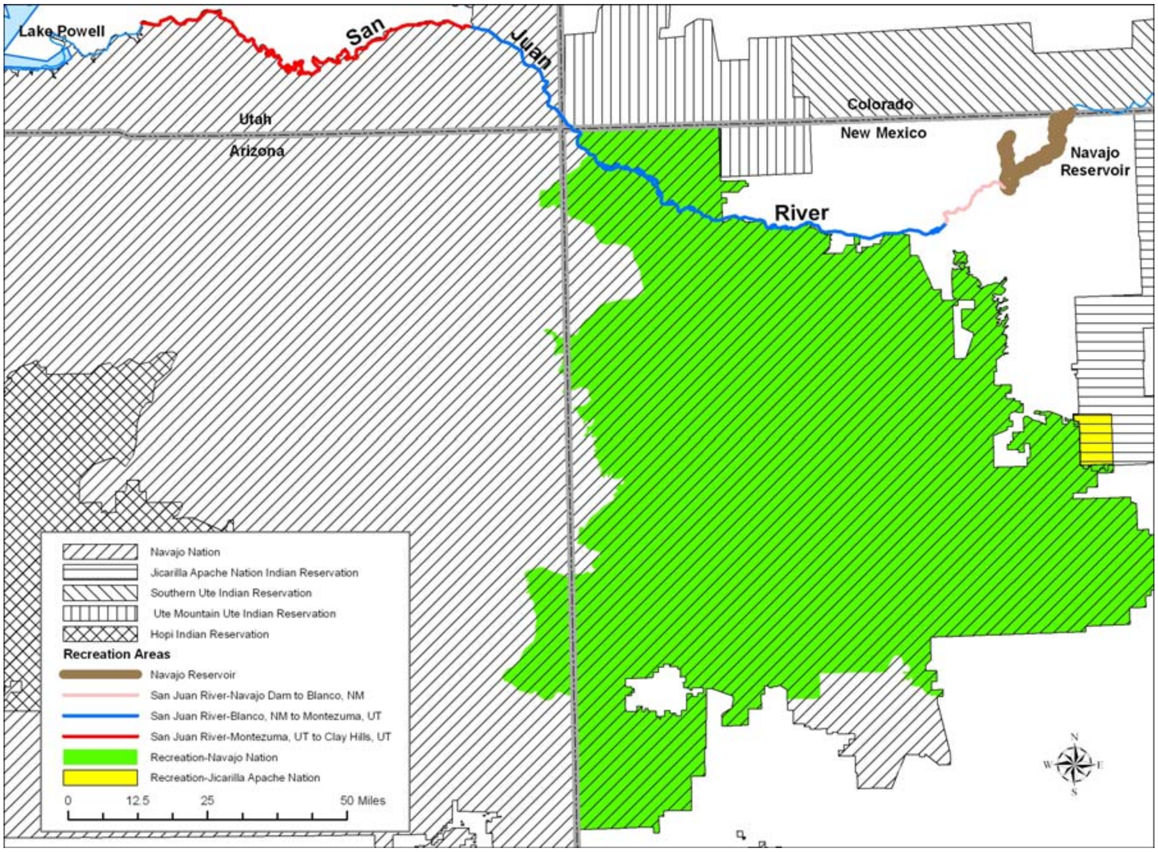

Figure V-7.—San Juan River segments and general recreation areas potentially affected by the proposed project.

Developed Recreation – Developed recreation facilities currently available for public use at Navajo Reservoir include swimming beaches, marinas, boat launch facilities, campgrounds, numerous picnic areas, and hiking trails. Extensive renovations of recreation facilities on the Colorado side were completed in 2002. Improvements included construction of a large parking lot, a new fishing access, 3 campgrounds totaling 110 sites, an enlarged amphitheater at the existing campground, additional picnic sites, rental cabins, a group-use area, and a new park headquarters.

Undeveloped Recreation – Concentrated use in Colorado occur at Arboles Point and several locations along the San Juan and Piedra arms of Navajo Reservoir. The San Juan and Piedra Rivers are both popular trout fishing areas. Kokanee salmon snagging is seasonally allowed within the Navajo Recreation Area. Designated roads provide easy vehicular access to parking areas near the reservoir from both the east and west sides of the Piedra arm, where day use (picnicking, fishing, and hiking) and primitive camping in designated areas regularly occurs throughout the summer recreation season.

In New Mexico, dispersed use occurs at many locations, with access provided by numerous roads developed for natural gas production. In addition, the many coves of the reservoir are attractive for camping and exploring by boat. Water skiing is allowed on most of the reservoir except in some of the canyons where the channel becomes too narrow or shallow to safely ski.

Park Visitation Levels – Visitation to Navajo Reservoir has increased by 61 percent since 1990, an average rate of 8.6 percent per year. In 1999, total visitation equaled 534,099 in the New Mexico portion of Navajo Reservoir. Boating and camping uses on the reservoir are concentrated within a 4-month period, while the San Juan River attracts heavy use on a year-round basis. Additional information on visitation levels, visitor profiles, visitor activities, and satisfaction levels can be found in the Navajo Reservoir Operations FEIS (Reclamation, 2006).

San Juan River.—

Navajo Dam to Blanco, New Mexico (Tailwater Trout Fishery) – Navajo Dam tailwater is a unique environment characterized by cobble substrate and cool hypolimnetic releases. The NMDGF manages the tailwater as a trout fishery from the base of Navajo Dam 17 miles downstream to Blanco, New Mexico. The upper 4 miles are managed as special trout water. Regulations within the first one-quarter mile require catch-and-release using only barbless flies and lures. The remaining 3.75 miles carry the same tackle restrictions, but anglers are allowed to keep one fish over 20 inches per day. Immediately downstream of the special trout water for 3.3 miles (to the confluence of the San Juan River and Gobernador Arroyo) are regular regulation waters. NMDGF imposes no tackle restrictions in this reach and allows a daily bag limit of five fish. The remaining 10 miles of river to Blanco, New Mexico, are under the same regulations, but are bordered by private land and less accessible to anglers (Wethington, 2002).

Hunting activities on the river are restricted to waterfowl and small game, while the surrounding areas offer opportunities such as camping, picnicking, hiking, wildlife viewing, and bird watching. Along this reach, day-use areas provide fishing access to the San Juan River and, in some cases, boating access.

No recreational boats are allowed for the first 1.5 miles below the dam; beyond that, float fishing is popular. In 2002, 43 outfitters and 89 guides were licensed to operate on this reach of the San Juan River (Reclamation, 2006). Outfitters are not limited on the number of days they can operate. Most outfitters (93 percent) that use dory boats put in at the Texas Hole Day-Use Area below Navajo Dam and take out at the Gravel Pit Day-Use Area at the end of the quality waters.

Annual NMDGF electrofishing surveys from 1997–2001 found an increasing percentage of brown trout in the special trout water and regular regulation reaches. Increases in brown trout numbers may be due to improved spawning success associated with high spring releases from Navajo Dam. The average length of rainbow trout from the special regulation waters was 15 inches, and on average, 18 percent of the rainbow trout were over 18 inches. In contrast, less than 2 percent of trout in the regular regulation waters were over 18 inches; trout in regular regulation waters averaged 9 inches. Since then, NMDGF has managed the effects of whirling disease by stocking only fish 4 inches or larger (Wethington, 2002).

Further downstream, very good brown and rainbow trout fishing from Citizens Ditch to Hammond diversion (within Navajo Dam to the Blanco stretch of the San Juan River) exists. Because the river is bounded by private lands in this area, fishing data are not available. Within the quality waters along the San Juan River, over one-half of all visitors to the river were from out of State, primarily from Texas, Colorado, Arizona, or California. Only 25 percent of visitors to the river are of local origin. Downstream from the quality waters, out-of-State users have made up 8 to 15 percent of users in recent years. Total annual angler days in the first 7.5 miles of river varied from an estimated 44,000 to 61,000 between 1995 and 2001. The months of July through October have the highest use. Approximately 6,000 to 7,000 of these visitors use guides or outfitters (Reclamation, 2006).

The fishery in the lower 10-mile reach is maintained primarily through natural reproduction of brown trout. In 1992, the fish composition within this reach included 62 percent native species (flannelmouth sucker, bluehead sucker, and mottled sculpin). By 1998, this number had declined to less than 1 percent. Higher releases from Navajo Dam associated with the 199–97 Navajo Dam test flows may be causing this shift (Wethington, 2002).

NMDGF creel surveys found catch rates up to 1.23 fish per hour in the special trout waters; however, less than 1 percent of anglers had harvested a fish. Approximately 90 percent of the trout surveyed in these waters showed hooking scars. In contrast, over 90 percent of the fish over 8 inches caught in the regular regulation waters were harvested. Catch rates averaged 0.57 fish per hour. Creel data are not available for the lower 10-mile reach due to lack of access (Wethington, 2002).

Blanco, New Mexico, to Montezuma Creek, Utah – Below the trout fishing area that ends at the Hammond diversion, the San Juan River is not managed for recreation purposes by any public entity. The river is predominately flanked by private lands to just past Farmington, New Mexico, where it is bordered on the north by private lands and on the south by Navajo Nation lands. This land ownership pattern continues for several more miles until the river is adjoined on both sides by Navajo Nation lands. Recreation in this area is minimal; there is little fishing and float boating. Numerous water diversions in this reach make floating difficult and dangerous (Reclamation, 2006).

When the river enters Navajo Nation lands, recreation management is administered by the Navajo Nation Parks and Recreation Department (NNPRD). Although the NNPRD does not issue rafting permits or track rafting numbers, it does issue about 450 camping and hiking permits annually for the river corridor at a cost of $5 per permit. Besides camping and hiking, these visitors also fish for catfish. A lack of river access to the general public appears to limit rafting in this stretch.

Montezuma Creek, Utah, to Clay Hills, Utah – BLM has management responsibilities along the river for 104 miles from Montezuma Creek to Clay Hills, Utah, in conjunction with the Navajo Nation and the National Park Service (NPS). Most rafting occurs between the Sand Island launch site near Bluff, Utah, the Mexican Hat boat launch site near Mexican Hat, Utah, and the Clay Hills boat launch in the Glen Canyon National Recreation Area. The rafting access facilities at Clay Hills are affected by Lake Powell water levels and riverflows. In particular, large sediment deposits and low flows can make it very difficult to access the boat launch site.

BLM manages commercial trips by issuing permits based on historical use and allowing changes at the outfitters' request and within guidelines. At Sand Island, the commercial sector is allowed one to two launches per day. The core season for rafting companies is June through August. However, there is additional use during March through May and September and October. Private rafting is managed by requiring permits all year, and about 900 permits are issued each year. August to March permits are issued on a first-come, first-served basis, while lottery draws fill the launch calendar from mid-April to the end of July. Additional information on rafting use on this stretch of the San Juan River can be found in the Navajo Reservoir Operations FEIS (Reclamation, 2006).

General Recreation on Navajo Nation Lands – General recreation on the Navajo Nation is managed by the NNPRD. Recreation opportunities include hiking and camping on the Navajo Nation. For the protection of natural and cultural resources, the NNPRD has implemented guidelines for backcountry use. The trails are not improved or maintained and are usually marked with rock cairns. Most trails are rated strenuous to moderately strenuous. A number of trails and routes are used by hikers from the Little Colorado Gorge, from Cameron to the confluence with the Colorado River, Marble Canyon bordering the Navajo Nation from Lee Ferry to the confluence of the Little Colorado River; side canyons of the San Juan River bordering the Navajo Reservation from Sand Island (Montezuma Creek) to Paiute Farms Wash, and Rainbow Bridge trails around Navajo Mountain (NNPRD, 2005). Established recreation trails are limited within the proposed project area.

A backcountry permit fee of $5 per person is required by the Navajo Nation. The Navajo Nation also issues camping permits at a rate of $5 per person, per night. Dune buggies, jeeps, 4-wheel drive vehicles, and motorcycles are prohibited off established trails (NNPRD, 2005).

The NNPRD also manages Navajo Tribal Parks, which include (1) Monument Valley National Park, (2) Antelope Canyon, (3) Bowl Canyon Navajo Recreation Area, (4) Four Corners Monument, (5) Little Colorado Gorge Overlook, (6) Navajo Nation Zoo and Botanical Park, (7) Window Rock Sports Center, and (8) the Veterans Memorial Park (NNPRD, 2005). Only the last three parks listed are within the proposed project service area and may receive domestic water from the proposed project.

Hunting, fishing, and boating activities on Navajo Nation lands are managed by the Navajo Nation Department of Fish and Wildlife (NNDFW). Limited hunting occurs within the proposed project area (NNDFW, 2005).

General Recreation on Jicarilla Apache Nation Lands – General recreation on Jicarilla Apache Nation lands is managed by the Jicarilla Game and Fish Department (JGFD). Activities include hunting, fishing, boating, and camping (JGFD, 2005). Fishing, camping, and boating activities are limited to the Navajo River and lake in the northeastern portion of the reservation. The Jicarilla Apache Nation manages a hunting and fishing program that provides hunting opportunities to Tribal and non-Tribal members. Hunting programs focus on mule deer, elk, mountain lion, black bear, and turkey and also are primarily restricted to the northern portion of the Jicarilla Apache Reservation. Hunting activities within the proposed project area of the reservation are limited to Tribal members.

Recreation – Methodology

Data used in this analysis were initially presented in the Navajo Reservoir Operations FEIS because more current information was not available in a complete form when this analysis was conducted. In addition, it was assumed that for all alternatives, based on historic trends, there would be continued increases in demand for fly fishing on the San Juan River below Navajo Dam, continued pressure on BLM to issue more river rafting use permits on the Lower San Juan River during the summer, increased Navajo Reservoir recreation (about 5 to 6 percent annually), and an increased demand for recreation activities on Navajo and Jicarilla Apache Nation lands.

Impacts were evaluated by developing baseline information, using the hydrologic model, modeling trout physical habitat, and extrapolating results from results of the 2001 Summer Low Flow Test and the 1996–97 Winter Flow Tests (Reclamation, 1998 and 2002b).

The development of baseline information came from researching the consulting Federal, State, Tribal, county, and city agencies; publications; and using existing information collected in the Navajo Reservoir Operations FEIS.

Recreation – Impacts Analysis

No Action Alternative.—Under the No Action Alternative, the following future resource conditions are predicted.

Navajo Reservoir Recreation – Under the No Action Alternative, average reservoir elevation reductions of approximately 10 feet are expected to occur during the recreation season (April through October). In dry periods, this fluctuation could average as much as 30 feet. Low water levels and accompanying exposure of mud flats, gravel bars, tree stumps, and rocks could reduce boating, fishing, and reservoir aesthetic values, especially in the Colorado portion where the waters are generally shallower.

River Recreation – Future conditions under the No Action Alternative predict reductions over time in trout habitat and decreased angling success. Downstream rafting recreation is also predicted to decrease under the No Action Alternative. Both the trout fishing and river rafting future conditions are discussed below.

Trout Fishing – Under future conditions for the No Action Alternative, flows immediately below Navajo Dam would range from approximately 250 cfs to 500 cfs 70 percent of the time. Dory boat fishing becomes more difficult under these lower flow conditions, and wade fishing tends to increase. Conflict between wade and boat fishing may increase as use overlaps during low-flow periods. The existing and future conditions of the recreational fisheries resource are discussed in the “Aquatic Resources” section.

Under the No Action Alternative, it is predicted that some outfitters would continue float fishing trips at lower flows and use rubber or vinyl rafts that are able to float the river at these lower flows, representing a change from the more commonly used dory boats. When flows drop below 500 cfs (estimated at 63 percent of the time during high-use months), crowding or concentrating fishing use of popular locations is expected.

Actual fishing use depends on many factors: catch rate, size of fish, angler crowding, economic conditions, regional human population growth, and other considerations; therefore, it is not possible to accurately predict changes in fishing use. In the short term, it is anticipated that more shore or wade fishing would be substituted for a portion of dory boat use because of navigation problems.

Table V-11 shows estimated angler hours and days for both the quality and regular water below Navajo Reservoir from 1995–2001 (Wethington and Wilkenson, 2004). Under the

Table V-11.—Estimated angler use below Navajo Reservoir

	Quality waters		Regular waters		Total	
Year	**Angler hours**	**Angler days**	**Angler hours**	**Angler days**	**Angler hours**	**Angler days**
1995	160,909	32,181	47,910	11,977	208,819	44,158
1996	238,140	47,628	54,211	13,553	292,351	61,181
1997	213,324	42,664	54,985	13,746	268,309	56,410
1998	222,172	44,434	47,218	11,805	269,390	56,239
1999	243,842	48,768	46,737	11,684	290,579	60,452
2000	216,688	43,333	34,668	8,667	251,336	52,000
2001	175,053	35,010	36,051	9,013	211,110	44,023

Note: Data taken from Wethington and Wilkenson, 2004.

No Action Alternative, predicted adult trout habitat reduction is assumed to result in fewer fish and reduced quality of the recreation experience and perhaps reduced angler use below Navajo Dam when compared to the 1995–2001 period. Trout habitat would be reduced 30 to 37 percent when dam releases decline from 500 to 250 cfs, average river depth would be reduced by 4.5 inches and wetted perimeter by 5 to 10 percent, and while trout numbers are predicted to diminish significantly, they are not expected to decline in proportion to habitat reduction (Reclamation, 2006).

Reductions in angling below the quality waters to Blanco, New Mexico, when compared to the 1995–2001 period (table V-11) are also predicted under the No Action Alternative. This reduction would be proportionally greater than those expected in the quality waters because of further reduced flows under the No Action Alternative.

Rafting – Optimum flow conditions for rafting under the No Action Alternative occur less frequently in the future under the No Action Alternative because of reduced base flows. Optimum flows for rafting average 1,000 to 3,000 cfs, and most commercial rafters currently do not raft the river when flows drop below 500 cfs because of safety concerns and problems with river navigation. Between 500 and 800 cfs, commercial rafters can use smaller boats, but the smaller boats have reduced capacity and efficiency and therefore increase costs. The river, however, would remain floatable throughout the recreation season because one of the Flow Recommendations criteria is to maintain flows above 500 cfs for endangered fish habitat.

General Recreation on Navajo Nation and Jicarilla Apache Lands – The No Action Alternative would have no effect on general recreation activities on Navajo Nation and Jicarilla Apache lands. Hunting, fishing, hiking, and camping activities would continue. Other recreational developments would continue to be limited by the available water supply.

SJRPNM Alternative.—When compared to the No Action Alternative, there would be limited benefits to river recreation based on additional releases from Navajo Dam to meet the proposed project's demands.

Reservoir Recreation – Under the SJRPNM Alternative, mean reservoir elevations would increase by 1.3 feet when compared to the No Action Alternative. However, in dry periods, reservoir elevation average fluctuations would be as predicted under the No Action Alternative. The SJRPNM Alternative is predicted to have no measurable impact on reservoir recreation.

River Recreation – River recreation would slightly benefit under the SJRPNM Alternative, and potential impacts associated with the SJRPNM Alternative are as follows:

Trout Fishing – The SJRPNM Alternative would provide additional flows in the San Juan River from Navajo Dam to the PNM diversion to meet project demands. This would result in up to an additional 40 cfs during drought conditions when natural flows were not able to meet the proposed project's demand. Under extreme drought conditions, this would result in a 27- to 66-percent increase in summer flows (60 to 150 cfs increased to 100 to 190 cfs flows) below the Citizens Ditch. The SJRPNM Alternative would benefit the trout fishery by decreasing the frequency of flows that drop below 134 cfs when water quality parameters exceed tolerance limits for trout. Additional discussion is included in the "Aquatic Resources" section.

Rafting – The SJRPNM Alternative would have no measurable effect on downstream rafting recreation when compared to the No Action Alternative. All Flow Recommendations criteria would be met under this alternative, which would maintain base flows near Bluff, Utah, at 500 cfs or higher, maintaining minimum floatable flows to the Clay Hills takeout. In addition, the higher spring releases required to meet the Flow Recommendations would continue to flush accumulated sediments further into Lake Powell, making the river more floatable.

General Recreation on Navajo Nation Lands – The SJRPNM Alternative is predicted to have no adverse impacts on general recreation activities on Navajo Nation lands within the proposed project area. No campgrounds, hiking trails, or established recreation areas would be affected. Hunting activities are limited within the proposed project area due to the types of habitat that occur within the proposed project area (see the "Vegetation Resources" and "Wildlife Resources" sections).

An occasional Tribal member hunts small game or elk (NNDFW, 2005). Construction could temporarily displace wildlife game species, which could reduce hunting success; however, construction is not expected to significantly affect hunting opportunities on the Navajo Nation.

Existing Tribal parks within the proposed project service area (the Navajo Nation Zoo and Botanical Park, Window Rock Sports Center, and the Veterans Memorial Park) would likely benefit from a dependable domestic water supply. In addition, a dependable domestic water supply would enable future recreational development within the proposed project area. However, no future plans to expand recreational features (camping, hiking, and others) within the proposed project area have been identified by the Navajo Nation.

General Recreation on the Jicarilla Apache Lands – The SJRPNM Alternative is predicted to have no adverse impacts on general recreation activities on Jicarilla Apache Nation lands within the proposed project area. No campgrounds, hiking trails, or established recreation areas would be affected. Hunting activities are limited within the proposed project area due to the types of habitat that occur within the proposed project area (see the "Vegetation Resources" and "Wildlife Resources" sections).

Dependable water supplies in the Jicarilla Apache Nation portion of the proposed project would allow the Jicarilla Apache to develop and promote recreational opportunities in this area; however, no recreational developments are planned as part of the proposed project.

NIIP Amarillo Alternative.—With the exception of river recreation, impacts to recreation resources under the NIIP Amarillo Alternative would be similar to those of the SJRPNM Alternative.

Reservoir Recreation – Under the NIIP Amarillo Alternative, mean reservoir elevations would increase by 0.9 foot; however, during dry periods, reservoir elevations' average fluctuations would continue as described under the No Action Alternative. The SJRPNM Alternative is predicted to have no measurable impact on reservoir recreation.

River Recreation – River recreation impacts under the NIIP Amarillo Alternative would be similar to those under the No Action Alternative because no additional releases would be made from Navajo Dam to meet project demands.

Trout Fishing – The NIIP Amarillo Alternative would have no effect on trout fishing. Additional flows would not be released downstream of Navajo Dam to meet project demands because all water demands would be delivered through the NIIP system upstream of Navajo Dam.

Rafting –Rafting impacts are the same as those under the SJRPNM Alternative.

General Recreation on Navajo Nation Lands – Impacts to general recreation activities on the Navajo Reservation would be similar to those described for the SJRPNM Alternative.

General Recreation on Jicarilla Apache Lands – The impacts are the same as those for the SJRPNM Alternative.

Recreation – Mitigation Measures

No mitigation measures are proposed for the SJRPNM or NIIP Amarillo Alternatives.

Recreation – Summary of Impacts

The SJRPNM and NIIP Amarillo Alternatives are predicted to have no measurable effect on reservoir recreation or general recreation activities on the Navajo and Jicarilla Apache Nation lands. However, when comparing the SJRPNM Alternative to the No Action and NIIP Amarillo Alternatives, there would be some benefits to trout fishing below Navajo Dam under the SJRPNM Alternative based on additional releases via the San Juan River to meet project demands.

Land Use

This section addresses the potential impacts to land use that could result from actions associated with the proposed project under the alternatives considered.

Issue: How would the No Action, SJRPNM, and NIIP Amarillo Alternatives affect land use?

Overview

Scope

The scope includes lands in use from Navajo Dam and Reservoir downstream along the San Juan River to Lake Powell and the proposed project service area.

Impact Indicators

Irreversible changes in land use within the proposed project area.

Land Use – Affected Environment

Figure V-8 shows land ownership within the proposed project area. There are approximately 5,060,064 acres within the proposed project service area. These lands include privately owned lands, lands owned by the State of New Mexico, and lands owned by the United States (Federal lands). Federal lands include lands held by the BIA in trust for the Navajo and Jicarilla Apache Nations, as well as lands under the jurisdiction of BLM, the Forest Service, Reclamation, and the Department of Defense (table V-12). Major landowners within the proposed project service area include Federal lands held in trust by the BIA for the Navajo Nation (76 percent), Federal lands under the jurisdiction of BLM (14 percent), and private landowners in New Mexico (5 percent).

Navajo Reservoir.—Federal lands under the jurisdiction of Reclamation around and below Navajo Reservoir are managed for uses compatible with Navajo Dam and Reservoir (including mineral extraction, grazing, wildlife, and recreation) by State and Federal entities under agreements with Reclamation. Recreation-based lands within Navajo State Park are managed by the Colorado Department of Parks and Recreation and the NMDPR.

A mixture of Federal, State, Tribal, and private land surrounds Navajo State Park. In New Mexico, Federal land adjacent to Navajo State Park are under the jurisdiction of BLM; State lands are managed by the NMDGF and New Mexico State Land Office. In Colorado, Southern Ute Indian lands are managed by the Tribe. Private lands bordering Navajo Reservoir in Arboles, Colorado, remain primarily agricultural with some areas of rural residential development.

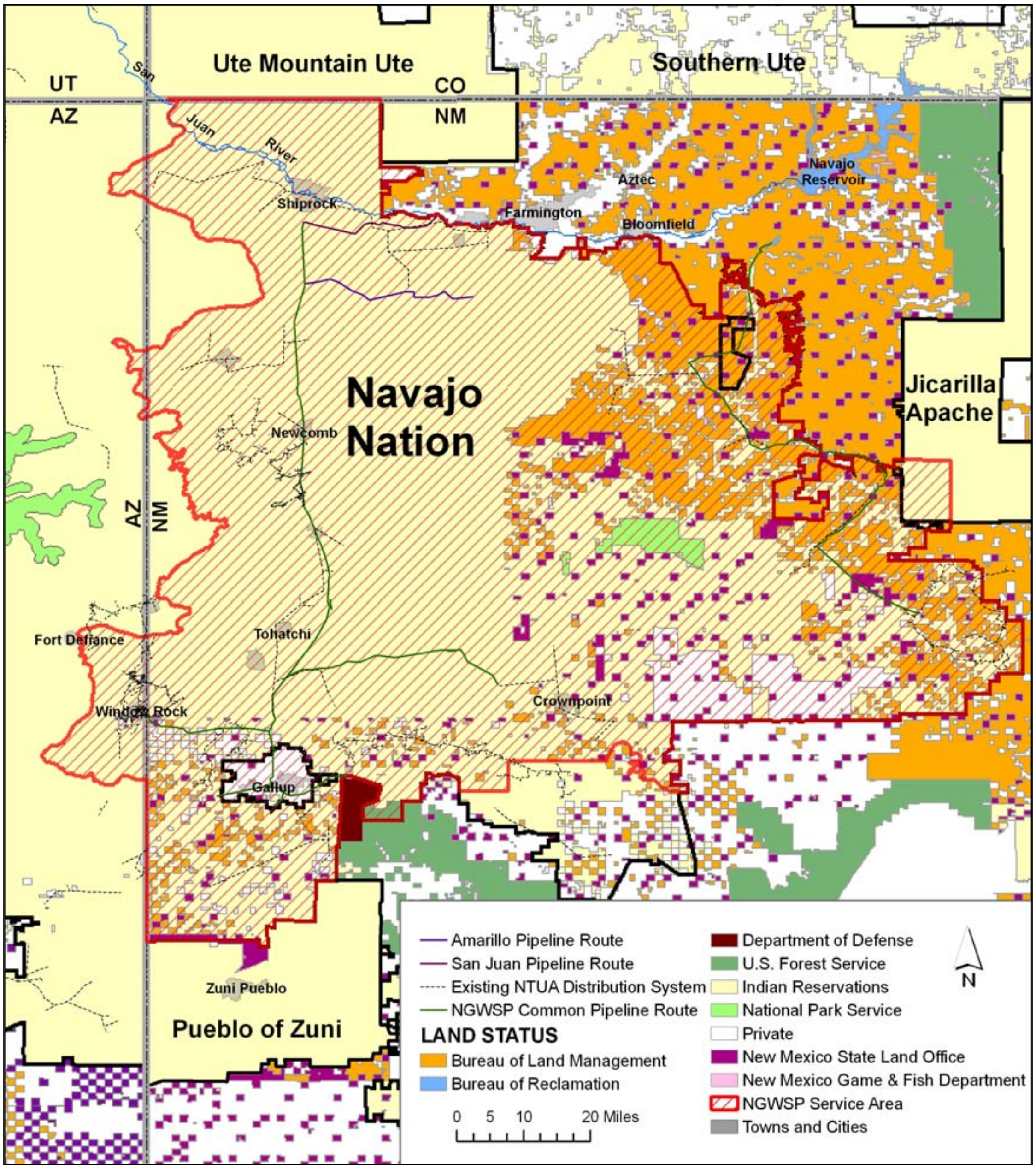

Figure V-8.—Land ownership within the proposed project area.

Indian Reservations.—Navajo Nation lands comprise the largest Indian reservation holdings within the proposed project area (79 percent of the project area). Of Navajo Nation lands, approximately 3,730,555 acres occur in New Mexico and 140,891 within Arizona. Forty-three Navajo Nation chapters would be serviced by the proposed project (see the "Indian Trust Assets" section for additional discussion). The latest Navajo

Table V-12.—Land ownership within the project area

Ownership	Acres	Percent
Navajo Nation – New Mexico	3,730,555	73
Navajo Nation – Arizona	140,891	3
BLM	680,014	13
Private – New Mexico	251,693	5
Private – Arizona	1,376	<1
State of New Mexico	179,666	4
NPS	34,199	<1
Jicarilla Apache Nation	33,954	<1
U.S. Forest Service	7,488	<1
Reclamation	164	<1
Department of Defense	64	<1
Total	5,060,064	

Reservation land Use Plan is dated March 2, 1961, and primarily inventories physical features, conditions, and resources at that time. An updated Land Use Plan is in progress, but not ready for public use.

Some Jicarilla Apache lands (approximately 33,954 acres, or less than 1 percent of total Jicarilla lands) within the southwest corner of the Jicarilla Apache Reservation are also included within the proposed project area. The Southern Ute Indian Reservation borders Reclamation lands on the Colorado side of Navajo Reservoir and the north end of the San Juan River in Colorado. The Ute Mountain Ute Tribe has a small portion of land within the San Juan River corridor within the Four Corners area in Colorado-New Mexico. The Pueblo of Zuni borders the Navajo Nation south of Gallup, New Mexico. The Southern Ute, Ute Mountain Ute, and Pueblo of Zuni Reservations are not serviced or affected by the proposed project.

BLM.—No project water is planned for delivery to Federal lands under the jurisdiction of BLM. Primary land use activities on BLM's 680,014 acres include mineral extraction and livestock grazing. Roads and pipeline corridors constructed for natural gas development are common in this area.

Private and Other Lands.—Private lands in the proposed project service area include approximately 251,693 acres in New Mexico and 1,376 acres in Arizona. A majority of these lands are "in-holdings" within the Navajo Reservation. Private lands in the proposed project area fall under the jurisdiction of San Juan and McKinley Counties in New Mexico and Apache County in Arizona. The proposed project service area also includes the city of Gallup, New Mexico, which is approximately 7,200 acres.

Approximately 179,666 acres (4 percent) within the proposed project area are owned by the State of New Mexico. Other Federal lands include 34,199 acres under the jurisdiction of the NPS (Chaco Culture National Historic Park), 164 acres under the jurisdiction of Reclamation, and 64 acres under the jurisdiction of the Department of Defense (less than 1 percent).

Land Use – Methodology

Contacts were made with various State, county, and local government agencies and the Navajo and Jicarilla Apache Nations to discuss land use impacts from implementation of the No Action, SJRPNM, and NIIP Amarillo Alternatives.

Land Use – Impacts Analysis

No Action Alternative.—The No Action Alternative would have no effect on existing land uses in the Navajo Reservoir area. The No Action Alternative would, however, limit changes in land use to meet future needs on the Navajo Nation. The absence of dependable domestic water supplies and long distances to haul water for domestic use would limit the Navajo Nation's abilities to meet future demands for housing and economic development. Land use planning for the city of Gallup would also be impacted by a decreasing domestic water supply as existing groundwater wells become exhausted.

The Jicarilla Apache Nation, on the other hand, has other viable options to deliver water to meet future water demands on the Jicarilla Apache Nation lands within the proposed project area. The No Action Alternative would have no effect on land use for other lands within the proposed project service area.

SJRPNM Alternative.—The SJRPNM Alternative would have no effect on existing land uses within the Navajo Reservoir area.

Under the SJRPNM Alternative, dependable domestic water supplies would be available to accommodate land use changes needed to meet Navajo and Jicarilla Apache Nation population growth projections. Foreseeable changes in land uses for the Navajo Nation include increased housing densities within the existing Navajo Tribal Utility Authority (NTUA) service areas.

Lands within 1 mile of the existing NTUA distribution system and proposed project pipeline were used to estimate potential new housing and economic development within the Navajo Reservation. An estimated 9 percent (714,637 acres) of Navajo Nation lands occur within 1 mile of these features (668,634 acres in New Mexico; 46,003 acres in Arizona). Service-industry businesses (i.e., gas stations, grocery stores) would likely increase in these areas as well.

Jicarilla Apache Nation lands serviced by the proposed project would also experience some changes in land use. The SJRPNM Alternative includes a turn-out in the Cutter pipeline lateral capable of providing up to 1,200 acre-feet of water to the Jicarilla Apache Nation for future use and development. The dependable water supply provided by the proposed project would assist the Jicarilla Apache Nation in housing development for its members along U.S. Highway 44 and New Mexico State Road 573. The Jicarilla Apache Nation economic development plans for this area center on an existing casino and planned travel service center and accompanying business at and near the U.S. Highway 44/State Road 537 junction, where Jicarilla-refined fuel would be sold at retail and possibly wholesale. In addition, the Jicarilla Apache Tribal Utility Authority may ultimately develop a 100-megawatt, gas-fired commercial plant that could supply local power needs and also sell wholesale power on the open market.

The majority of the SJRPNM's pipeline route would follow existing transportation and utility corridors. A total of 31,686 acres would be temporarily disturbed during construction, as described in the "Vegetation Resources" section. Table V-13 describes land ownership within 500 feet of the proposed SJRPNM pipeline route.

Table V-13.—Land ownership within 500 feet of the SJRPNM Alternative pipeline route

Land ownership	Acres	Percent
Navajo Nation	17,715	56
Tribal allotment	3,072	9
BLM	5,240	17
Private (including city of Gallup)	4,076	13
State of New Mexico	1,583	5
Total	31,686	100

Some grazing activities may be temporarily impacted during construction along the proposed project pipeline.

Approximately 20 acres of private land adjacent to the San Juan River and 23 acres of Navajo Nation lands would be acquired and converted for project features, resulting in a change of land use. A trailer park and fallow agricultural land would be converted to pumping and water treatment facilities (i.e., siltation and evaporation ponds). The remaining acreage used for project features is primarily used for grazing activities. Future land uses within private lands serviced by the city of Gallup would also likely change as a result of the SJRPNM Alternative as additional domestic water became available.

NIIP Amarillo Alternative.—The NIIP Amarillo Alternative would have no effect on existing land uses within the Navajo Reservoir area.

Dependable domestic water supplies would be available to accommodate land use changes needed to meet Navajo and Jicarilla Apache Nation population growth projections as described for the SJRPNM Alternative.

The majority of the NIIP Amarillo Alternative's pipeline route would follow existing transportation and utility corridors. A total of 31,464 acres would be temporarily disturbed during construction, as described in the "Vegetation Resources" section. Table V-14 describes the land ownership within 500 feet of the proposed NIIP Amarillo pipeline route.

Table V-14.—Land ownership within 500 feet of the NIIP Amarillo Alternative pipeline route

Land ownership	Acres	Percent
Navajo Nation	17,493	56
Tribal allotment	3,072	9
BLM	5,240	17
Private (including city of Gallup)	4,076	13
State of New Mexico	1,583	5
Total	31,464	100

Some grazing activities may be temporarily impacted during construction along the proposed project pipeline.

Approximately 249 acres of Navajo Nation lands would be permanently converted for project features and would result in a change of land use. Approximately 23 acres would be converted for pumping plants and storage tanks, and 226 acres would be converted to a storage reservoir.

Future land uses within private lands serviced by the city of Gallup would also likely change as a result of the NIIP Amarillo Alternative as additional domestic water became available.

Land Use – Mitigation Measures

Both action alternatives include proposed mitigation measures to reduce impacts to current land uses (primarily livestock grazing). Mitigation measures include re-vegetation of pipeline corridors concurrent with construction activities as described under the "Vegetation Resources" section of this chapter, fencing of re-vegetated areas to prevent grazing activities while disturbed areas become re-established, and offering relocation assistance to affected residences displaced by construction of the San Juan River water treatment facility.

Land Use – Summary of Impacts

Changes in land use to meet future needs on the Navajo Nations lands would be limited under the No Action Alternative because of the absence of dependable domestic water supplies to meet future demands for housing and economic development. Land use planning for the city of Gallup would also be impacted by a decreasing domestic water supply as existing groundwater wells become exhausted.

Under the SJRPNM and NIIP Amarillo Alternatives, Navajo and Jicarilla Apache Nations' lands and the city of Gallup would experience some changes in land use as areas are developed to meet future population demands. Changes in land use would occur through planning and zoning controlled by the Tribal Nations, the city of Gallup, and affected counties.

Under the SJRPNM Alternative, approximately 20 acres of private land adjacent to the San Juan River and 23 acres of Navajo Nation lands would be acquired and converted for project features and would result in a change of land use.

With the NIIP Amarillo Alternative, approximately 249 acres of Navajo Nation lands would be permanently converted for project features, resulting in a change of land use. Approximately 23 acres would be converted for pumping plants and storage tanks, and 226 acres would be converted to a storage reservoir.

Hazardous Materials

This section address the potential impacts to hazardous material sites that could result from actions associated with the No Action, SJRPNM, and NIIP Amarillo Alternatives.

Issue: How would the No Action, SJRPNM, and NIIP Amarillo Alternatives affect hazardous material sites?

Overview

Scope

The hazardous material sites in this analysis include oil and gas pipelines crossing the San Juan River and other drainages, gas wells, and documented hazardous material sites. It does not include impacts on water quality or associated waste water discharge permits resulting from stream water quality standards for the San Juan River that were considered in the "Water Quality" section.

Impact Indicators

Impacts were considered adverse if implementation of alternatives disturbed hazardous material sites, resulting in a health risk to the public or the environment.

Hazardous Materials – Affected Environment

The hazardous materials of most concern are petroleum products that are transported in pipelines within the proposed project area, including the San Juan River and its tributaries. Crossings are predominately compressed natural gas (CNG) lines with a few liquefied petroleum gas (LPG) lines. If pipeline exposure/erosion occurred and the line was damaged, the CNG would be an airborne hazard, while the LPG would become a waterborne petroleum hazard.

Other areas of concern include oil and gas wells, primarily in northern and eastern portions of the proposed project service area. Over 7,772 active wells occur within the proposed project area, and new wells are continuing to be developed. The Shiprock Uranium Mill Tailings Remedial Action (UMTRA) Project site is also located southeast of Shiprock, New Mexico, on an elevated terrace about 50 feet above the San Juan River; however, the UMTRA site is outside the proposed pipeline routes.

Hazardous Materials – Methodology

GIS data were used to analyze potential hazardous sites within 500 feet of the SJRPNM and NIIP Amarillo Alternatives' pipeline routes. Existing oil, gas, and other hazardous material pipeline locations were obtained from the Department of Transportations' Office of Pipeline Safety (OPS) (OPS, 2005). Well location data were obtained from the New Mexico Oil Conservation Division's "Allwells" database (Petroleum Recovery Research Center, 2005). In addition, Federal, State, Tribal, city, and county governments within the proposed project area were contacted to develop information on hazardous material sites.

Information on the Shiprock UMTRA site was obtained from the Animas-La Plata Project Final Supplemental Environmental Impact Statement (Reclamation, 2000a).

Hazardous Materials – Impacts Analysis

No Action Alternative.—No impacts are projected under the No Action Alternative for pipeline crossings, gas wells, or other hazardous material sites.

SJRPNM Alternative.—Under the SJRPNM Alternative, the Cutter Lateral and PNM Lateral pipelines would cross an extensively developed natural gas field and transmission lines within the northern and eastern portions of the proposed project area. Based on geographic information data provided by the OPS and New Mexico Oil Conservation Division, the SJRPNM pipeline alignment would cross existing oil, gas, and other hazardous material pipelines 15 times, and 65 wells would be within 500 feet of the proposed pipeline routes (San Juan Lateral–7 wells, Cutter Lateral–57 wells, and Main Lateral–1). The proposed pipeline would parallel approximately 40 miles of existing natural gas transmission pipeline.

NIIP Amarillo Alternative.—Under the NIIP Amarillo Alternative, the Cutter Lateral and Amarillo Lateral pipelines would cross extensively developed natural gas fields and transmission lines within the northern and eastern portions of the proposed project area. Based on geographic information data provided by the OPS and New Mexico Oil Conservation Division, the NIIP Amarillo pipeline route would cross existing oil, gas, and other hazardous material pipeline 12 times, and 66 wells would be within 500 feet of the proposed pipeline routes (Amarillo Lateral–8 wells, Cutter Lateral–57 wells, and Main Lateral–1). The proposed pipeline would parallel approximately 40 miles of existing natural gas transmission pipeline.

Hazardous Materials – Mitigation Measures

Proposed mitigation measures include contacting pipeline and gas well companies prior to construction activities under both alternatives to identify and avoid existing hazards. The SJRPNM and NIIP Amarillo pipeline alignments could be adjusted as needed to avoid impacts to pipelines and wells.

Hazardous Materials – Summary of Impacts

The No Action Alternative would have no effect on hazardous material sites (oil and natural gas pipelines and wells). Both the SJRPNM and NIIP Amarillo Alternative pipeline alignments would cross existing oil, gas, and other hazardous material pipelines and existing gas wells and would parallel approximately 40 miles of existing natural gas transmission pipeline. Project pipeline alignments could be relocated to avoid impacts to hazardous materials.

Soils

This section address the potential impacts to soils that could result from actions associated with the No Action, SJRPNM, and NIIP Amarillo Alternatives.

Issue: How would the No Action, SJRPNM, and NIIP Amarillo Alternatives affect soils?

Overview

Scope

This scope includes soils and erosion characteristics within the construction footprints of the SJRPNM and NIIP Amarillo Alternatives.

Impact Indicators

The following impact indicators were applied because of the value of avoiding displacement or degradation of soil resources. Potential soil impacts were considered adverse if they would result in:

(1) Soil stability hazards
(2) Substantial soil losses due to wind and water erosion

Soils – Affected Environment

General Soil Classifications.—General soil classifications within the proposed project area are broken into 13 general classification types (figure V-9; New Mexico Resource Geographic Information System Program [NMRGISP], 2005). These generalized classifications are made by combining the delineations of detailed soil survey maps to form broader map units. These broader map units group similar map unit delineations and are commonly named for the two or three most dominant soil series or taxa. Detailed descriptions of the general soil classification types are included in attachment J.

Soils – Methodology

The Soil Survey Geographic (SSURGO) (Natural Resource Conservation Service, [NRCS], 2005) database for the Shiprock area; Parts of San Juan County, New Mexico; and Apache County, Arizona, SSURGO database for McKinley County area, New Mexico, and Soil Survey Tabular Database for San Juan County, New Mexico, Eastern Part available on the NRCS Soil Data Mart Web site were used to identify potentially affected soil resources. Applicable soil survey maps, unit descriptions, and supporting tabular information are summarized in attachment J, based on the extent of physical environmental impact that would result from the construction and operation of the proposed project. Land capability definitions are also included in attachment J. Impacts associated with pipeline excavation, backfill, and land conversion were quantitatively assessed from current project plans as overlain on soil survey map units.

Soils – Impacts Analysis

Soil resources are valuable because of the variety of land uses they support. Physical construction and operation of project structural components could generally disturb soil resources by either displacing them or degrading their ability to support land uses. Soil displacement occurs through either water- or wind-caused erosion. Eroded soils can subsequently lead to secondary water and/or air pollution. Large soil disturbances, such as mudslides or landslides, can also expose people to related physical hazards.

No Action Alternative.—During high (5,000 cfs) flow tests in 1998 and 2000, bank erosion concerns were identified in numerous places (at least 20 sites) from Navajo Dam to Kirtland, New Mexico.

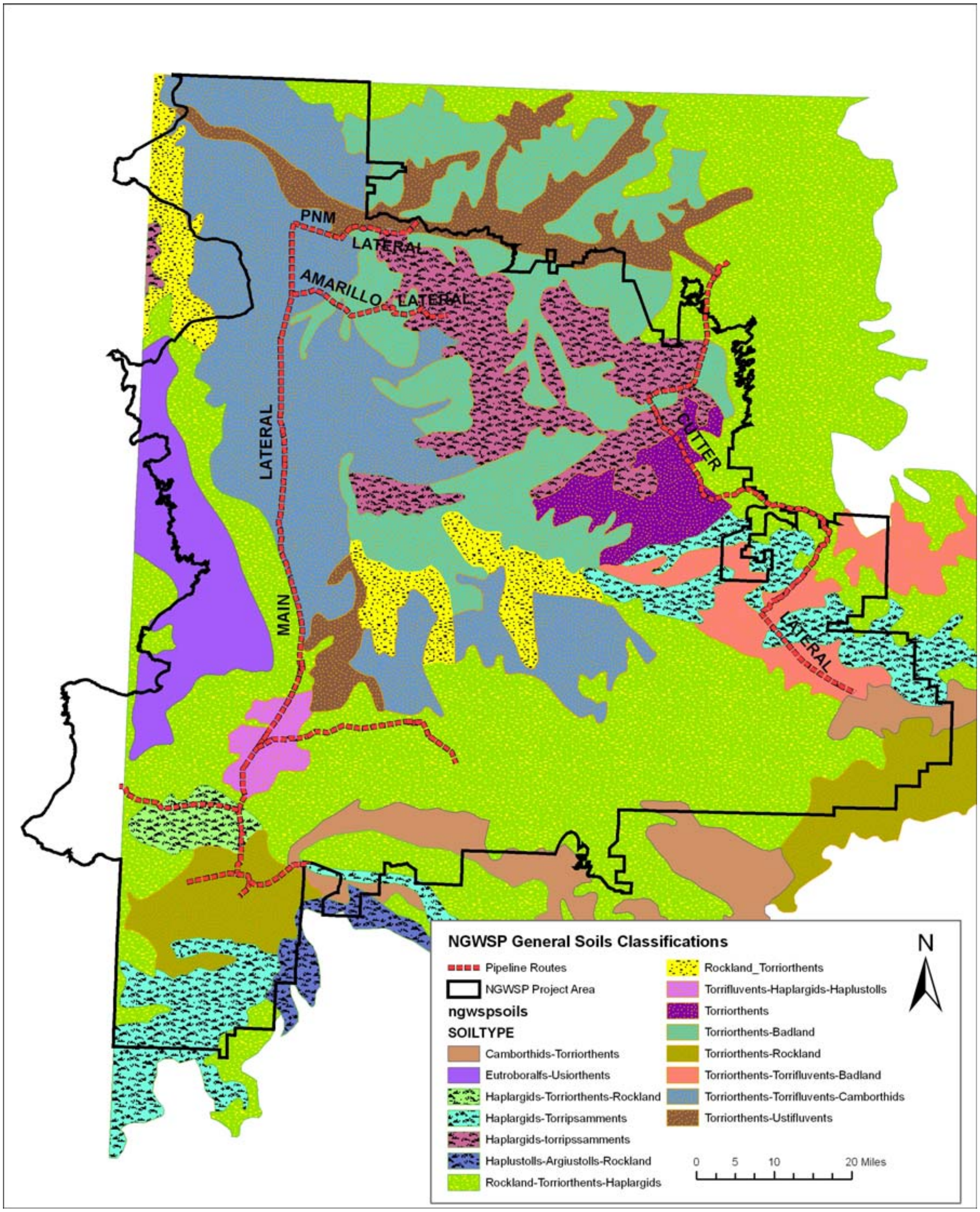

Figure V-9.—General soil classifications within the proposed project area.

Under the No Action Alternative, bank erosion is predicted to continue until the river stabilizes itself or property owners stabilize the banks using BMPs (berms, riprap, rock vanes, vegetation, and others). Long-term impacts from bank erosion would likely not be adverse due to stabilization of the banks.

In reaches of critical habitat for endangered fish species between Farmington and Lake Powell, soil erosion from the contributing drainage area would continue to add sediments to the San Juan River. Peak releases from Navajo Dam are anticipated to be sufficient to scour and transport this sediment down the river, in which case sediment of the river bottom would not occur and habitat conditions would be conducive to spawning and rearing of endangered fish.

SJRPNM Alternative.—Under the SJRPNM Alternative, soil erosion along the San Juan River would be similar to that described under the No Action Alternative because Navajo Reservoir would continue to be operated to meet the Flow Recommendations.

Additional soil erosion impacts would likely occur during SJRPNM pipeline construction. Using GIS to overlay SJRPNM pipeline routes and project features on existing NRCS soils data identified seven soil map units within the SJRPNM Alternative pipeline corridor that are either severe or very serve erosion hazards (attachment J). In addition, all soil types that occur within the SJRPNM Alternative pipeline corridor have severe limitations that make them generally unsuitable for cultivation and limit or restrict their uses to grazing, woodland, or wildlife.

Ground disturbance associated with construction of pipeline laterals and associated facilities would expose soils to potentially significant water and wind erosion from grading, excavation, alteration of surface hydrology, and vegetation removal. These disturbances could increase soil erosion through disturbed soils exposure. These impacts could be significant due to the large amount of total disturbance that would occur and the potential for secondary effects of water and air quality degradation from sediment and particulate matter releases.

Aquima-Hawaikuh silt loams, Badland-Genats complex, Brimham-Benally-Genats association, Calladito-Elias association, Camac-Kimbrito-Badlands association, Counselor-Eslendo-Calladito complex, Farb-Chipeta-Rock outcrop complex, Jeddito-Escavada association, and Notal-Escavada-Riverwash association soil map units may be affected by the SJRPNM Alternative (attachment J). These soil types comprise about 4.9 percent (741 acres) of the 15,245 acres of soils classified within 100 feet of the proposed pipeline route and under Land Capability Subclass E. Land Capability Subclass E is made up of soils where excessive water is the dominant hazard or limitation in their use. Erosion susceptibility and past erosion damage are the major soil factors for placing soils in this subclass. All other soils occurring within the pipeline corridor are classified as Land Capability Subclass C or S. Subclass C is made up of soils where the climate (temperature or lack of moisture) is the only major hazard or limitation on their use, and Subclass S includes soils that have such limitations as shallowness of rooting zones, stones, low moisture-holding capacity, low fertility difficult to correct, and salinity and sodium.

NIIP Amarillo Alternative.—Under the NIIP Amarillo Alternative, no changes in soil erosion along the San Juan River are predicted because Navajo Reservoir would continue to be operated to meet the Flow Recommendations.

Additional soil erosion impacts would also likely occur during NIIP Amarillo pipeline construction. With exception of the Camac-Kimbrito-Badland association and Notal-Escvada-Riverwash association soil map units, highly erodible soils identified in the SJRPNM Alternative occur within 100 feet of the NIIP Amarillo pipeline corridor (attachment J).

As is the case under the SJRPNM Alternative, all soil types that occur within the NIIP Amarillo Alternative pipeline corridor have severe limitations that make them generally unsuitable for cultivation and limit or restrict their uses to grazing, woodland, or wildlife.

Soils – Mitigation Measures

Impacts to soils can be mitigated by using responsible erosion control guidelines and BMPs to reduce erosion and sedimentation resulting from pipeline lateral and associated project feature construction activities. Proposed mitigation measures for both the SJRPNM and NIIP Amarillo Alternatives include the following activities for all soils affected:

(1) Using water trucks to minimize wind erosion and dust during construction

(2) Avoiding or minimizing disturbance of steep slopes whenever feasible

(3) Constructing fill slopes to a 2 (horizontal) to 1 (vertical) ratio gradient or flatter

(4) Constructing V-ditches above all cut and fill slopes to divert water from newly exposed slope faces

(5) Re-vegetating existing slopes before the rainy season

(6) Locating straw bale dikes or filter fabric barriers downslope of disturbed areas to act as sediment traps

(7) Constructing temporary or permanent sedimentation basins as needed

(8) Selectively removing, stockpiling, and replacing top soil as a surface medium for re-vegetation

(9) Stabilizing drainage channels using rock lining or similar natural materials

Soils – Summary of Impacts

Soils map unit types with erosion susceptibility and past erosion damage would be affected by both action alternatives. Nine soils map unit types occur within 100 feet of the proposed SJRPNM Alternative's pipeline alignment, and seven soil map unit types occur within 100 feet of the proposed NIIP Amarillo Alternative's pipeline alignment. BMPs would be implemented under both alternatives, and impacts to soils would not be significant.

Geology

This section address the potential impacts to geology that could result from actions associated with the No Action, SJRPNM, and NIIP Amarillo Alternatives.

Issue: How would the No Action, SJRPNM, and NIIP Amarillo Alternatives affect geology?

Overview

Scope

This scope includes the San Juan River Valley and the Colorado Plateau within the project area.

Impact Indicators

The following indicators were used to evaluate the potential impacts to geologic resources. An impact would be considered adverse if one of the following were to occur as result of the proposed project:

(1) Navajo Reservoir-induced seismicity resulting in dangerous conditions around the reservoir or damage to facilities

(2) An increase in erosion and sedimentation around the perimeter of Navajo Reservoir that affected operations of the dam or caused damage to equipment

(3) Catastrophic landslide damage to facilities around the reservoir or catastrophic endangerment to human life

(4) The potential to restrict recovery of mineral resources

Geology – Affected Environment

The scope includes portions of the San Juan, Little Colorado, and Rio Grande Basins, including the Colorado Plateau (figure V-10). Descriptions of the geologic map units within the proposed project are described in attachment J and summarized in table V-15 (Manley et al., 1987; NMRGISP, 2005).

Geology – Impacts Analysis

No impacts are projected under the No Action, SJRPNM, and NIIP Amarillo Alternatives. Any geological resource impacts from the operation of Navajo Reservoir would fall within historic parameters. As a result, there would be no anticipated erosion, sedimentation, landslide activity, or potential restriction of mineral resource recovery. In addition, no active surface faults have been found within a relevant distance of the dam; therefore, reservoir-induced seismicity is not expected to be a problem.

For the action alternatives, no active surface faults have been found within a relevant distance of the structural components (intake and others); therefore, construction-induced seismicity is not expected to be a problem for the action alternatives.

Geology – Mitigation Measures

The proposed project is predicted to have no effect on geologic resources; therefore, no mitigation measures are proposed.

Paleontologic Resources

This section address the potential impacts to paleontologic resources that could result from actions associated with the No Action, SJRPNM, and NIIP Amarillo Alternatives.

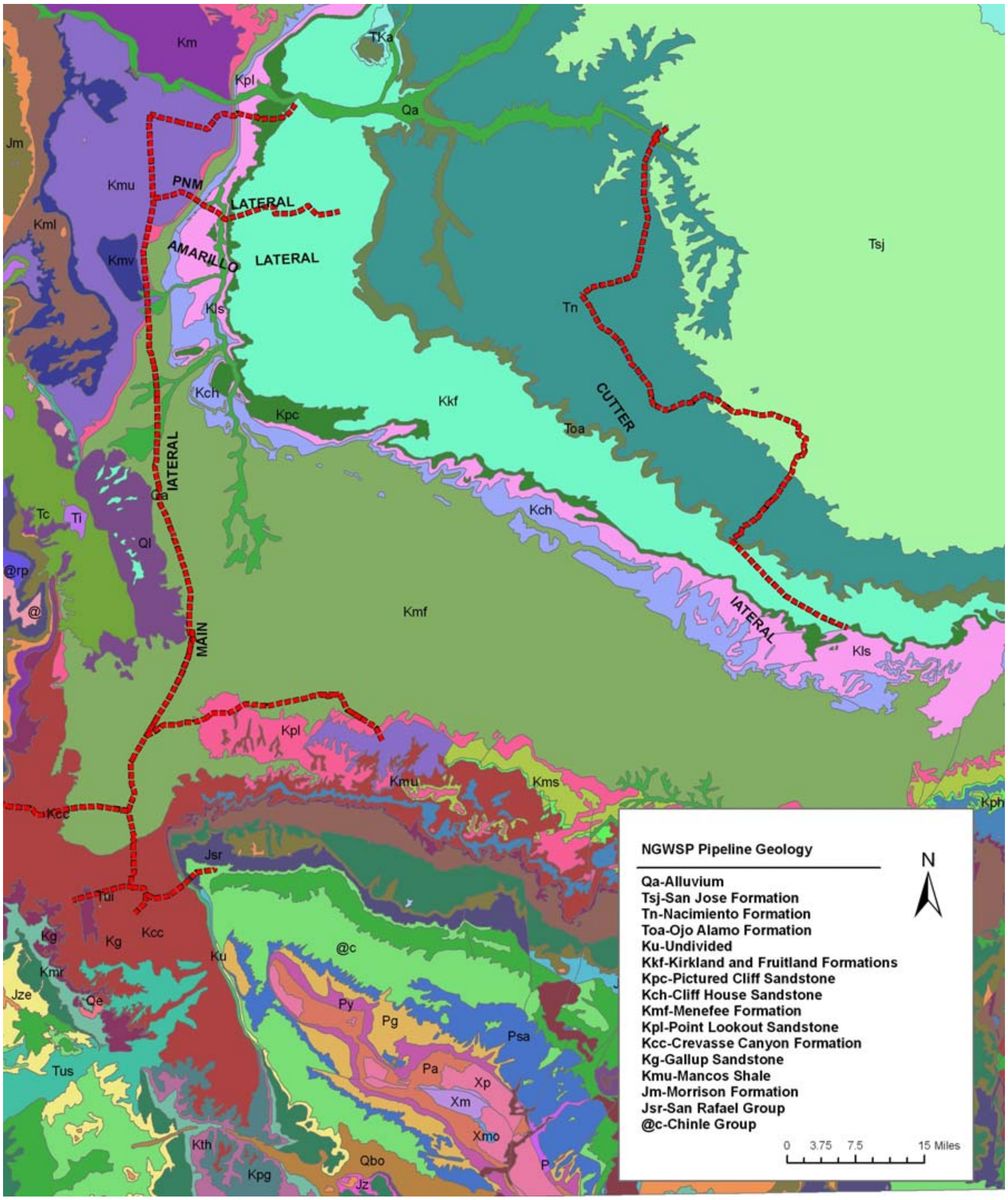

Figure V-10.—Geologic formations within the proposed project area.

Table V-15.—Geologic formations within the proposed project area

System	Series	Formation	Basin	Project feature
Quaternary	Holocene	Alluvium (Qa)	San Juan	Cutter Lateral Main Lateral Amarillo Lateral
Tertiary	Eocene	San Jose Formation (Tsj)	San Juan	Navajo Reservoir Cutter Lateral
	Paleocene	Nacimiento Formation (Tn)	San Juan	Cutter Lateral
		Ojo Alamo Formation (Toa)	San Juan	Cutter Lateral
Cretaceous	Upper Cretaceous	Undivided (Ku)	Little Colorado	Main Lateral
		Kirtland and Fruitland Formations (Kkf)	San Juan Rio Grande	Cutter Lateral Amarillo Lateral Main Lateral
		Pictured Cliff Sandstone (Kpc)	San Juan Rio Grande	Cutter Lateral Amarillo Lateral SJRPNM Lateral
		Cliff House Sandstone (Kch)	San Juan Rio Grande	Amarillo Lateral SJRPNM Lateral
		Menefee Formation (Kmf)	San Juan Rio Grande Little Colorado	Amarillo Lateral SJRPNM Lateral Main Lateral
		Point Lookout Sandstone (Kpl)	San Juan	Amarillo Lateral SJRPNM Lateral Main Lateral
		Crevasse Canyon Formation (Kcc)	Little Colorado	Main Lateral
		Gallup Sandstone (Kg)	Little Colorado	Main Lateral
		Mancos Shale, Upper Part (Kmu)	San Juan	Amarillo Lateral SJRPNM Lateral Main Lateral
Jurassic	Upper Jurassic	Morrison Formation (Jm)	Little Colorado	Main Lateral
	Middle Jurassic	San Rafael Group (Jsr)	Little Colorado	Main Lateral
Triassic	Upper Triassic	Chinle Group (c)	Little Colorado	Main Lateral

Note: Navajo Reservoir and Cutter and Main Laterals are common to both the SJRPNM and NIIP Amarillo Alternatives.

Issue: How would the No Action, SJRPNM, and NIIP Amarillo Alternatives affect paleontologic resources?

Overview

Scope

The area of potential effects is defined as the proposed project alternative pipeline delivery routes and associated impact areas (project impact corridors) in the proposed project service area.

Impact Indicators

A significant environmental effect occurs when the proposed project will disrupt or adversely affect scientifically important fossil (paleontologic) resources. Adverse impacts to paleontologic resources could include destruction, disturbance, inundation, or vandalism to significant resources.

Paleontologic Resources – Affected Environment

Fossils are the remains, imprints, and traces of once-living organisms preserved in the Earth's crust. They may be bones and teeth, shells, leaf impressions, footprints, or burrows. Fossils are nonrenewable and (except for microfossils and those that make up the energy minerals) relatively rare resources with significant scientific, educational, commercial, and recreational values. Paleontology is the science that uses fossils to study life in past geologic times.

The Basin, which includes most of the proposed project, is an important area for paleontology. Some of the best-preserved botanical, mammalian, and reptilian fossils in North America are known to occur in the Triassic, Jurassic, Cretaceous, and Tertiary rock formations in the Basin. Dinosaurs and other fossils that have made significant contributions to the scientific record have been recovered, including a well-preserved Tyrannosaur discovered in 1998. To preserve important paleontologic resources for scientific study and other public benefits, BLM has designated a number of areas for special management emphasis. Included in and around the proposed project area are the Bisti/De-Na-Zin Wilderness, the Carson Fossil Pocket, the Fossil Forest, the Kutz Canyon Fossil Area, and the Ah-Shi-Sle-Pah Wilderness Study Area. Immediately adjacent to or potentially impacted by the action alternatives are the Lybrook and Betonnie Tsosie Fossil Areas. The Betonnie Tsosie Fossil Area is a type location for early Paleocene North American land mammals (BLM, 2003).

Paleontologic Resources – Methodology

There is no overarching legislation protecting fossil resources. While neither Reclamation nor the Navajo Nation has an existing written policy for dealing with paleontologic resources on their lands or projects, early in its history, Reclamation recognized the importance of fossils. A 1905 circular produced by the agency included the following language:

> *In constructing irrigation works it is probable that fossiliferous beds will be uncovered, giving exceptionally good opportunities for collecting specimens of value to geologists and paleontologists. Well-preserved imprints of leaves, ferns, or other plant remains, fossil shells, and the bones and teeth of animals are always interesting, and may add much to our knowledge of the geologic history and structure of the region.*

Paleontologic resources are protected under Federal property rules and regulations. Anyone wishing to collect fossils on Navajo Nation or Federal land must first obtain a permit. Permits are only issued for scientific research. They are given to people with specific qualifications that include related college education and experience.

Paleontologic Resources – Impacts Analysis

There may be significant impacts, short or long term, to paleontologic resources as a result of any of the SJRPNM and NIIP Amarillo Alternative plans for constructing the current project. The most probable area where impacts could occur is where the pipeline delivery route and associated impact areas cross through the Nageezi Chapter, which is common to both action alternatives. Here, the pipeline corridor skirts the Lybrook and Betonnie Tsosie Fossil Areas. Paleontologic resources could be exposed and impacted as a result of project implementation.

Paleontologic Resources – Mitigation Measures

Proposed mitigation measures for paleontologic resources follow three basic conditions:

Condition 1 (the majority of the area of potential effects): These are areas that contain no known vertebrate fossils or noteworthy occurrences of invertebrate or plant fossils and are unlikely to yield any based on surface geology and/or soils. There are no mitigation requirements.

***Condition* 2**: These are areas that contain no known vertebrate fossils or noteworthy occurrences of invertebrate or plant fossils, but possess a high likelihood of occurrence because of exposed geological units or settings that indicate a high likelihood to yield them. These areas may have to be monitored during construction activities, and in the event of a discovery of paleontologic resources, the discovery will have to be evaluated for significance before construction can proceed at the point of discovery.

Condition 3: Areas that are known to contain vertebrate fossils or noteworthy occurrences of invertebrate or plant fossils (e.g., the Lybrook and Betonnie Tsosie Fossil Areas) would be managed on a case-by-case basis. It would require a paleontological clearance prior to any surface-disturbing activities and possibly include stipulations, constraints, and treatment measures that protect paleontologic values.

Paleontologic Resources – Summary of Impacts

Under the No Action Alternative, the proposed project would not be constructed and there would be no impacts to paleontologic resources. Existing management of paleontologic resources would be expected to continue in the project impact corridors.

Under both the SJRPNM and NIIP Amarillo Alternatives, there are probable impacts to paleontologic resources where construction activities would occur in fossil-bearing formations. Both alternatives' pipeline corridors skirt the Lybrook and Betonnie Tsosie Fossil Areas.

Air Quality and Noise

This section addresses the potential impacts to air quality and noise levels that could result from actions associated with the No Action, SJRPNM, and NIIP Amarillo Alternatives.

Issue: How would the No Action, SJRPNM, and NIIP Amarillo Alternatives affect air quality and noise levels?

Overview

Scope

This analysis centers on air quality and noise within the proposed project construction footprint.

Impact Indicators

An air quality impact would be considered adverse if one of the following were to occur as a result of the proposed project:

(1) Short- or long-term violation of any national, State, or Tribal ambient air quality standards

(2) Interference with any local air quality management planning efforts to attain or maintain air quality standards

The indicators used to determine noise impacts centered on whether the following effects would be caused by construction of the proposed project:

(1) Noise generated that exceeded established ordinances or criteria

(2) Substantial increases in noise levels over existing noise levels in noise-sensitive areas

(3) Noise that would be disturbing or injurious to wildlife

Air Quality and Noise – Affected Environment

Air Quality.—The proposed project area lies within the Four Corners Interstate Air Quality Control Region with the closest ambient air monitoring sites located in Bloomfield and near Waterflow, New Mexico, in San Juan County.

Parameters measured at the site are nitrogen dioxide, sulfur dioxide, ozone, and meteorology. Major sources of air pollution in the area include the PNM San Juan Power Generating Station, the Arizona Public Services Four Corners Power Generating Station, and several oil and gas production facilities.

San Juan County is an attainment area for all air quality standards. Isolated exceedences have occurred in past years, and the mining of coal in the Basin between Farmington and Shiprock, New Mexico, causes occasional localized dust emissions. An emissions inventory in the county showed that the county leads the State of New Mexico in emissions from permitted stationary sources, primarily from oil and gas extraction and electric, gas, and sanitary services (New Mexico Air Quality Bureau, 1997). Two coal-fired powerplants are situated between Farmington and Shiprock.

Noise.—In general, the dominant sounds in the proposed project area originate from existing roadways, gas and oil production, and natural sources (water, wind, and wildlife). Localized traffic noise is generated within the proposed project area along New Mexico State Highway 511 and U.S. Highways 491 and 550.

Air Quality and Noise – Methodology

Impacts were evaluated by the following measures:

(1) Local existing air quality material from various Federal and State agencies, Web sites, and publications was examined. A list was developed from the information obtained. The impacts included fugitive dust from vehicles or recreation exhaust and traffic patterns and any nearby industrial sources.

(2) The expected impacts on local and regional air quality were evaluated against Federal and local requirements for protecting public health (table V-16).

Table V-16.—Air quality criteria pollutants and regulatory limits

Pollutant	Period	National[1]	New Mexico[2]
Particulate matter 10 (PM_{10})	24-hour average Annual	150 µg/m[3] 50 µg/m[3]	150 µg/m[3] 60 µg/m[3]
Particulate matter 2.5 ($PM_{2.5}$)	24-hour average Annual	65 µg/m[3] 15 µg/m[3]	— —
Sulfur dioxide	3-hour average 24-hour average Annual	0.5 ppm 0.14 ppm 0.03 ppm	— 0.10 ppm 0.02 ppm
Carbon monoxide	1-hour average 8-hour average	35 ppm 9 ppm	13.1 ppm 8.7 ppm
Nitrogen dioxide	Annual	0.053 ppm	0.05 ppm
Ozone	1-hour average Annual	0.12 ppm 0.08 ppm	— —
Lead	Annual	1.5 µg/m[3]	

[1] Source: 40 Code of Federal Regulations sections 50.4 through 50.12 (1999).
[2] Source: New Mexico Ambient Air Quality Standards 20 NMAC 2.03 (1996).
[3] The new $PM_{2.5}$ (particulate matter) standards have not been implemented.

Air Quality and Noise – Impacts Analysis

No Action Alternative.—Under the No Action Alternative, air quality may slightly increase when compared to historic levels because of more soil to wind erosion (Reclamation, 2006). Oil and gas exploration is expected to continue within the proposed project area, and vehicles driving to service pads and wells will continue to cause small, localized fugitive dust. Recreational use will continue and possibly increase over time, with some intermittent periods of increases in fugitive dust associated with the construction of new recreation facilities. Overall, no adverse impact on air quality is predicted.

SJRPNM Alternative.—Fugitive dust would be emitted during excavation and related earthwork during construction of the action alternative pipelines, pumping plants, and associated facilities. Fugitive dust emissions (of which PM_{10} is a component) would occur during ground-disturbing construction activities.

The construction schedule presented in attachment G shows construction of the proposed project in phases. Under normal weather conditions, the dust and other emissions caused by the proposed project would be localized in the immediate areas of construction. However, under infrequent conditions of high winds, the dust could become additive for brief periods. Sources of emission from the SJRPNM Alternative would be from the construction of (1) the PNM diversion structure, pumping plant, and water treatment facility; (2) Cutter Reservoir pumping plant and water treatment facility; (3) PNM Lateral; (4) Cutter Lateral and associated facilities; and (5) the Main Lateral and associated facilities. Most of these emissions are from equipment travel over unpaved roads or direct disturbance of the soil by excavation, transport, grading, and compacting. Application of standard dust suppression techniques (e.g., soil stabilization or watering of trench stockpiles) would reduce daily PM_{10} emissions. Impacts to air quality under the SJRPNM Alternative would be minor and are not considered significant.

NIIP Amarillo Alternative.—Impacts under the NIIP Amarillo Alternative would be similar to those describe under the SJPNM Alternative except that sources of emission would be from construction of (1) Cutter Reservoir pumping plant and water treatment facility, (2) Amarillo Lateral and associated reservoirs and facilities, (3) Cutter Lateral and associated facilities, and (4) the Main Lateral and associated facilities. Impacts to air quality under the NIIP Amarillo Alternative would be minor and are not considered significant.

Air Quality and Noise – Mitigation Measures

Proposed mitigation measures for air quality include water spraying of haul roads, work areas, and storage piles that are prone to wind-blown dust; operating practices that minimize the area of exposed soil subject to producing dust; and re-vegetation of disturbed areas.

No mitigation measures are proposed for noise.

Air Quality and Noise – Summary of Impacts

The No Action, SJRPNM, and NIIP Amarillo Alternatives would not result in any significant adverse impacts, short or long term, to air quality or noise levels.

Socioeconomics

This section addresses the potential impacts to social conditions and economic sectors that could result from actions associated with the No Action, SJRPNM, and NIIP Amarillo Alternatives.

Issue: How would the No Action, SJRPNM, and NIIP Amarillo Alternatives affect local social conditions and economies?

Overview

Scope

This section addresses the potential impacts to social conditions and economic sectors that could result from actions associated with the No Action, SJRPNM, and NIIP Amarillo Alternatives. This section focuses on the issue of how these alternative scenarios could affect local socioeconomic attributes and considers impacts on three groups of people—the Navajo Nation, the Jicarilla Apache Nation, and the broader northwest New Mexico area composed of McKinley and San Juan Counties. The types of socioeconomic impacts addressed include (1) accessibility to water, (2) public health, (3) employment impacts, and (4) demand for local services.

Impact Indicators

The following indicators are used to assess the socioeconomic impacts of alternative project scenarios:

(1) Access to adequate, piped water supply
(2) Access to clean water supply
(3) Regional economic output
(4) Regional personal income
(5) Regional employment
(6) Increase in demand for local service relative to normal year-to-year fluctuation

Socioeconomics – Affected Environment

Access to Adequate, Piped Water Supply.—

Navajo Nation – More than 40 percent of the Navajo people living in the proposed project service area presently have no access to piped water and, consequently, haul water from sometimes distant sources. Some of the water they do consume is from nonpotable sources intended for stock watering and is not in compliance with EPA water quality standards.

City of Gallup – The city of Gallup currently relies on groundwater pumping to supply water to its residents. The water level in the city's wells has been falling by 7 to 29 feet per year over an extended period, and at some point, the production capacity of the current well system is expected to diminish. The quality of this groundwater exceeds the national secondary water quality standard for TDS and sulfate, causing increased corrosion and rapid degradation of plumbing and appliances.

Regional Economics.—The San Juan-McKinley County area has experienced long-term unemployment problems, particularly in the Navajo and Jicarilla Apache Nation. In recent years, the overall unemployment rate in the area has exceeded the national rate by approximately 10 percent to 70 percent, while the unemployment rate among Navajo and Jicarilla Apache Nations' people has been six to ten times the national rate. To the extent that the construction and operation jobs could be filled by currently unemployed local people, the proposed project could represent an important benefit to the local area's socioeconomic condition. The Water Resources Council's *Principles and Guidelines* conclude that in an area of substantial and persistent unemployment, a local hire rule can increase the percent of jobs going to otherwise unemployed people from 30 percent to 43 percent (in the case of skilled workers) and from 47 percent to 58 percent (in the case of unskilled workers).

Socioeconomics – Methodology

Existing population, employment, and income information was compared with the anticipated impacts of construction and project operation. An economic impact assessment model, IMPLAN, was used to estimate the impacts of economic changes in the area.

Socioeconomics – Impacts Analysis

No Action Alternative.—

Access to Adequate, Piped Water Supply – The No Action Alternative would not improve access to water for the Navajos. It is estimated that the available water per capita for the city of Gallup would fall to less than one-half of existing water use by the year 2033. The Jicarilla Apache Nation has an alternative means potentially available to deliver water to the proposed project service area.

Access to Clean Water – A primary rationale for the public policy of providing clean and reliable water to all people in the United States is the resulting health benefit. Lack of a clean water supply would continue to be a problem on the Navajo Reservation under the No Action Alternative. The city of Gallup and the Jicarilla Apache Nation would have access to clean water.

Regional Economic Output – The No Action Alternative would not result in any regional economic stimulus.

Regional Personal Income – The No Action Alternative would not result in any regional earnings stimulus.

Regional Employment – The No Action Alternative would not provide any construction phase or long-term employment.

Increase in Demand for Local Services – The No Action Alternative would not affect the demand for local services.

SJRPNM Alternative.—

Access to Adequate, Piped Water Supply –The SJRPNM Alternative would provide a reliable supply of treated water to areas that are presently without a piped water supply. The SJRPNM Alternative would provide the city of Gallup with water needed to replace the diminishing groundwater supply. The Jicarilla Apache Nation has an alternative means potentially available to deliver water to the proposed project service area, so this would provide another alternative.

Access to Clean Water – The SJRPNM Alternative would provide a safe water supply to many households who would otherwise not have it, particularly on the Navajo Reservation. The city of Gallup and the Jicarilla Apache Nation would have access to clean water under any alternative.

Regional Economic Output – The proposed project would stimulate the local economy for both the construction and operation phases. The construction phase is expected to last about 13 years, and construction would occur primarily in San Juan and McKinley Counties. In addition to the direct spending on the proposed project, regional economic output to support the proposed project and purchases by project workers should amount to about $688,000 for every $1 million spent on the proposed project. Over the entire construction period, this should total about $492 million for the SJRPNM Alternative (January 2005 dollars).

Regional Personal Income – The proposed project would generate earnings not only for construction workers but also for employees in the businesses supporting the proposed project and those providing goods and services to other workers. Total earnings generated should amount to about $644,000 for every $1 million in project construction costs. Over the entire construction period, this should total about $460 million for the SJRPNM Alternative (January 2005 dollars).

Regional Employment – The proposed project would not only employ workers for construction and operation, but it would result in additional employment in the businesses providing goods and services to the project and to its workers. Under the SJRPNM Alternative, the construction employment could average about 600 workers and peak at about 650 workers during the 3rd through 12th years of construction. These employment numbers could increase to 1,240 when employees are counted in businesses providing goods and services to the proposed project and to its workers. The operational phase would employ about 22 full-time equivalent workers on a long-term basis. The proposed project could result in a significant number of jobs for otherwise unemployed people—potentially in the range of an estimated 30 to 58 percent.

Increase in Demand for Local Services – Although many project workers may be hired from the local population base, some other workers may be attracted from outside the area. If the number of immigrants is sufficiently large, it may have negative effects on both the community infrastructure and on the community social fabric. As indicated in the previous section, the SJRPNM Alternative would add about 1,240 total employees to the McKinley/San Juan County area. The significance of these increases is a remaining question. Regional employment has varied considerably from year to year.

The project-related total employment change is estimated to be well within the magnitude of annual variation in regional employment, represented by one standard deviation, and therefore would not be expected to result in any unusual stress on local services or infrastructure.

Project operation would require operations and maintenance personnel, and local businesses would hire additional employees to provide goods and services for the proposed project and its employees. A total of about 66 workers would be needed for either project alternative. Of the total, about one-third would work directly on the proposed project, another third would work for businesses that supply goods and services to the proposed project, and the remaining third would work for businesses that provide goods and services to project employees and employees of the businesses supplying the proposed project. Sixty-six employees represent about one-tenth of 1 percent of total area employment. This level of employment should not have more than a minor impact on the area's infrastructure and services.

NIIP Amarillo Alternative.—Impacts for the NIIP Amarillo Alternative are the same as under the SJRPNM Alternative except for a minor difference in construction regional economic employment. Under the NIIP Amarillo Alternative, construction employment should average about 640 workers and peak at about 690 workers during the 3rd through 12th years of construction. These employment numbers would increase to 1,320 when employees are counted in businesses providing goods and services for the proposed project and its workers.

Socioeconomics – Mitigation Measures

No mitigation measures are proposed for socioeconomic resources.

Socioeconomics – Summary of Impacts

The SJPNM and NIIP Amarillo Alternatives should have strong positive effects on accessibility to water, public health, and employment. If project jobs were filled predominantly by new arrivals to the area, there may be a minor negative impact on demand for local services. Although there could be positive effects on employment, total project employment would not represent a fluctuation beyond extremes in the area's year-to-year total employment.

Environmental Justice

This section addresses the potential impacts to Environmental Justice that could result from actions associated with the No Action, SJRPNM, and NIIP Amarillo Alternatives.

Issue: How would the No Action, SJRPNM, and NIIP Amarillo Alternatives affect environmental justice?

Overview

Scope

The area of potential effects is defined as the proposed project construction and service areas.

Impact Indicators

The indicators applicable to the environmental justice parameter are whether the proposed project would create disproportionately adverse effects to minority or low-income populations.

Environmental Justice – Introduction

The environmental justice parameter is essentially one of assessing or analyzing discrimination against specific subpopulations. Executive Order 12898 directs that Federal programs, policies, and activities not have a disproportionately high and adverse human health and environmental effect on minority and low-income populations (Federal Register, 1994).

Environmental Justice – Affected Environment

Substantial populations in the proposed project area clearly qualify as minority and/or low income. The 2000 Census of Population reports that 74.7 percent of the 74,798 people in McKinley County and 36.9 percent of the 113,801 people in San Juan County are American Indians. The 2000 census also shows median household income for both the Navajo people ($21,830) and Jicarilla Apache people ($26,667) in New Mexico is below the New Mexico State average ($34,133).

Environmental Justice – Methodology

Census data for race and ethnicity, poverty levels, and median household income (1999 dollars) were analyzed.

Environmental Justice – Impacts Analysis

No major adverse impacts from either project alternative have been identified, and, accordingly, there is no indication that any adverse impacts would have a disproportionate effect on the minority and low-income populations.

Conversely, the beneficial effects of providing water to those who would otherwise have to haul water would accrue primarily to the minority and low-income populations. This access-to-water benefit and related health improvements are discussed in earlier sections of this report. These important positive project impacts would assist rather than harm minority and low-income populations.

Environmental Justice – Mitigation Measures

No mitigation measures are proposed for environmental justice.

Environmental Justice – Summary of Impacts

The action alternatives would assist minority and low-income populations.

Cultural Resources

This section addresses the potential impacts to cultural resources that could result from actions associated with the No Action, SJRPNM, and NIIP Amarillo Alternatives.

Issue: How would the No Action, SJRPNM, and NIIP Amarillo Alternatives affect cultural resources?

Overview

Scope

The area of potential effects is defined as the proposed project alternative pipeline delivery routes and associated impact areas (project impact corridors) in the proposed project service area.

Impact Indicators

For cultural resources, a significant environmental effect would occur when the proposed project disrupted or adversely affected historic properties. Adverse impacts to cultural resources could include destruction, disturbance, inundation, or vandalism to significant resources. Other adverse impacts could include disturbance to graves and cultural items and destruction of, or preventing access to, sacred sites or in-use areas.

Cultural Resources – Introduction

Cultural resources are physical or other expressions of past human activity or occupation. Such resources include culturally significant landscapes, prehistoric and historic archaeological sites and isolated artifacts or features, historic structures, human burials, sacred sites, and areas of important cultural value to existing communities (traditional cultural properties [TCPs]). Cultural resources that are eligible for inclusion in the *National Register of Historic Places* (*National Register*) are protected under the National Historic Preservation Act (NHPA) of 1966, as amended in 1992, are hereby referred to as historic properties. Cultural resources may also be protected under the NAGPRA; the American Indian Religious Freedom Act; Executive Order 13007, Protection of Native American Sacred Sites; and other State, agency, or Tribal laws and policies.

Cultural Resources – Affected Environment

The proposed alternatives lie in the San Juan, Rio Grande, and Little Colorado River Basins, an area well known for its archaeology and contemporary/historical Native American culture. More than 10,000 years of human existence are represented in the area. Prominent cultural/archaeological features in or around the proposed project area include the Navajo Reservoir Archaeological District, Salmon Ruins, Canyon de Chelly National Monument, and the Navajo and Jicarilla Apache Indian Reservation lands. Chaco Culture National Historic Park lies in the approximate center of the proposed project area.

The mobile hunter-gatherer PaleoIndian and Archaic (9500 B.C. to A.D. 1) groups were followed by the pre-Puebloan and Ancient Puebloan (Anasazi) (A.D. 200–1300) occupations, which represent the highest frequency of cultural resources in the proposed project area. By A.D. 500, the Basketmaker culture was firmly established, with increased agricultural production and less dependence on hunting. The subsequent development and expansion of the Ancient Puebloan culture is best represented at Chaco Culture National Historic Park, which had become the major population center prior to its decline in the 12^{th} century. These sedentary farmers and villagers had developed a system of roads that connected population centers to outlying communities. This system then fragmented and the area had completely depopulated by A.D. 1250. This is followed by the Athabascan (Navajo and Jicarilla Apache) Settlement Period (A.D. 1400–1870) and EuroAmerican settlement (1870–Present).

Historic Inhabitants.—

PaleoIndian – The earliest known human presence is that of the PaleoIndians who inhabited the area as early as 9500 B.C. Their presence across the landscape was presumably small and disperse, and evidence of their occupation is nebulous.

Archaic – The Archaic period in the region is typified by a change from a big-game hunting emphasis to the hunting of smaller, modern game and the intensive collection of plant foods. Most sites of this period date between 8000 and 2000 BP (Before Present).

Pre-Puebloan and Puebloan – The (pre-Puebloan) Basketmaker culture was named for its finely woven baskets and lack of pottery. The Basketmaker II period is characterized by the adoption of structures and features for habitation and storage of surplus foods. Basketmaker II sites appear to date between A.D. 200 and 400. The Basketmaker III period (A.D. 400–700) marks the beginning of a more sedentary agricultural lifestyle and the use of ceramics and adoption of the bow and arrow. This period also represents the beginnings of the typical Anasazi (Ancient Pueblo) site layout.

The Pueblo I period (A.D. 700–900) is well represented with small hamlets scattered across the proposed project area. It is during this period that surface structures, identified as pueblos, become increasingly common.

The Pueblo II and Pueblo III periods (A.D. 900–1300) are characterized by larger pueblos, which usually include masonry roomblocks and larger semicircular pit structures (kivas). They are the ruins familiar to most modern visitors to the area, such as the sites on display at Chaco Canyon National Historic Park. The Pueblo II and Pueblo III periods are well represented in the proposed project area.

Athabascan – Two Native American protohistoric/historic traditions are found in the region—the Navajo and the Jicarilla Apache. The earliest evidence for the Athabascan occupation may date as early as the 1400s.

Modern-Day.—The majority of the proposed project impact corridors occur within the boundaries of the Navajo Nation. In accordance with Navajo Nation policies, contemporary or recently abandoned residences and features or areas (in-use areas) are considered historic sites. Additionally, a number of contemporary Native American

Tribal Nations have ancestral and traditional ties to the proposed project area. Archaeological data provide some information about prehistoric and historic aboriginal use of the region; however, each Tribe or community has its own account of the traditional use of the area. There is a high likelihood of encountering in-use areas, TCPs, sacred items, and human remains during project planning, archaeological excavation, or construction activities.

Ethnographic.—Consultation has been initiated to identify the potential for TCPs that may be affected by the proposed project. This is intended to assist compliance with the NHPA, using guidelines in *National Register* Bulletin 38 (Parker and King, 1990) and *National Register* Bulletin 15 (NPS, 1991). It was also done in accordance with Bureau of Reclamation Guidance for Implementing Indian Sacred Sites Executive Order 13007 and to solicit Tribal and Chapter input on the treatment of human remains and cultural items covered under NAGPRA. A total of 21 Native American Tribal Nations and 23 Navajo Nation chapters have been contacted. The contacts solicited comments from the Tribes and chapters regarding their concerns about potential impacts of the proposed project on TCPs, sacred sites, and burials that may be in or adjacent to the proposed project area.

TCPs and Human Remains.—TCPs are sites or areas of important cultural value to existing communities. They may not have actual physical remnants associated with their existence. Research indicates that approximately 21 Native American Tribes/Tribal Nations have ancestral and contemporary ties to the proposed project area. Archaeological data provide some information about prehistoric and historic aboriginal use of the region; however, each Tribe has its own account of the Tribe's traditional use of the area.

While direct evidence for the existence of burial sites in the proposed project area is lacking, knowledge of the cultural resources indicates a high likelihood of encountering human remains during archaeological excavation or construction activities. Burials on Puebloan archaeological sites are rather common and are to be expected. On past projects, a number of the consulted Tribes expressed concerns about the human remains and cultural items that may be affected. Intact Basketmaker and Puebloan habitation sites were of particular concern to a number of Tribes and are considered TCPs. These sites are extant across all features/elements of the proposed project. Tribes may request to visit the proposed project area to determine if ground disturbance will impact TCPs, traditional use areas, or sacred sites as fieldwork is ongoing. Further identification and treatment efforts will be in consultation with these and other consulting Tribes/Tribal Nations as appropriate.

In dealing with the discovery and disposition of human remains, the regulations in NAGPRA must be followed on Federal projects. NAGPRA requires consultation with Indian Tribes and a permit under the Archaeological Resources Protection Act before human remains and associated funerary objects are exhumed from Federal lands and Indian Trust Lands (State permits are required for State and private lands). Chapter VII provides additional information on the current status of Tribal and chapter consultation.

Cultural Resources – Methodology

Methodology.—The methods used to determine the presence of cultural resource sites located within the proposed project area consisted of a literature review, limited archaeological field surveys, and supplemental ethnographic evaluation. These studies were conducted to provide additional information for areas that had not undergone previous examination and to verify previous results.

Significance Criteria.—Criteria were developed and used to determine the significance of impacts to cultural resources resulting directly or indirectly from the action alternatives. For cultural resources, a significant environmental effect occurs when the proposed project would disrupt or adversely affect a prehistoric or historic archaeological site or a property of historic interest or cultural significance to a community or ethnic or social group. Adverse impacts to cultural resources could include destruction, disturbance, alteration, inundation, or vandalism; these impacts are considered significant if they would occur to cultural resource sites that are eligible, or listed for inclusion in, the *National Register* or protected under other Federal or Tribal laws and policies. Other adverse impacts would include disturbance to graves and cultural items protected under NAGPRA and destruction of, or preventing access to, sacred sites protected under Executive Order 13007.

It should be noted that while significant impacts to cultural resources may be "resolved" through treatment measures of encountered resources such as data recovery (excavation) in compliance with applicable regulations and guidelines, such resolution would not reduce impacts to less-than-significant levels. As such, significant impacts, which may be resolved, would remain significant and unavoidable.

Cultural Resource Tasks.—Cultural resource tasks included cultural resource surveys, ethnographic investigations, identification and evaluation of in-use areas, and consultations with chapters and State, Tribal, and Federal entities. Additional work on these tasks would be necessary if the proposed project were implemented.

Tribal and Chapter Contact.—A letter describing the proposed project and a request for input on traditional cultural use and/or history of the area was sent to the consulting Tribal governments and Navajo Nation chapters. Responses were received from the Navajo Nation, Pueblo of Zuni, Laguna Pueblo, Hopi Tribe, and Isleta Pueblo. Followup telephone calls and meetings were also held to identify further work with a specific Tribe or chapter. Tribes requested to be kept informed as more information on cultural resources becomes available.

In addition, Reclamation has held several meetings with the Navajo Nation Historic Preservation Office to discuss and review potential project alignments.

Cultural Resources – Impacts Analysis

Based on the significance criteria described under "Cultural Resources Methodology," there would be significant impacts, short or long term, to cultural resources as a result of any of the alternative plans for constructing the proposed project. Archaeological, historical, and traditional cultural resources would be exposed and impacted as a result project implementation. Generally, the NIIP Amarillo Alternative is more impacting to cultural resources than the SJRPNM Alternative at a 1.75:1 ratio.

Various studies have been conducted (Pfaff, 1993; Mabry, 2001; Wharton and Cleveland, 2002) to evaluate the relative impacts (and associated mitigation costs) to cultural resources of the proposed action. Most recently, the Navajo Nation Archaeology Department conducted background research and a sample inventory of selected areas from the various alternatives being considered. The study concluded that all of the action alternatives would result in a significant environmental effect to cultural resources to varying degrees.

No Action Alternative.—Under the No Action Alternative, current trends that have an impact to cultural resources would continue. The Colorado Plateau (of which the proposed project area is a part) was listed in 1995 by the National Trust as one of the 11 most endangered historic treasures in the United States. Archaeological and historic sites that are important to the Native American heritage of the region are particularly threatened. Trends of looting and development would continue without the proposed project. There is no mitigation required under the No Action Alternative. Without the proposed project, existing (Navajo Nation, State, Federal, and city of Gallup) resource management policies are employed to ensure the protection of cultural resources.

SJRPNM Alternative.—

Archaeological and Historical –Under the SJRPNM Alternative, it is estimated that 104 cultural resource sites would be within the area of potential effects. Ground disturbance and other activities associated with construction and operation of the proposed project would disturb and/or destroy cultural resources located in these areas. Due to the known significance of the area, the impacts to an estimated 80–90 sites for the SJRPNM Alternative are considered significant. The potentially affected sites include PaleoIndian Archaic period sites, Anasazi (Ancient Pueblo) habitation and limited-use sites, historic Native American (Athabascan) sites, and other Historic (EuroAmerican) properties. Specific effects would be identified upon complete inventory of these actions. Ground disturbance and other related activities would create the potential for disturbing or destroying cultural resources. Roads in rights-of-way corridors along pipelines would also afford greater public access to previously undisturbed areas. Damage to sites could occur in the form of off-road vehicle use on cultural resources sites, vandalism, or erosion from tertiary roads or trails.

NIIP Amarillo Alternative.—

Archaeological and Historical.—Cultural resource impacts are similar to those described under the SJRPNM Alternative, except that more sites could be affected under the NIIP Amarillo Alternative. It is estimated that 183 cultural sites would be within the NIIP Amarillo Alternative area of potential effects. Ground disturbance and other activities associated with construction and operation of the proposed project would disturb and/or destroy an estimated 145 sites under the NIIP Amarillo Alternative, which is considered significant.

Cultural Resources – Mitigation Measures

It is anticipated that approximately 145 cultural resource sites under the NIIP Amarillo Alternative and approximately 80–90 cultural resource sites under the SJRPNM Alternative would require some level of mitigative treatment, including archaeological testing or full data recovery (archaeological excavation).[21] Proposed mitigation measures include avoiding sites where possible or a program to compensate for losses of archaeological sites that would occur as a result of construction and operation of the proposed project and the construction of conveyances. The program would be undertaken by Reclamation in coordination with the New Mexico State Historic Preservation Officer (NMSHPO), the Navajo Nation Tribal Historic Preservation Officer

[21] The term “treatment,” rather than mitigation, is the preferred term because excavation may not be appropriate in regard to some cultural resources (i.e., ceremonial sites).

(NNTHPO), BLM, BIA, the city of Gallup, and the Advisory Council on Historic Preservation. The proposed program would consist of recovery, analysis, technical publication, and providing for storage and curation for permanent maintenance of the artifact collection and other related information. In addition to the scientific value, this would produce information of considerable public interest.

Implementation of the historic/archaeological treatment measures and publication of results would be completed pursuant to a programmatic agreement. Proposed measures to minimize and avoid impacts to cultural resources, such as in-place preservation, monitoring, distribution of information, and public and Tribal/Tribal Nation involvement, would be implemented. If cultural resource sites cannot be avoided and protected in place, a program to compensate for losses to sites as a result of project implementation would be needed. This program would include archaeological excavations and publications and reports detailing the findings of those excavations. Educational programs and public access to the excavations would be part of the mitigation plan.

Historic American Building Survey/Historic American Engineering Record recordation, written and/or oral histories, site stabilization, and/or ethnographic studies would also be implemented, as appropriate. In addition to the archaeological interpretation of the site data, consulting Tribes/Tribal Nations would be given the opportunity to provide input to the treatment of sites of cultural importance and to form their own interpretation of these data, in the form of continued consultation between Reclamation and the consulting Tribes/Tribal Nations. Tribal consultation is also recommended regarding data collection at certain traditional cultural resources sites (collection areas, ceremonial sites, trails, etc.) when avoidance is not possible.

Mitigation of impacts to cultural resource sites could be accomplished through archaeological excavation and the study and publication of the results. Through consultation with the Advisory Council on Historic Preservation, interested Tribes/Tribal Nations, the NMSHPO and NNTHPO, and involved agencies, a research design and work plan would be produced that, along with the programmatic agreement, would guide the mitigation efforts.

Activities described could disturb or expose Native American human remains and cultural items protected under NAGPRA or prevent access to sacred sites protected under Executive Order 13007. Mitigation measures would be followed in accordance with NAGPRA and EO 13007. The preferred mitigation would be the avoidance and in-place preservation of graves and sacred sites to the degree possible. When this was unavoidable, Reclamation would consult with affected Tribes/Tribal Nations to determine the most appropriate action. Since no sacred sites have yet been identified that would be impacted by the alternative, no specific mitigation measures are described. However, since it is likely that human remains will be encountered, a NAGPRA Plan, in consultation with the potentially affected Tribes/Tribal Nations, would be developed.

The NAGPRA Plan would describe the procedures that are to be followed in the event that human remains or cultural items are encountered during the course of project activities.

Cultural Resources – Summary of Impacts

Under the No Action Alternative, the proposed project would not be constructed, and there would be no impacts to cultural resources attributable to the project. Existing management of cultural resources would be expected to continue in the project impact corridors.

Under the SJRPNM Alternative, it is estimated that 104 cultural resource sites would be within the area of potential effects (with 80–90 sites impacted). For the NIIP Amarillo Alternative, it is estimated that 183 cultural resource sites would be within the area of potential effects (with 145 sites impacted).

Biodiversity and Sustainability

Biological diversity, or “biodiversity,” has become a significant focus of land management agencies throughout the Western United States. The loss of biological diversity is currently recognized as an important issue that may have ecological and economic consequences. Biodiversity focuses on native species or communities that are rare or under-represented, emphasizing the genetic, structural, compositional, and functional components of diversity. While the wide-ranging vegetation types within the proposed project area support many levels and scales of biological diversity, this section focuses on species and communities that are considered sensitive to disturbance.

Biodiversity is defined as the variety of life and its processes and the interrelationships within and among various levels of ecological organization. Conservation, protection, and restoration of biological species and genetic diversity are needed to sustain the health of existing biological systems. Federal resource management agencies must examine the implications of management actions and development decisions on regional and local biodiversity.

The major grassland, shrubland, woodland, and forest types would, at the regional ecosystem level, define the primary scale of analysis for the proposed project. The major ecosystem types extend over hundreds of square miles. In addition, a more detailed, local scale of analysis considers much smaller land areas encompassing community types of limited extent or specialized requirements. Examples of these more localized ecosystems include streams and rivers, the riparian zone associated with streams and rivers, natural wetlands, and wetlands associated with manmade facilities such as irrigation canals. The primary factors that alter biodiversity at the scales discussed above include climate and human activities. Elements of biodiversity that are directly affected by the activities associated with a water supply development project include the composition and abundance of native vegetation species and fishery and wildlife populations. Threatened and endangered species represent a special category of biodiversity because of their vulnerability to small habitat alterations. Human activities that influence biodiversity include habitat fragmentation from construction or corridors and settlements; agricultural activities, including diversion of streams for irrigation and the use of pesticides; livestock grazing, and forestry; and surface disturbance associated with mineral extraction.

In relation to the proposed project, the topics in this PR/DEIS that are related to maintenance or loss of biodiversity include vegetation (upland and wetland/riparian), special status species, wildlife, and fisheries (see the “Vegetation Resources,” “Special Status Species,” “Wildlife Resources,” and “Aquatic Resources” sections). Changes to water regimes and habitat types, such as conversion of upland vegetation to a pump station, could affect species diversity locally and within a watershed. Notably, habitat for such threatened and endangered species, such as the Mesa Verde cactus, could be at risk due to this conversion, but “nonprotected” wildlife that are equally important to biodiversity could also be affected.

In the context of maintaining biodiversity, the concept of resource sustainability has guided the planning of the proposed project and the preparation of this environmental analysis. In this PR/DEIS, the concept of “sustainability” refers to the maintenance of a landscape and lifestyle in some agreed-upon form that includes both a space for human economic activity and a space to preserve the ecosystem under natural controls and evolution. Sustainability presumes a certain value in the natural landscape and seeks to preserve a functioning remnant of that world under the pressure of human presence.

To this end, Reclamation is taking an ecosystem approach to mitigating the impacts of the proposed project. The incorporation of native seeds for re-vegetation of disturbed areas’ association with pipeline construction, and the acquisition and management of a single tract of land to enhance wetland/riparian habitats, would benefit the diversity of plant and animal species in an area that has or will continue to undergo habitat fragmentation as a result of development. Although the proposed project may locally reduce biodiversity, species’ composition and populations are not static, and project effects with appropriate mitigation are unlikely to exceed natural variability or the variability attributed to activities unrelated to the proposed project. It is important to note that the SJRPNM Alternative may actually enhance biodiversity when compared to the No Action and NIIP Amarillo Alternatives by providing additional water to the San Juan River between Navajo Reservoir and the SJRPNM intake structure.

OTHER IMPACTS CONSIDERATIONS

Indirect Effects

Population in the project area has been limited by the lack of dependable domestic water supplies. Population trends are expected to remain consistent with the proposed project. Population projections, as shown in volume II, appendix A, predict a 2.48 percent population increase on the Navajo Nation, a 1.7 percent increase on the Jicarilla Apache Nation, and a 1.82 percent increase in the city of Gallup.

Many of the Navajo communities in the proposed project service area that do have a piped water supply rely on wells with a limited water supply. The proposed project would allow these communities to provide an adequate water supply for their future population and commercial needs.

The city of Gallup currently relies on groundwater pumping to supply water to its residents. The water level in the city's wells has been falling by 7 to 29 feet per year over an extended period, and at some point, the production capacity of the current well system is expected to diminish. Therefore, without the proposed project, the city of Gallup would be faced with some combination of the following scenarios: (1) development of alternative water supply projects, (2) diminishing per capita water supply, and/or (3) curtailment of population growth. The city has not been able to identify any other water supply project that is as cost effective as this project. Without new water, it is estimated that the available water per capita would fall to less than one-half of existing water use by the year 2033. Thus, without the proposed project, the city of Gallup would have to make major changes in water use patterns, with consequential negative implications for the city's economic well-being. Accordingly, one project impact is to prevent the overall economic losses to the city that would occur if future water shortages caused residents and businesses to locate elsewhere.

The Jicarilla Apache Nation has established a policy of developing the southwest portion of its reservation. To attract housing and commercial enterprises to that area, they must develop a reliable, sustainable water supply. The Jicarilla Apache Nation has no adequate local water sources capable of providing such a water supply, so they have investigated various alternatives for importing water from nonlocal sources. Of the alternatives investigated, the proposed project offers the best combination of reliability and cost effectiveness. Therefore, the effect of the proposed project would be to facilitate the Jicarilla Apache Nation's plans to diversify their reservation, both residentially and economically.

Connected, Cumulative, and Related Actions

The Council on Environmental Quality regulations for implementing National Environmental Policy Act (NEPA) require the determination of short- and long-term impacts, direct and indirect, irreversible and irretrievable commitments of resources, and unavoidable adverse impacts. The regulations also call for the consideration of the relationship of the proposed action and its impacts to other projects and activities in the area. The relationship can be direct, indirect, or cumulative in nature. Connected actions are those actions that are interrelated with the proposed action; cumulative actions are those actions, which, when viewed with other proposed actions, have cumulatively significant impacts; and related actions are those actions which, when viewed with other proposed actions, have similarities to the proposed action that provide a basis for evaluation together, such as common timing or geography.

Connected actions include Navajo Reservoir Operations and the SJRBRIP. Cumulative and related actions include operations of the Navajo Unit; Dolores, Pine River, Florida, and Mancos Projects; ALP Project; the NIIP; San Juan-Chama Project, the San Juan River Irrigation Projects; the proposed Desert Rock Energy Project; all Indian Health Service Navajo domestic water supply projects; the JANNRWSP, and the pending Navajo San Juan Basin Water Rights Settlement.

Because the United States owns and operates Navajo Reservoir and has ESA and Tribal trust responsibilities in the Basin, the proposed project is designed to accommodate, to the extent possible, overlapping concerns. The actions described below summarize these United States' responsibilities and how they are affected by the proposed project.

Navajo Reservoir Operations and the San Juan River Basin Recovery Implementation Program

The operation of Navajo Reservoir is a connected action to the proposed project and other water resource activities in the Basin such as the NIIP and ALP Project. This connection stems from:

(1) Past ESA consultations that established and relied upon the SJRBRIP and listed certain RPAs in question

(2) San Juan River Flow Recommendations developed and approved by the SJRBRIP

(3) Reclamation's commitment as described in the Navajo Reservoir Operations FEIS to operate Navajo Reservoir to assist in meeting the Flow Recommendations for endangered fish in the Basin

Consideration of Navajo Reservoir operation issues and impacts (e.g., flow regimes, riparian impacts, reservoir levels, reservoir recreation issues, trout fishing, and habitat uses) were included in this PR/DEIS and the Navajo Reservoir Operations FEIS (Reclamation, 2006). Reclamation has completed the environmental compliance process for Navajo Reservoir operation, which is separate from, but coordinated with, the proposed project PR/DEIS.

Background Information.—Navajo Dam and Reservoir is owned, operated, and maintained by Reclamation. Navajo Dam is located on the San Juan River about 44 miles upstream from Farmington, New Mexico. The reservoir created by the dam extends into the State of Colorado. The Navajo Unit is a storage unit of the CRSP and is subject to the terms of the Upper Colorado River Basin Compact, the Colorado River Storage Project Act of April 11, 1956 (70 Stat. 105), and the Act of June 13, 1962, authorizing the San Juan-Chama Project and the NIIP. Since its original authorization, Congress has approved the use of Navajo Reservoir to fulfill a portion of the Jicarilla Apache Nation Water Rights Settlement; such use is within the authorized purposes of the Navajo Unit.

After completion of the Navajo Unit in December 1963, the focus of the criteria for releasing water from the dam was primarily on flood control, NIIP supplies, and water storage.

However, in the 1990s, the focus of the criteria and associated pattern of releasing water from the dam changed. The new focus included the needs of the endangered fish species, such as the Colorado pikeminnow and the razorback sucker, in the San Juan River. Criteria for reservoir operation decisions that include the needs of endangered fish in the San Juan River are fairly new to the operations decision process of the Navajo Unit. Operations that result from implementing the Flow Recommendations for endangered fish are different than historic operations of the first 30 years after completion of Navajo Dam. The Navajo Reservoir FEIS documents these changes (Reclamation, 2006).

Animas-La Plata Project

The ALP Project, located in southwestern Colorado and northwestern New Mexico, is being implemented as a settlement of the Colorado Ute Tribal water rights. At full development, the ALP Project will deplete about 57,100 acre-feet from the Basin.

Construction is approximately 45 percent complete on the ALP Project, and it is anticipated to be completed in 2012 or 2013. Implementation of the SJRBRIP is the key element of the reasonable and prudent alternative[22] (RPA) for section 7 consultation under the ESA that would permit completion of the ALP Project.

Navajo Indian Irrigation Project and San Juan River Irrigation Projects

The NIIP, a participating project of the CRSP, was authorized on June 13, 1962 (P.L. 87-483, as amended by P.L. 91-416 on September 25, 1970). Its principal purpose is to irrigate 110,630 acres of land owned by the Navajo Nation in northwestern New Mexico, generally south of Farmington. Water is delivered from Navajo Dam through a series of tunnels, canals, and pipelines to the sprinkler systems that irrigate agricultural land. The proposed project began operation in 1976 with the first of 11 Blocks; it was scheduled for completion in 1986, but funding delays have postponed the completion.

In 1991, a biological opinion was completed for the first 8 Blocks. The biological opinion required that depletion be limited to that required for Blocks 1 through 6, 133,000 AFY, plus 16,420 AFY transferred from land not presently irrigated in the Hogback Project. Given that a substantial portion of the acreage in Blocks 1 through 6 was in conservation reserve, this allowed construction through Block 8. The acreage through Block 8, which was completed and in full operation in 2002, totals about 76,481 acres.

In 1999, a biological assessment was prepared and letter of concurrence from the Service was received by BIA allowing completion of all 110,630 acres of irrigated land in 11 Blocks with an average annual depletion of 280,600 acre-feet. This depletion is included in the baseline used to analyze the impacts of the proposed project on water supply and the ability to meet the SJRBRIP Flow Recommendations. Eventually, the proposed project depletions will drop to 270,000 AFY as return flows reach equilibrium. No additional environmental compliance analysis pursuant to NEPA is planned for completion of the NIIP.

The San Juan River Irrigation Projects include the Hogback, Fruitland-Cambridge, and Cudei Projects along the San Juan River. These BIA projects were initiated between 1900 and 1937. As of 2000, these projects provided irrigation water to about 5,300 acres. A summary of the San Juan River Irrigation Projects is as follows:

[22] Regulations implementing the ESA, section 7, define reasonable and prudent alternatives as alternative actions that avoid jeopardy identified during formal consultation with the Service.

(1) The *Hogback Irrigation Project* supplies water for lands on the north side of the San Juan River, from the Hogback, located about 9 miles east of Shiprock, New Mexico, to about 17 miles northwest of Shiprock. In recent years, the acreage irrigated under the Hogback Irrigation Project has ranged from an estimated 2,580 acres to about 2,830 acres. In 1991, 16,420 AFY of depletion of the inactive portions of the Hogback Irrigation Project was applied to the NIIP for ESA consultation purposes. Construction of NIIP Blocks 1 through 8 was to proceed while research on endangered fish recovery took place.

(2) The *Cudei Project* supplies water for lands on the south side of the San Juan River about 6 miles northwest of Shiprock. In recent years, the acreage irrigated under the Cudei Project has ranged from an estimated 290 acres to 390 acres. The Cudei diversion dam was removed in 2002, and supply to the project was provided via a siphon from the Hogback main canal.

(3) The *Fruitland-Cambridge Irrigation Project* diversion dam and headworks are located 2 miles west of Farmington, New Mexico, on the south bank of the San Juan River. In recent years, the acreage irrigated under the Fruitland-Cambridge Irrigation Project has ranged from an estimated 1,950 acres to about 2,140 acres.

The Navajo Nation projects account for over 300,000 acre-feet of the depletions in the baseline. In the event that the sum of all the actual depletions that are included in the depletion baseline, including the project depletion, exceeds the level of depletion that is currently allowable within the Flow Recommendations, the Navajo Nation commits to reducing its total depletion to stay below the allowed total for the Basin. This could be accomplished by changes in operation of any of the Navajo projects that deplete water from the San Juan River. By way of example, the operation of irrigation projects adjacent to the San Juan River could be limited to use less than the full allowed depletion, the operation of the Navajo portion of the project could be modified to reduce use, or the NIIP could be modified in terms of service acreage, fallow land, or crop mix change to reduce demand. The maximum guaranteed requirement is 20,782 acre-feet, and changes in the Flow Recommendations or in species status may result in a reduction or removal of this guarantee in the future.

Desert Rock Energy Project

Sithe Global Power, LCC (Sithe Global) proposes to construct a hybrid dry-cooled, coal-fired, 1,500-megawatt (mW) electrical power generating plant approximately 30 miles southwest of Farmington, New Mexico, on the Navajo Indian Reservation. Sithe Global is developing the project with the Diné Power Authority, an enterprise of the Navajo Nation.

The primary components of the proposed project include:

- Two 750-mW, coal-fired generating units and associated facilities and operations including a plant cooling system; flue-gas cleaning equipment to reduce sulfur dioxide, nitrogen oxide, and mercury emissions; a fuel supply system; waste management operations; and safety systems
- Water supply infrastructure (e.g., water well field, pipeline)
- Power transmission interconnection facilities
- Access roads
- Construction staging areas
- Coal from Areas IV South and V of the BHP Navajo Coal Company Lease Area

A DEIS is currently being drafted by the BIA, the lead Federal agency for preparing the document.

Jicarilla Apache Nation Navajo River Water Supply Project

The Jicarilla Apache Tribe Water Rights Settlement Act (106 Stat. 2237) was enacted in 1992. The water delivery provisions for future uses of the Jicarilla Apache Tribe Water Rights Settlement mandated certain requirements to be fulfilled before the water could be available for Tribal use. All of these requirements have been met, and on February 23, 1999, the Eleventh Judicial District Court, County of San Juan, State of New Mexico, entered a Partial Final Judgment and Decree adjudicating the Tribe's water rights in the San Juan River system. Thus, the settlement is now in full effect. The settlement act provides the Tribe the right to divert 6,500 AFY of San Juan-Chama Project water from Heron Reservoir and the right to divert 33,500 AFY from Navajo Reservoir or the Navajo River, of which 25,500 AFY may be depleted. The Jicarilla Apache Nation also has the right to market third-party subcontracts, the water to which the Nation is entitled from the Navajo Reservoir water supply and the San Juan-Chama Project under the settlement contract for off-reservation uses, subject to the approval of the Secretary and to requirements and conditions of applicable Federal and State law and interstate compacts, including the Partial Final Judgment and Decree adjudicating the Nation's water rights in the Basin in New Mexico. The Jicarilla Apache Nation's water rights, based on historic and existing uses on their reservation, were also quantified, with a total annual diversion of 5,683 AFY, or the quantity of water necessary to supply a depletion of 2,195 AFY, whichever is less, and a net evaporation from existing stock ponds and reservoirs of 2,187 AFY.

Presently, the 25,500 AFY of Navajo Reservoir water supply contract depletion rights of the Jicarilla Apache Nation are allocated to the following uses: 16,200 acre-feet to the PNM for use at the San Juan Generating Station, 770 acre-feet to minor subcontracts, 6,654[23] acre-feet for the proposed JANNRWSP, and 1,876 acre-feet remain unallocated. In addition, the Nation has 2,190 acre-feet of historical use rights, of which 1,846 acre-feet were committed to the JANNRWSP and 346 acre-feet are presently used for M&I purposes. The plans for the JANNRWSP include the allowance to divert all or part of water presently allocated for the JANNRWSP to other uses, including the proposed Navajo-Gallup Water Supply Project, at a time it should be needed. For purposes of this project analysis, it is assumed that the JANNRWSP would divert no future use water, 220 acre-feet of the historical water would be used for other purposes, and 8,700 acre-feet would be delivered to the proposed Navajo-Gallup Water Supply Project (6,570 acre-feet previously committed to the JANNRWSP plus 1,960 acre-feet of additional future use water and 170 acre-feet of other water) to meet full demands anticipated from the Jicarilla Apache Nation's water rights.

Cumulative Impacts

The projects listed above would have cumulative impacts when taken in conjunction with the completion of this proposed project. The following describes the impacts by project.

Operation of Navajo Dam

The operation of Navajo Dam to mimic the natural hydrograph of the San Juan River by implementing the SJRBRIP Flow Recommendations is the centerpiece of a strategy to facilitate recovery of endangered fish species and, therefore, provides, at present, the primary mechanism that supports ESA compliance for water development to continue in the Basin. In 1991, the status of endangered fish in the San Juan River made additional water depletions in the Basin uncertain.

The San Juan River Basin Hydrology Model was developed by Reclamation and BIA for support of the Flow Recommendations process, with oversight and model review by an ad hoc modeling group made up of hydrologists representing the various interests in the Basin. The model was used initially to analyze the ability of the San Juan River system to be operated to meet the Flow Recommendations and to assess the impacts of future development on that ability. Operating criteria were developed as part of the Flow Recommendations that would allow Flow Recommendations to be met with the

[23] San Juan River Basin Hydrology Model that shows average project depletion of 6,570 acre-feet.

development of additional water in the Basin. However, as noted in the report, *Flow Recommendations for the San Juan River* (Holden, 1999), the operating criteria specified were not optimized to maximize developable water. Allowance was made in the Flow Recommendations for the San Juan River for development of other operating criteria that may provide for additional water development as long as the Flow Recommendations themselves are met and the nature of the release hydrographs are not altered.

Following the completion of the Flow Recommendations report, the model became available for the assessment of water development project impacts on the ability to meet the Flow Recommendations. When applied for this purpose, modification of operating criteria to optimize system operations was anticipated.

The model is an ongoing process of review and improvement. The current model configuration indicates that Navajo Dam can be operated to meet the demands of the proposed project, in addition to all depletions in the baseline (table V-3), while minimally impacting meeting the Flow Recommendations. All but two of the flow criteria are met for the worst-case scenario, and these criteria have been determined by the SJRBRIP SJRBRIP to be ineffective in accomplishing the anticipated results (Miller, 2005). The 2,500 cfs criteria are missed by about 12 percent for 3 days in 1 year out of the 65-year period, or 0.01 percent of the time. All other Flow Recommendations criteria are fully met.

Reclamation prepared an FEIS for Navajo Reservoir Operations (Reclamation, 2006) to evaluate impacts associated with implementing the Flow Recommendations. The EIS evaluated a No Action Alternative and 250/5000 and 500/5000 Alternatives. The No Action and 500/5000 Alternatives do not fully meet the Flow Recommendations. Reclamation identified the 250/5000 Alternative as the preferred alternative and will implement the 250/5000 Alternative after the ROD has been executed.

The model, in its present configuration, represents the best science available to assess the impacts the proposed project on the ability to meet Flow Recommendations for endangered fish and to test operating rules designed for that purpose. The presently defined operating rules and model configuration do not indicate availability for substantial additional depletions in the Basin with the present Flow Recommendations. Furthermore, modification of the operating rules and/or improvement in the simulation of system operation in the San Juan River would be required to demonstrate the possibility of further development within the present Flow Recommendations. The Navajo Depletion Guarantee, as previously discussed, would allow the proposed project's full development without exceeding the level of depletions specified in the baseline.

Animas-La Plata Project

Full development of the water supply made available by completion of the ALP Project will increase depletions in the Basin by about 57,100 acre-feet. The biological opinion relies on implementation of the Flow Recommendations through re-operation of Navajo Reservoir to avoid jeopardy to the Colorado pikeminnow and razorback sucker.

Navajo Indian Irrigation Project

Completion of the NIIP will increase depletions on the San Juan River by about 120,580 AFY under equilibrium conditions and by about 131,180 AFY until return flows reach equilibrium. The 1999 biological assessment and letter of concurrence from the Service provided ESA compliance for construction to proceed up to the full level of development, using a large portion of the remaining developable water within the Basin.

Desert Rock Energy Project

Construction of the Desert Rock Energy Project could overlap with the construction footprint of the proposed project. Water well fields, pipelines, and power-transmission interconnect facilities may cross or run parallel to some of the proposed project facilities.

Jicarilla Apache Nation Navajo River Water Supply Project

At full project development, the JANNRWSP, if implemented, would divert up to 12,000 AFY from the Navajo River, resulting in a depletion of 8,500 AFY on average. Of the 8,500 AFY average depletion, 6,654 AFY on average is considered a new depletion that would be sourced from the Navajo River through the Jicarilla Apache Nation's settlement contract with the Secretary (Service, 2004). The Jicarilla Apache Nation, pursuant to the Jicarilla Apache Tribe Water Rights Settlement Act, has a right to deplete up to 25,500 AFY from the Navajo River or Navajo Reservoir pursuant to the Nation's settlement contract with the Secretary. The Jicarilla Apache Nation currently has 8,530 AFY of depletions available from the Navajo Reservoir water supply under its settlement contract (25,500 AFY minus 16,200 AFY subcontracted to PNM minus 770 AFY minor subcontracted in 2005) that they may choose to use for the JANNRWSP or on the proposed project. The 6,564 average new depletion comes out of the 8,530 AFY water rights mentioned above.

Under the proposed project, it is assumed that the JANNRWSP would not divert future use water, 2,020 acre-feet of historical water right would be used for other purposes, and

8,700 acre-feet would be delivered to the proposed project (6,570 acre-feet previously committed to JANNRWSP plus 1,960 acre-feet of additional future use water and 170 acre-feet of other water) to meet the full demands anticipated from the Jicarilla Apache water right.

San Juan River Basin in New Mexico Navajo Nation Water Rights Settlement Agreement

On April 19, 2005, the State of New Mexico and the Navajo Nation signed the San Juan River Basin in New Mexico Navajo Nation Water Rights Settlement Agreement (Navajo Nation - State of New Mexico, 2005). The proposed settlement would resolve the claims of the Navajo Nation to the use of waters of the Basin in New Mexico. The settlement agreement is intended to provide water rights and associated water development projects, including the proposed project, for the benefit of the Navajo Nation in exchange for a release of claims to water that potentially might otherwise displace existing non-Navajo water uses in the Basin in New Mexico.

If the proposed settlement is approved by Congress and signed into law by the President, the Secretary would execute the settlement agreement and the settlement contract, and the proposed project would be authorized for construction.

The proposed settlement would finalize the remaining Navajo Nation water right claims in the New Mexico portion of the Basin. Additional NEPA compliance may be needed to implement other portions of the agreement (Fruitland-Cambridge, Hogback-Cudei, conjunctive use groundwater wells, and others).

Relationship between Short-Term Uses and Long-Term Productivity

This section discusses the short-term use of man’s environment that would be required to construct and implement the proposed project alternatives and the long-term productivity that would result from operation of the proposed project.

Short-term use of man’s environment refers to either the actual use of resources during construction (e.g., energy, manpower, and monetary investments) or impacts to environmental resources that would occur during construction or as a result of operation. Long-term productivity refers to the benefits that would be realized during operation of the proposed project. In most instances, short-term use of (or impacts to) a given resource would not have a directly corresponding long-term benefit to the resource. Additionally, certain long-term impacts would occur to some resources. These impacts are discussed in detail in the "Affected Resources" section.

The following sections discuss (1) the long-term productivity that would result from the operation of the SJRPNM and NIIP Amarillo Alternatives and (2) the short-term use of resources that would be required to realize such productivity.

Long-Term Benefits and Productivity

Long-term benefits that would be realized from implementation of the SJRPNM Alternative include (1) providing dependable domestic water supplies for current and future needs of the Navajo Nation, Jicarilla Apache Nation, and the city of Gallup; (2) increased development and employment opportunities and associated revenues to the Navajo Nation, Jicarilla Apache Nation, city of Gallup, and other area residents and businesses as a result of water deliveries; (3) a reduction of impacts to aquatic and river recreation resources from Navajo Dam to the SJRPNM intake structure as identified in the No Action Alternative; and (4) provision of a much-needed M&I water supply to the Navajo Nation that should assist the possibility of settling the Navajo Nation water right claims in the Basin.

Long-term benefits that would be realized from implementation of the NIIP Amarillo Alternative would be the same as those identified above, with the exception of reduced impacts to aquatic and recreation resources as identified in the No Action Alternative.

Short-Term Uses of Resources

Resources that would be required for construction and operation of the SJRPNM Alternative include construction materials, energy, land, manpower, and monetary expenditure. (Specific project requirements for construction and operation are described in Chapter IV–Alternatives of this PR/DEIS). Additionally, commitments of certain resources would result from impacts that would occur during construction and operation of the structural components, water end uses, and water conveyance systems. These commitments or impacts would indirectly allow for the long-term benefits of the proposed project, as described in the next section. Such commitments include a commitment of water storage resources in Navajo Reservoir, disturbance of cultural resources, changes in land use, destruction of riparian and wetland habitats, and increased traffic congestion associated with construction traffic at project features and pipeline locations.

Resources required for construction and operation of the NIIP Amarillo Alternative would differ slightly from those required for the SJRPNM Alternative. Construction of the NIIP Amarillo Alternative would require more construction materials, energy, land, and monetary expenditures. Operational expenditure required for the NIIP Amarillo Alternative would be less than that required of the SJRPNM Alternative. Specific project requirements for construction and operation are described in Chapter IV–Alternatives of this PR/DEIS. Additionally, "commitments" of certain resources would result from impacts that occur during construction and operation of the structural components, water end uses, and water conveyance systems. These commitments, or impacts, would indirectly allow for the long-term benefits of the project, as described in the next section. Such commitments include a commitment of water storage resources in Navajo Reservoir, disturbance and inundation of cultural resources, inundation of upland habitats, changes in land use, destruction of riparian and wetlands habitats, and increased traffic congestion associated with construction traffic at project features and pipeline locations.

Irreversible and Irretrievable Commitments of Resources

The irreversible and irretrievable commitments of certain resources would be required to implement the proposed project. Irreversible and irretrievable commitments would occur from the use of resources for the construction and operation of the proposed project features and land acquisition and would also occur through impacts to resources as a result of implementation of the proposed project alternatives.

For purposes of this section, the irreversible commitment of a renewable resource means that following the decision to take certain actions that would result in the utilization or loss of a given resource (in part or whole), either the decision could not be changed or the action could not practicably be reversed due to physical or economical constraints. The irretrievable commitment of a resource is defined as the loss of future options and/or a given resource. Consequently, a resource used for the construction and/or operation of the proposed project would be an irretrievable commitment of a resource. Additionally, the loss of a resource resulting from project impacts, such as disturbance of cultural resources, inundation of upland habitats, destruction of riparian and wetland habitats, and increased traffic congestion associated with construction traffic, would be considered an irretrievable commitment of that resource. For example, once water is diverted from a river and put to particular use, it cannot feasibly be retrieved and, as such, would be considered an irretrievable commitment of resources. However, the decision and physical action to divert the water is not irreversible. If policy, legislative, or management decisions were made to end the diversion of water to a particular use, then diversion facilities could be reconfigured accordingly, and the commitment of the water to that use would be reversed.

Resources that would be used for the construction and operation of the SJRPNM and NIIP Amarillo Alternatives' structural components and end uses and conveyance systems include:

- Construction materials
- Energy resources, such as fuel for construction equipment and electricity for operating pumps
- Manpower for construction and operation
- Financial resources
- Cultural resource destruction

Additionally, the operation of potential end uses of project water would, by definition, consume water and would also consume other resources such as electricity and natural gas (as Tribal communities and the city of Gallup develop and expand to meet future population demands).

The decision to commit resources for the construction of the SJRPNM and NIIP Amarillo Alternatives would be irreversible once construction activities had taken place. The energy, manpower, and other resources that would be used for development of the proposed project facilities would be foregone following construction of the facilities, and reusing these resources for alternative purposes would not be feasible.

The decision to commit water to a particular use, however, would be reversible. The Navajo and Jicarilla Apache Nations and the city of Gallup plan to use project water for domestic purposes. While the water for these uses could not feasibly be retrieved, the decision to commit this water to a particular purpose could be reversed. It is possible that with this timespan, economic circumstances could arise or technical advances could occur that would influence decisionmakers to alter the operational specifications of particular project features, thereby changing the resources necessary for operation or creating an opportunity to put such water to a more beneficial use. These decisions could result in a reduction or elimination of the further consumption, thereby reversing the resources' commitment.

CONCLUSIONS AND SUMMARY OF IMPACTS

Table V-17 (at the end of this chapter) provides a summary of impacts associated with the No Action, SJRPNM, and NIIP Amarillo Alternatives.

Under the No Action Alternative, the proposed project would not be constructed and a lack of dependable municipal water supplies would likely limit existing communities and future growth.

The SJRPNM and NIIP Amarillo alternatives would deplete 35,893 acre-feet of water from the Basin to supply water in New Mexico and Arizona for project purposes, and dependable water supplies would be available to the Navajo and Jicarilla Apache Nations, and the city of Gallup to meet existing and future municipal water demands. Both alternatives meet the Flow Recommendations 99.9 percent of the time and have potential adverse impacts to beautiful gilia and Mesa Verde cactus. Grazing activities and paleontological resources adjacent to the pipeline corridors would likely be impacted during the construction phase of the SJRPNM and NIIP Amarillo Alternatives.

The SJRPNM Alternative would increase San Juan River mean average flows by 4.6 cfs, which is predicted to have beneficial impacts on water quality, aquatic resources, and recreation resources below Navajo Dam. Under the SJRPNM Alternative, 31,686 acres could be temporarily disturbed for pipeline construction and 43 acres permanently removed for project features, including 1.1 acres of wetland habitat. Seventeen acres of non-native riparian vegetation would be removed and re-vegetated with native riparian species. Potential entrainment of larval Colorado pikeminnow, razorback sucker, bluehead sucker, flannelmouth sucker, and speckled dace may occur under the SJRPNM Alternative at the PNM diversion on the San Juan River; however, the amount of entrainment is not predicted to be significant. An estimated 104 cultural resource sites may occur within the SJRPNM Alternative's area of potential effect, and 80–90 cultural resource sites may be impacted. Other impacts associated with the SJRPNM Alternative are presented in table V-17.

The NIIP Amarillo Alternative would decrease San Juan River mean average flows by 4.0 cfs, with limited negative impacts on water quality, aquatic resources, and recreation resources below Navajo Dam. Under the NIIP Amarillo Alternative, 31,841 acres could be temporarily disturbed for pipeline construction and 249 acres permanently removed for project features, including 0.1 acre of wetland habitat. An estimated 183 cultural resource sites may occur within the SJRPNM Alternative's area of potential effect, and 145 cultural resource sites may be impacted. Other impacts associated with the NIIP Amarillo Alternative are presented in table V-17.

Based on the analysis conducted in chapters IV and V, the SJRPNM Alternative has been identified as the preferred alternative.

Table V-17.—Summary of Impacts

<table>
<tr><th>Resource</th><th>No Action Alternative</th><th>SJRPNM Alternative</th><th>NIIP Amarillo Alternative</th></tr>
<tr><td rowspan="4">Water uses and water resources</td><td rowspan="4">No significant changes.[1]</td><td>Increases Navajo Reservoir mean elevation by 1.3 feet.</td><td>Increases Navajo Reservoir mean elevation by 0.9 foot.</td></tr>
<tr><td>Increases San Juan River mean average flow by 4.6 cfs</td><td>Decreases San Juan River mean average flow by 4.0 cfs</td></tr>
<tr><td colspan="2">Flow Recommendations met 99.9% of the time. All but two flow criteria met for the worst-case scenario.</td></tr>
<tr><td colspan="2">35,893 acre-feet total depletion;
New Mexico–29,482 acre-feet; Arizona–6,411 acre-feet</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td rowspan="4">Indian Trust Assets</td><td rowspan="4">Lack of dependable municipal water supply for existing communities and future growth.</td><td colspan="2">Navajo Nation uses 20,782 acre-feet in New Mexico and 6,411 acre-feet in Arizona for dependable municipal water supply for existing Navajo communities and future growth.</td></tr>
<tr><td colspan="2">Navajo Depletion Guarantee of 20,782 acre-feet used to stay within existing San Juan River baseline.</td></tr>
<tr><td colspan="2">1,200 acre-foot Jicarilla Apache Nation on-reservation demand met using a portion of the Jicarilla Apache Tribe Water Rights Settlement Act and potential for third-party contract for 7,500 acre-feet to the city of Gallup for remaining settlement act.</td></tr>
<tr><td colspan="2">May impact development of future use water from the Colorado Ute Indian Water Rights Settlement Act.</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td rowspan="2">Water quality</td><td rowspan="2">Water quality degradation would continue in low flow periods.</td><td>Water quality benefit from slight decrease in concentrations of contaminants below Navajo Reservoir.</td><td>Same as No Action.</td></tr>
<tr><td>NPDES permitted facilities above the PNM diversion would benefit from increased flow during critical low flow conditions.</td><td>Same as No Action.</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td rowspan="2">Vegetation resources</td><td rowspan="2">No significant changes.[1]</td><td>31,686 acres of temporary disturbance.</td><td>31,841 acres of temporary disturbance.</td></tr>
<tr><td>43 acres of permanent loss for project features.</td><td>249 acres of permanent loss for project features.</td></tr>
</table>

Table V-17.—Summary of Impacts (continued)

<table>
<tr><th>Resource</th><th>No Action Alternative</th><th>SJRPNM Alternative</th><th>NIIP Amarillo Alternative</th></tr>
<tr><td rowspan="4">Vegetation resources (continued)</td><td rowspan="2">No significant changes.[1]</td><td>Permanent loss of 0.09 acre of non-native riparian shrub habitat for project features.</td><td rowspan="2">Same as No Action.</td></tr>
<tr><td>Benefit from removal of 17 acres of non-native riparian vegetation along the San Juan River and re-vegetated with native riparian vegetation.</td></tr>
<tr><td>Potential loss of wetlands associated with changes in irrigation.</td><td>Permanent loss of 1.1 acres of wetlands (1.0 acre adjacent to the PNM Diversion Dam and 0.1 acre below Cutter Reservoir).</td><td>Permanent loss of 0.1 acre of wetlands below Cutter Reservoir.</td></tr>
<tr><td>No significant changes.[1]</td><td>3.6 acres of temporary impact to wetlands along the San Juan River.</td><td>Same as No Action.</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td rowspan="5">Wildlife resources</td><td rowspan="5">No significant changes.[1]</td><td>Temporary disturbance of 31,686 acres of marginal wildlife habitat.</td><td>Temporary disturbance of 31,841 acres of marginal wildlife habitat.</td></tr>
<tr><td>Permanent loss of 43 acres of wildlife habitat.</td><td>Permanent loss of 249 acres of wildlife habitat.</td></tr>
<tr><td>Temporary impacts to 23.86 acres of key wildlife habitat.</td><td>Temporary impacts to 3.26 acres of key wildlife habitat.</td></tr>
<tr><td>Loss of 1.19 acres of key wildlife habitats.</td><td>Loss of 0.1 acre of key wildlife habitats.</td></tr>
<tr><td colspan="2">Construction of 19.2 miles of transmission line through raptor cliff-nesting habitat and potential avian collision risk.</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td rowspan="3">Aquatic resources</td><td rowspan="3">No significant changes.[1]</td><td colspan="2">Flow Recommendations met 99.9% of the time. All but two flow criteria met for the worst-case scenario.</td></tr>
<tr><td>Potential beneficial impacts to native and tailwater trout fisheries associated with increased flows below Navajo Dam.</td><td rowspan="2">Same as No Action.</td></tr>
<tr><td>Potential entrainment losses at PNM diversion for flannelmouth sucker and speckled dace larvae.</td></tr>
</table>

Table V-17.—Summary of Impacts (continued)

<table>
<tr><th>Resource</th><th>No Action Alternative</th><th>SJRPNM Alternative</th><th>NIIP Amarillo Alternative</th></tr>
<tr><td rowspan="4">Special status species</td><td rowspan="4">No significant changes.[1]</td><td colspan="2">Flow Recommendations met 99.9% of the time. All but two flow criteria met for the worst-case scenario.</td></tr>
<tr><td>Potential entrainment losses at PNM diversion for Colorado pikeminnow, razorback sucker, and bluehead sucker.</td><td rowspan="2">No effect.</td></tr>
<tr><td>Potential impacts to bald eagle and Southwestern willow flycatcher along the San Juan River.</td></tr>
<tr><td colspan="2">Potential negative impacts to beautiful gilia and Mesa Verde cactus.</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td>Recreation</td><td>No significant changes.[1]</td><td>Some beneficial impacts to trout fish associated with increased releases from Navajo Reservoir.</td><td>Same as No Action.</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td rowspan="4">Land use</td><td rowspan="4">No significant changes.[1]</td><td colspan="2">Potential changes in land use associated with dependable water supply from the proposed project.</td></tr>
<tr><td colspan="2">Temporary impacts to grazing on Navajo Nation lands during pipeline construction and during re-vegetation.</td></tr>
<tr><td>20 acres of private land converted to project features.</td><td>Same as No Action.</td></tr>
<tr><td>23 acres of Navajo Nation lands converted to project features.</td><td>249 acres of Navajo Nation lands converted to project features.</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td rowspan="3">Hazardous materials</td><td rowspan="3">No significant changes.[1]</td><td>15 crossings of existing natural gas pipelines.</td><td>12 crossings of existing natural gas pipelines.</td></tr>
<tr><td>65 oil and gas wells within 500 feet of pipeline.</td><td>66 oil and gas wells within 500 feet of pipeline.</td></tr>
<tr><td colspan="2">Pipelines parallel about 40 miles of existing natural gas transmission line.</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td>Soils</td><td>No significant changes.[1]</td><td>9 highly erodible soil map unit types within 100 feet of proposed pipeline.</td><td>7 highly erodible soil map unit types within 100 feet of proposed pipeline.</td></tr>
</table>

Table V-17.—Summary of impacts (continued)

<table>
<tr><th>Resource</th><th>No Action Alternative</th><th>SJRPNM Alternative</th><th>NIIP Amarillo Alternative</th></tr>
<tr><td>Geology</td><td colspan="3">No significant impacts predicted to geological resources.</td></tr>
<tr><td>Paleontological resources</td><td>No significant changes.[1]</td><td colspan="2">Potential impacts to paleontological resources in areas where the proposed pipeline skirts the Lybrook and Betonnie Tsosie Fossil Areas.</td></tr>
<tr><td>Air quality and noise</td><td colspan="3">No significant impact predicted to air quality and noise.</td></tr>
<tr><td rowspan="5">Socioeconomics</td><td>Continued consumption of nonpotable water not compliant with EPA standards.</td><td colspan="2">Increased access to treated water for current communities and future population and economic growth.</td></tr>
<tr><td rowspan="4">No significant changes.[1]</td><td>Regional economic output estimated at $462 million for the proposed project construction period.</td><td>Regional economic output estimated at $523 million for the proposed project construction period.</td></tr>
<tr><td>Regional personal income estimated at $460 million for the proposed project construction period.</td><td>Regional personal income estimated at $490 million for the proposed project construction period.</td></tr>
<tr><td>Increase of 600–650 in regional employment during project construction period.</td><td>Increase of 640–690 in regional employment during project construction period.</td></tr>
<tr><td colspan="2">Project could employ an estimated 30–58 percent in local hiring.</td></tr>
<tr><td>Environmental justice</td><td>No significant changes.[1]</td><td colspan="2">Significantly benefits low-income and minority populations by increasing access to clean, dependable domestic water supplies.</td></tr>
<tr><td rowspan="2">Cultural resources</td><td rowspan="2">No significant changes.[1]</td><td>104 cultural resource sites within area of potential effects.</td><td>183 cultural resource sites within area of potential effects.</td></tr>
<tr><td>80–90 cultural resource sites would require treatment.</td><td>145 cultural resource sites would require treatment.</td></tr>
</table>

[1] No significant changes from future conditions described in the Navajo Operations EIS (Reclamation, 2006).

Chapter VI

ENVIRONMENTAL COMMITMENTS AND MITIGATION MEASURES

INTRODUCTION

This chapter discusses the environmental commitments that have been made by the Bureau of Reclamation (Reclamation) during the development of the San Juan River Public Service Company of New Mexico (SJRPNM) Alternative (Reclamation's preferred alternative). Reclamation would share responsibility by implementing measures that would avoid or reduce potential environmental impacts of the Navajo-Gallup Water Supply Project (proposed project). This responsibility would be shared with other Federal agencies, the Navajo and Jicarilla Apache Nations, and the city of Gallup, as well as third-party entities that could include New Mexico and Arizona State agencies and local governments.

This chapter summarizes the commitments made during the planning process and incorporated into the proposed project plan as discussed in chapter IV and mitigation measures proposed in chapter V to reduce or avoid impacts that would otherwise occur as a result of the implementation of the preferred alternative.

As discussed below, the commitments described herein would be implemented by Reclamation, or Reclamation would require their implementation by construction contractors or management authorities. Commitments for pre-construction activities would generally be completed by Reclamation or by the contractors during the final design process and prior to construction activities. Wildlife, wetland, cultural resources, and other mitigation would be completed by Reclamation as described in the following paragraphs. Some commitments, such as monitoring, would continue beyond completion of construction of structural facilities.

GENERAL COMMITMENTS

Throughout the planning process for the proposed project, efforts have been made to avoid impacts where practicable. If avoidance was not possible, then mitigation measures have been developed to reduce the level of impact. The proposed mitigation measures for each resource, if appropriate, were discussed in chapter V. In addition to specific mitigation measures identified in chapter V, other management practices would be employed during construction activities to minimize environmental effects and would be included in construction specifications. Many of these measures are required in order to comply with Federal, State, or local laws and regulations, regardless of whether they are specifically identified in this document. Reclamation would comply with all relevant Federal, State, and local laws, ordinances, regulations, and standards during the implementation of the preferred alternative. Reclamation would prepare and implement an Environmental Commitments Plan for the proposed project to document and track the completion of the environmental commitments.

Navajo Reservoir Operations

Reclamation would be able to issue water service contracts to meet project demands from Navajo Reservoir provided a successful hydrological determination was completed. At full San Juan River Basin (Basin) development, depletions would increase by 5,270 acre-feet from the Basin over the baseline presented in chapter V, table V-3.

Releases would be similar to those described in the Navajo Reservoir Operations Final Environmental Impact Statement (Reclamation, 2006) to meet the San Juan River Flow Recommendations; however, additional flows would be released from Navajo Reservoir downstream when needed to meet project demands at the SJRPNM intake structure. The demands for the Cutter Lateral portion of the proposed project would be delivered from Navajo Reservoir through the existing Navajo Indian Irrigation Project (NIIP) intake structure in Navajo Reservoir.

Water Uses and Resources Commitments

Until depletions in the Basin reach the baseline depletion in table V-3 plus the 5,270 acre-feet added to the baseline for this project, the Flow Recommendations can be met or only missed less than 0.01 percent of the time for only one category. When the total depletions reached this new baseline depletion, the Navajo Nation would reduce an amount from one or more projects that are presently in the baseline to ensure that the total depletions in the basin remain below the baseline depletions (Navajo Depletion Guarantee).

Under the depletion guarantee, Reclamation would track actual depletions for the NIIP and Animas-La Plata (ALP) Project through the 5-year consumptive use and loss reporting. When the sum of depletions for the NIIP and ALP Project reach a 290,000 acre-foot yearly average, more detailed accounting will be required. Since the NIIP and ALP Project can be tracked, this will minimize monitoring requirements for the Basin. At that point, hydrologic modeling would be completed for the limits the Navajo Nation would propose putting in place to meet flow conditions described here. No modifications of operating rules are proposed until the method of meeting the depletion guarantee is finalized and the model runs are completed to determine the needed operating criteria. The Navajo Nation would then implement the limitations necessary to keep Navajo's Basin depletions under the baseline depletion unless future consultations, a change in San Juan River Basin Recovery Implementation Program (SJRBRIP) Flow Recommendations, or changes in endangered species' status removed the requirement for such a guarantee.

If there is a different approach taken to the section 7 consultation that will provide for full development of the proposed project in the absence of the depletion guarantee, or there are other changes in terms of water development or status of listed species, Reclamation may have to re-initiate section 7 consultation. If such re-initiation were to occur, additional measures could be required for the proposed project to be in compliance with the ESA and to avoid jeopardy to the Colorado pikeminnow and razorback sucker.

Indian Trust Assets Commitments

No mitigation measures for Indian Trust Assets are proposed at this time. On March 6, 2006, letters requesting identification and consultation regarding Indian Trust Asset issues were sent to 18 Tribal governments. After consultations with affected Tribes/Tribal Nations are completed, mitigation measures may be developed and incorporated into the next draft of this document.

Water Quality Commitments

Reclamation would develop and implement a program to reduce, minimize, or eliminate temporary, short-term increases in suspended sediment loading or other water quality constituents potentially caused by project construction through the incorporation of permits, Best Management Practices (BMPs), and sediment control structures as described under mitigation measures for water quality in chapter V.

Vegetation Commitments

Reclamation would ensure that construction contractors limit ground disturbance to the smallest feasible areas and that they implement BMPs along with the planting or re-seeding of disturbed areas using native plants to assist in the re-establishment of native vegetation as described under mitigation measures for vegetation resources in chapter V.

Reclamation would use accepted erosion control measures during construction, supplement grass seeding with native shrub seed in upland areas where shrub cover is diminished due to pipeline disturbance, monitor planting to ensure establishment, and control noxious weeds in disturbed areas.

Reclamation would replace riparian and wetland habitat with the creation of acre-per-acre replacement or enhancement of 3 acres for each acre lost to mitigate for impacts to riparian and wetland habitat. This includes re-vegetation of 17 acres of non-native riparian (Russian olive and tamarisk) and 3.6 acres of wetland temporarily removed during pipeline construction. Approximately 0.9 acre of nonnative riparian and 1.1 acres of wetlands would be permanently removed for project features.

Wildlife Commitments

Reclamation would ensure that construction contractors limit ground disturbance to the smallest feasible areas and that they implement BMPs along with the planning or re-seeding of disturbed areas using native plant species to assist in the re-establishment of native vegetation, as described under mitigation measures for vegetation resources in chapter V.

Reclamation would restrict activities along the Nutria and Defiance Monoclines, Cutter Canyon, Blanco Canyon, and the corridor from Cutter to Largo Canyons during the nesting season (January 15 to August 15). Reclamation would conduct extensive nest searches within a quarter mile of proposed activities immediately prior to construction and avoid active nests if construction activities could not be scheduled outside the January 15 to July 15 timeframe.

Reclamation would incorporate raptor perch guards or raptor safe configurations on all new transmission structures.

Reclamation would avoid removal of riparian and wetland vegetation between March 15 and August 15 to avoid potential impacts to migratory bird nesting.

Reclamation would trench and bury pipeline concurrently to minimize trapping of small wildlife. Reclamation would construct escape ramps for trenches left open overnight.

Aquatic Resources Commitments

The SJRBRIP would monitor and report total depletions in the Basin as described in the "Water Uses and Resources Commitments" section. The Navajo Nation would implement a Navajo Depletion Guarantee when needed to keep the Navajo Nation's depletions within the ESA depletion baseline.

Reclamation would also incorporate BMPs, as previously described in the "Water Quality Commitments" section, to avoid or minimize project impacts to aquatic resources.

Special Status Species Commitments

Reclamation would implement conservation measures found in the biological opinion on the proposed project (see appendix C, part III). These measures address the Colorado pikeminnow, razorback sucker, bald eagle, Southwestern willow flycatcher, and Mesa Verde cactus. In addition, Reclamation would implement conservation measures for Navajo Nation listed species as described under mitigation measures for sensitive species in chapter V.

Reclamation would conduct surveys for ferruginous hawk and bald eagle in proposed construction areas 1 year in advance of construction for pipeline routes and construction sites not adjacent to highways, well-traveled roads, or areas of regular human activity. If active nests were found, Reclamation would implement appropriate protective measures to avoid or minimize nest disturbance.

Reclamation would conduct surveys for Southwestern willow flycatcher in riparian and wetland habitat prior to construction within one-quarter mile of disturbed areas and avoid construction activities during the nesting season (March 15 to August 15) if active nesting is found.

Reclamation would delineate and avoid beautiful gila plants where possible.

Reclamation would, where possible, refine the pipeline alignment to avoid individual Mesa Verde cactus and populations. Reclamation would mark individual cacti with protective cones when construction activities occurred in their vicinity. Where impacts were unavoidable, Reclamation would consult with a qualified botanist and temporarily relocate affected cacti during construction and re-plant once construction is complete.

Reasonable and prudent measures (RPMs) for Colorado pikeminnow and razorback sucker included in the biological opinion are not included as environmental commitments. RPMs are measures to reduce incidental take of threatened or endangered species and are described as terms and conditions. The terms and conditions are nondiscretionary actions required by the action agency and are not included as mitigation measures.

Recreation Commitments

No environmental commitments are made for recreation resources.

Land Use Commitments

Reclamation would ensure that construction contractors limited ground disturbance to the smallest feasible area and that they implemented BMPs along with the planting or re-seeding of disturbed areas to minimize impacts to existing land uses as previously described in the "Vegetation Commitments" section.

Reclamation would ensure that construction contractors fenced re-vegetated areas to prevent grazing activities until disturbed areas became re-established, and Reclamation would work with the Navajo Nation to provide temporary relocation assistance to affected livestock owners along the pipeline corridor.

Reclamation would also provide relocation assistance to affected residences displaced by construction of the San Juan River water treatment facility.

Hazardous Materials Commitments

Reclamation would contact pipeline and gas well companies prior to construction activities to identify and avoid existing hazards. Pipeline alignments would be adjusted, as needed, to avoid impacts to pipelines and wells.

Soils Commitments

Reclamation would mandate that construction contractors use and implement measures contained in erosion control guidelines and BMPs to control soil erosion from construction areas, as described under mitigation measures for soils in chapter V.

Geology Commitments

No environmental commitments are made for geologic resources.

Paleontologic Commitments

During construction activities, Reclamation would monitor areas with exposure of geological units or settings that indicated a high likelihood of yielding vertebrate fossils or noteworthy occurrences of invertebrate or plant fossils. In the event of discovery, Reclamation would evaluate the significance before construction could continue.

Reclamation would manage, on a case-by-case basis, construction activities adjacent to the Lynbrook and Betonnie Tsosie Fossil Areas. Reclamation would conduct paleontologic clearances prior to any surface-disturbing activities along the pipeline corridor in the Lynbrook and Betonnie Tsosie Fossil Areas.

Air Quality and Noise Commitments

Reclamation would require that construction contractors implement measures to control fugitive dust during construction, as described under mitigation measures for air quality and noise in chapter V. No environmental commitments are made for noise abatement.

Socioeconomics Commitments

No environmental commitments are made for socioeconomic resources.

Environmental Justice Commitments

No environmental commitments are made for environmental justice.

Cultural Resources Commitments

Reclamation would implement a program to compensate for losses of archaeological sites that would occur as a result of construction and operation of the proposed project and the construction of conveyances, as defined in the mitigation measures for cultural resources in chapter V.

Reclamation would coordinate the program with the New Mexico State Historic Preservation Officer, the Navajo Nation Tribal Historic Preservation Officer, Bureau of Land Management, Bureau of Indian Affairs, the city of Gallup, and the Advisory Council on Historic Preservation.

Reclamation would ensure compliance with mitigation measures developed in accordance with the Native American Graves Protection and Repatriation Act and Executive Order 13007, as described under the mitigation measures for cultural resources in chapter V.

Chapter VII

CONSULTATION AND COORDINATION

INTRODUCTION

This chapter documents the consultation and coordination activities undertaken by the Bureau of Reclamation (Reclamation) during preparation of this planning report and draft environmental impact statement (PR/DEIS) for the Navajo-Gallup Water Supply Project (proposed project).

SCOPING MEETINGS

A Notice of Intent to prepare a PR/DEIS on construction and operation of the proposed project appeared in the *Federal Register* on March 27, 2000. The notice announced that public scoping meetings were to be held throughout the proposed project area. A news release announcing the scoping meetings was distributed to an extensive mailing list as well as to the local media. Meeting locations and dates were as follows:

Crownpoint Chapter House, Crownpoint, New Mexico	April 25, 2000
Saint Michaels Chapter House, Saint Michaels, Arizona	April 26, 2000
University of New Mexico Campus, Gallup, New Mexico	April 27, 2000
Diné College, Shiprock, New Mexico	May 2, 2000
San Juan College, Farmington, New Mexico	May 3, 2000

The issues identified were as follows:

- Support for the proposed project to supply municipal water to the Navajo Nation and the city of Gallup to provide a comfortable and healthy place to live, promote a sense of community, and provide for economic development.

- A Navajo Water Rights Settlement is needed along with the proposed project.

- Good quality of water for drinking is as important as quantity of water.

- Support was expressed for the San Juan River diversion alternatives with pipelines paralleling Route 491 and U.S. Highway 550. These are corridors where growth is planned to occur.

- Impacts to the Jicarilla Apache Water Rights Settlement should be considered.

- Impacts to Colorado River Basins States' ability to use compact apportionments should be considered.

- There is a concern that the city of Gallup will get water and that areas of the Navajo Nation will not.

- There is a concern that the water will promote uranium development and processing, resulting in contamination, as has happened in the past.

- American Indian (Indian) and non-Indian communities need to work together to make this project happen.

- There is a concern that tying into the Navajo Indian Irrigation Project (NIIP) may impact the NIIP and may not provide a reliable municipal water supply.

- The Navajo chapters surrounding the city of Gallup need a domestic water supply.

- Water for agriculture is also needed, at least for gardens and livestock.

- There is a demand for water further west of Window Rock, Arizona.

- There was support for concurrent groundwater development to get water to people before surface water would be available.

- There is a need to have water piped to locations where people are, and will be, living.

- There is a concern about sharing pipeline rights-of-way with the highway; the highway could have priority in the future.

CONSULTATION AND COORDINATION PROCESS

Interagency/intergovernmental coordination and consultation constitute an essential part of the environmental impact statement (EIS) process. They provide a forum in which close working relationships are developed with agencies and organizations that are affected by or concerned about a proposed project. Similar to public scoping, a key objective of a consultation and coordination program is to provide an opportunity for agencies and organizations to participate in the investigation of project alternatives and to provide input about specific project-related issues.

Coordination Activities

As the lead agency responsible for preparation of the PR/DEIS, Reclamation used an interdisciplinary team of consulting resource specialists to prepare the document, including the Navajo and Jicarilla Apache Nations and their staff and consultants. (A list of preparers is contained in the "List of Preparers" section). In addition, several other Federal, State, and local agencies participated with the interdisciplinary team during preparation of the PR/DEIS. Table VII-1 provides a list of those agencies with jurisdictional authority, interest, or expertise in the activities or issues associated with the proposed project.

Consultation Activities

U.S. Fish and Wildlife Service

Section 7 of the Endangered Species Act.—Reclamation and the U.S. Fish and Wildlife Service (Service) have consulted, both formally and informally, regarding potential impacts to special status species that may be affected as a result of the development and operation of the proposed project.

A biological assessment was developed by Reclamation, and the Service issued a draft biological opinion under the Endangered Species Act (ESA). In the draft biological opinion, the Service concluded that the proposed project, as described in the biological assessment and in this PR/DEIS, may affect, and is likely to adversely affect, the Colorado pikeminnow, razorback sucker, and Mesa Verde cactus. The draft biological opinion indicates that the final opinion would contain an incidental take permit for Colorado pikeminnow and razorback sucker larvae that may become entrained as a result

Table VII-1.—Agencies and organizations that participated in the project consultation and coordination process

Federal agencies
Bureau of Indian Affairs[1]
Bureau of Land Management
Bureau of Reclamation Department of Energy, Western Area Power Administration Environmental Protection Agency Indian Health Service U.S. Army Corps of Engineers U.S. Department of the Interior U.S. Fish and Wildlife Service
State of Colorado Water Conservation Board
New Mexico Department of Game and Fish New Mexico Interstate Stream Commission[1]
Local governments
Northwest New Mexico Council of Governments[1]
City of Gallup[1]
Tribal governments
Jicarilla Apache Nation[1] Navajo Nation[1] Pueblo of Zuni Hopi Tribe Laguna Pueblo Isleta Pueblo

[1] PR/EIS cooperating agencies.

of the diversion from the San Juan River. Mesa Verde cactus may be directly taken during the construction of project features. The Service concurred that the proposed project may affect, but is not likely to adversely affect, the Southwestern willow flycatcher and bald eagle.

The draft biological opinion incorporates a Navajo Nation depletion guarantee, which limits new depletion associated with the project to 5,271 acre-feet at full development (see chapter VI and volume II, appendix C). The opinion concludes that the 5,271 acre-feet of new depletions associated with the proposed project would not adversely impact the Colorado pikeminnow or razorback sucker. However, because larval fish may be lost due to the project diversions, the fish would be adversely affected. The opinion identifies the San Juan River Basin Recovery Implementation Program (SJRBRIP) as the reasonable and prudent measure to reduce incidental take of Colorado pikeminnow and razorback sucker and identifies conservation recommendations to reduce the direct take of Mesa Verde cactus. The opinion also states that if re-initiation is required, the Service will follow the procedures regarding re-initiation of consultation pursuant to the "Principles for Conducting Endangered Species Act Section 7 Consultations on Water Development and Water Management Activities Affecting Endangered Fish Species in the San Juan River Basin." Results of any additional consultation will be included in the final biological opinion and will be incorporated into the planning report and final environmental impact statement.

A Planning Aid Memorandum and draft Fish and Wildlife Coordination Act (FWCA) report have also been completed by the Service (volume II, appendix C). The draft FWCA report contains numerous recommendations; these recommendations are described in the "Fish and Wildlife" section of chapter VI.

FWCA.—A Planning Aid Memorandum and draft FWCA report have also been completed by the Service (volume II, appendix C). The draft FWCA report contains numerous recommendations. The Service's official recommendations will be contained in the final FWCA report, which will be included in the planning report and final environmental impact statement.

To minimize project impacts to fish and wildlife resources, the draft FWCA recommends that Reclamation incorporate the mitigation measures described below. Reclamation's preliminary responses to the draft FWCA recommendations follow each recommendation. Mitigation measures are discussed in greater detail in chapters V and VI.

FWCA Recommendation 1: Replace any woody vegetation (e.g., willows) unavoidably lost by establishing 2 acres of native vegetation for every acre impacted. If trees are removed, the Service recommends a minimum ratio of 10 saplings be planted for each mature tree lost. Planting of willows and cottonwood poles should be dense and in a location where adequate water is available to ensure that mitigation is successful. Mitigation should cover the direct removal of vegetation during construction as well as induced mortality that may occur in future years.

Reclamation's Response 1: Reclamation would minimize impacts to wetland and riparian vegetation where possible. Reclamation would replace removed riparian and wetland habitat with creation of acre-per-acre replacement or the enhancement of 3 acres for each acre lost. On-site and adjacent mitigation sites would be considered before enhancing off-project sites. Reclamation would re-vegetate disturbed areas using native species and monitor plantings to ensure establishment of native cover equivalent to pre-construction levels.

FWCA Recommendation 2: Tree stands or vegetated areas slated for grubbing or clearing should be surveyed for the presence of nesting birds during the general migratory bird nesting season of March through August. Avoid disturbing nesting areas until nesting is complete.

Reclamation's Response 2: Reclamation would survey previously undisturbed areas or suitable habitats for the presence/absence of nesting birds prior to implementing construction activities during the nesting season. If nesting birds are identified, construction activities would be modified to avoid disturbing nesting birds during the nesting season from March 15 to July 15.

FWCA Recommendation 3: Employ silt curtains, cofferdams, straw bales, or other suitable erosion control measures during construction.

Reclamation's Response 3: Best Management Practices are included to protect water quality and soils.

FWCA Recommendation 4: Monitor intake pump, sump, and settling ponds to estimate larval entrainment during periods of drift. Contact the Service to determine if further project review under the FWCA is appropriate if entrainment exceeds the estimates.

Reclamation's Response 4: Reclamation proposes that monitoring of larval entrainment be conducted as an activity of the SJRBRIP. Reclamation would re-consult with the Service under section 7 of the ESA if incidental take of threatened and endangered species exceeded the limits identified in the Incidental Take Statement likely included in the biological opinion.

FWCA Recommendation 5: Dewater in-channel construction areas prior to construction. Maintain fish passage around dewatered construction areas during construction. Construct the proposed project during periods of low flow and low precipitation.

Reclamation's Response 5: All in-channel construction areas would be dewatered prior to construction. Fish passage around the dewatered construction areas would be maintained while the PNM fish passage was in operation (April through October). In-channel construction activities would be limited to the period November through March.

FWCA Recommendation 6: Monitor water quality before, during, and after construction to ensure compliance with State water quality standards.

Reclamation's Response 6: Reclamation and its contractors would comply with all permit requirements issued under section 401 (State and Tribal Water Quality Certification), 402 (Dewatering) and 404 (Dredge and Fill) of the Clean Water Act.

FWCA Recommendation 7: Contain poured concrete in forms and/or behind cofferdams to prevent discharge into the river. Contain and treat or remove for off-site disposal any waste water from concrete-batching, vehicle wash-down, and aggregate processing.

Reclamation's Response 7: These recommendations are standard language included in Reclamation's construction contracts. Contractors are required to prepare and submit storm water and waste management plans for all construction-related activities.

FWCA Recommendation 8: Store and dispense fuels, lubricants, hydraulic fluids, and other petrochemicals outside the 100-year flood plain. Inspect construction equipment daily for petrochemical leaks. Contain and remove any petrochemical spills and dispose of these materials at an approved upland site. Park construction equipment outside the 100-year flood plain during periods of inactivity.

Reclamation's Response 8: These recommendations are also standard language included in Reclamation's construction contracts. Contractors are required to prepare and submit a Spill Prevention and Containment Plan for all construction-related activities.

FWCA Recommendation 9: Carry an oil kit or spill blanket at all times. Ensure equipment operators are knowledgeable in the use of spill containment equipment. Develop a spill contingency plan prior to initiation of construction. Immediately notify the proper Federal and State authorities in the event of a spill.

Reclamation's Response 9: See Reclamation's FWCA Response 8 above.

FWCA Recommendation 10: Use only clean cobble and quarry stone from an upland source. Use uncontaminated earth or alluvium suitable for re-vegetation with indigenous plant species for backfill. Re-vegetate or re-seed backfill and other disturbed areas with native plants or seeds to accelerate re-vegetation with native species.

Reclamation's Response 10: Reclamation would use only suitable uncontaminated material during construction. All disturbed areas would be re-vegetated with native plant species. Where feasible during pipeline and other project features construction, top soils would be stockpiled and used in re-vegetation efforts.

FWCA Recommendation 11: Where possible, minimize trapping of wildlife during pipeline installation by trenching and burying pipeline concurrently. Leave the least amount of trench open overnight, and provide escape ramps for trapped wildlife.

Reclamation's Response 11: Reclamation would minimize trapping of wildlife during pipeline installation by trenching and burying pipeline concurrently and leaving the least amount of trench open overnight as possible. Escape ramps would be provided for trapped wildlife.

FWCA Recommendation 12: Re-vegetate all upland areas disturbed during construction, using native plants and seeds. For those upland areas where soils have become compacted as a result of heavy equipment operation, soils should be scarified or additional topsoil placed prior to re-vegetation.

Reclamation's Response 12: Reclamation would return all disturbed areas as nearly as possible to previous conditions. Topsoil removed during construction would be stockpiled for re-vegetation efforts and native plants and seeds would be used. If soils were compacted, the areas would be scarified prior to planting.

FWCA Recommendation 13: Minimize electrocution risk to raptors by installing perch guards or raptor-safe configurations on all transmission structures. Minimize collision risks to raptors and other bird species by marking transmission lines that pose a high collision risk with spiral vibration dampers or bird flight diverters.

Reclamation's Response 13: Raptor perch guards or raptor-safe configurations would be incorporated on all new transmission structures.

Environmental Protection Agency/U.S. Army Corps of Engineers

Reclamation would also coordinate with the Environmental Protection Agency (EPA) regarding potential project effects on wetlands and water quality and with EPA and the U.S. Army Corps of Engineers.

Cultural Resources

Consultation/coordination occurred in two phases: (1) the Overview phase in 1992–93 and (2) the Alternatives Evaluation phase from 2000 through the present. During each phase, various parties were contacted to gather information and/or solicit their concerns about impacts and procedures to address those impacts.

Overview Phase:
The All-Indian Pueblo Council
Pueblo of Zuni
Pueblo of Acoma
Jicarilla Apache Nation

Ute Mountain Ute Tribe
Southern Ute Indian Tribe
Hopi Tribe
New Mexico Office of Cultural Affairs, Historic Preservation Division
Advisory Council on Historic Preservation
Bureau of Land Management, Farmington, New Mexico
New Mexico State Land Office
Navajo Nation Historic Preservation Department
New Mexico Laboratory of Anthropology

Alternatives Evaluation Phase:
Pueblo of Zuni
Pueblo of Acoma
Jemez Pueblo
Pueblo of Laguna
Nambe Pueblo
Pojoaque Pueblo
San Felipe Pueblo
Zia Pueblo
San Idelfonso Pueblo
San Juan Pueblo
Sandia Pueblo
Santa Ana Pueblo
Southern Ute Indian Tribe
Santa Clara Pueblo
Santo Domingo Pueblo
Taos Pueblo
Tesuque Pueblo
Ute Mountain Ute Tribe
Jicarilla Apache Nation
Hopi Tribe
New Mexico Office of Cultural Affairs, Historic Preservation Division
Bureau of Land Management, Farmington, New Mexico
City of Gallup, New Mexico
Navajo Nation Historic Preservation Department
Sheep Springs Chapter
Coyote Canyon Chapter
San Juan Chapter
Sanostee Chapter
Shiprock Chapter
Two Grey Hills Chapter
Naschitti Community Chapter
Tohatchi Chapter

Rock Springs Chapter
Tsayatoh Chapter
Pueblo Pintado Chapter
Huerfano Chapter
Burnham Chapter
Nenahnezad Chapter
Newcomb Chapter
Nageezi Chapter
Twin Lakes Chapter
Standing Rock Chapter
Ojo Encino Chapter
Torreon Chapter
Whiterock Chapter
Nahodishgish Chapter
Counselor Chapter
Bureau of Indian Affairs (BIA), Navajo Region (by copy)
Navajo Nation Water Resources Department

Most of the contacts were made via correspondence. Meetings were convened and phone calls were made, as well. As a result of these contacts, the studies that have been undertaken, and from consultations with the Navajo Nation Historic Preservation Department in particular, the general impacts have been determined, and an approach to addressing those impacts has been developed. This is described in chapter VI.

Navajo-Gallup Steering Committee

A project Steering Committee has been established and functioning since the early 1990s. The committee's purpose is to oversee and guide the planning and implementation of the proposed project. The committee is composed of representatives from the Navajo and Jicarilla Apache Nations, State of New Mexico, Northwest New Mexico Council of Governments, city of Gallup, Navajo Tribal Utility Authority, BIA, Indian Health Service, and Reclamation. Since 2000, the committee has met approximately four times a year to discuss planning status, address issues, and make assignments. The assignments are carried out by the various entities represented by the committee and interagency teams. For purposes of EIS preparation, the Steering Committee members also serve as the cooperating agencies for implementation of the National Environmental Policy Act. Cooperating agencies are Federal agencies and local, State, and Tribal governments with appropriate expertise or jurisdiction.

The Upper Colorado River Commission

The Upper Colorado River Commission (Commission) has been engaged in project water supply issues. The Commission passed a resolution in June 2003 supporting the proposed project and consenting to a diversion of water from the Upper Basin for use in the Lower Basin within New Mexico (attachment B). The Commission also passed a resolution in June 2006 supporting a proposed determination by the Secretary of the Interior (Secretary) that sufficient water is reasonably likely to be available to fulfill the proposed project needs in New Mexico from the Navajo Reservoir water supply (attachment B). This water is in addition to existing Navajo Reservoir water supply contract water for other uses under the allocations made to New Mexico in Articles III and XIV of the Upper Colorado River Basin Compact.

The proposed hydrologic determination prepared by Reclamation is currently being considered by the Secretary.

The Arizona Department of Water Resources

The Arizona Department of Water Resources (ADWR) has been involved with the proposed project's Arizona water supply. Discussions among Reclamation, the Navajo Nation, and the ADWR have been ongoing since 2003.

San Juan River Basin Recovery Implementation Program

Project planning has been discussed with the SJRBRIP Biology, Hydrology, and Coordinating Committees with presentations and discussions since 2002.

OTHER CONSULTATION/COORDINATION FUNCTIONS

In April 1998, George Galanis, the Mayor of the city of Gallup, and Thomas Atcitty, President of the Navajo Nation, signed an agreement to cooperate on the planning for the proposed project. That document commits the city and the Navajo Nation to:

- A cooperative effort to proceed with planning and development
- A project that works conjunctively with the NIIP
- A project that will result in a fair and equitable distribution of project water between the city of Gallup and the Navajo communities

- Cooperatively investigate all viable alternative project configurations
- Support the commitment of the BIA to engage in consultation with the Service as quickly as possible
- Working together to resolve issues affecting the implementation of the proposed project

The Memorandum of Agreement continues to serve as the basis for the collaborative efforts of the Navajo Nation and the city of Gallup to develop the proposed project (attachment A).

PUBLIC INFORMATION

The list of agencies, organizations, and interested individuals who received information about the proposed project described in the PR/DEIS are discussed in this section. A total of 150 individuals (who did not identify an affiliation with an agency, business, or interest group) received information about the proposed project, and a summary of primary areas represented include:

Primary cities and towns in the immediate project area
City of Farmington (36 individuals)
City of Bloomfield and City of Aztec (6 individuals)
Town of Shiprock (11 individuals)
Town of Window Rock (3 individuals)
City of Gallup (3 individuals)

Other primary areas in the State of New Mexico
City of Grants (2 individuals)
City of Santa Fe (1 individual)
City of Albuquerque (5 individuals)

Major cities in the State of Colorado
Denver (6 individuals)
Other Denver metropolitan areas from Ft. Collins to Colorado Springs (8 individuals)

Several States outside the region
New York, Washington, Portland (12 individuals)

A total of 479 individuals identified an affiliation with an agency, business, or interest group, and those agencies are listed by category in the distribution list.

DISTRIBUTION LIST

Congressional delegations	
U.S. and State Representatives	**City, State**
Wayne Allard U.S. Senator of Colorado	Washington, D.C.
Jeff Bingaman U.S. Senator of New Mexico	Washington D.C.
Ray Begaye New Mexico State Representative	Shiprock, New Mexico
Pete V. Domenici U.S. Senator of New Mexico	Washington D.C.
J.D. Hayworth U.S. Representative of Arizona	Washington D.C.
Jon Kyl U.S. Senator of Arizona	Washington D.C.
Linda Lovejoy New Mexico State Senator	Crownpoint, New Mexico
W. Ken Martinez New Mexico State Representative	Washington, D.C.
John McCain U.S. Senator of Arizona	Washington D.C.
Steve Pearce U.S. Representative of New Mexico	Washington D.C.
John Salazar U.S. Representative of Colorado	Washington, D.C.
Ken Salazar U. S. Senator of Colorado	Washington, D.C.
Bob Stump U.S. Representative of Arizona	Washington D.C.
Thomas C. Taylor New Mexico State Representative	Farmington, New Mexico
Sandra L. Townsend New Mexico State Representative	Aztec, New Mexico
Tom Udall U.S. Representative of New Mexico	Washington D.C.
Pete Valencia, Office of Rep. Tom Udall	Farmington, New Mexico
Heather Wilson U.S. Representative of New Mexico	Washington, D.C.

Congressional delegations (continued)	
Businesses or agencies	**City, State**
House Appropriations Committee	Washington, D.C.
House Energy and Water Development	Washington, D.C.
House Resources Committee	Washington, D.C.
House Water and Power Subcommittee	Washington, D.C.
Senate Appropriations Committee	Washington, D.C.
Senate Energy and Natural Resources Committee	Washington, D.C.
Senate Indian Affairs Committee	Washington, D.C.
Senate Water and Power Subcommittee	Washington, D.C.

Federal Government agencies	
Businesses or agencies	**City, State**
Advisory Council on Historic Preservation	Lakewood, Colorado Washington, D.C.
BLM/FS Public Land Center	Durango, Colorado
Bureau of Indian Affairs	Albuquerque, New Mexico Chinle, Arizona Dulce, New Mexico Española, New Mexico Farmington, New Mexico Gallup, New Mexico Ignacio, Colorado Kykotsmovi, Arizona Shiprock, New Mexico Towaoc, Colorado Zia Pueblo, New Mexico
Bureau of Land Management	Albuquerque, New Mexico Bluff, Utah Durango, Colorado Farmington, New Mexico Gallup, New Mexico Lakewood, Colorado Moab, Utah Montecillo, Utah
Bureau of Reclamation	Albuquerque, New Mexico Denver, Colorado Durango, Colorado Farmington, New Mexico Grand Junction, Colorado Salt Lake City, Utah Washington, D.C.

Federal Government agencies (continued)	
Businesses or agencies	**City, State**
Department of Justice Environment and Natural Resources Division Natural Resources Division/Policy Section	Washington, D.C.
Environmental Protection Agency	Dallas, Texas Denver, Colorado San Francisco, California Washington, D.C.
Federal Energy Regulatory Commission	San Francisco, California Washington, D.C.
Indian Health Service	Window Rock, Arizona
International Boundary and Water Commission	El Paso, TX
National Park Service	Denver, Colorado Mesa Verde, Colorado Santa Fe, New Mexico Washington, D.C.
Natural Resource Conservation Service	Durango, Colorado
Office of Emergency Management	Golden, Colorado
Office of the Field Solicitor	Salt Lake City, Utah
Office of the Regional Solicitor – Southwest Region	Albuquerque, New Mexico
U.S. Army Corps of Engineers	Albuquerque, New Mexico Durango, Colorado Sacramento, California Washington, D.C.
U.S. Fish and Wildlife Service	Albuquerque, New Mexico Denver, Colorado Grand Junction, Colorado Lakewood, Colorado Salt Lake City, Utah
U.S. Geological Survey	Albuquerque, New Mexico Yankton, South Dakota
Western Area Power Administration	Salt Lake City, Utah Washington, D.C.
Tribal governments	
Hopi Tribe	Kykotsmovi, Arizona
Jicarilla Apache Nation	Dulce, New Mexico Española, New Mexico

Tribal governments (continued)	
Businesses or agencies	**City, State**
Navajo Nation	
Beclabito Chapter	Shiprock, New Mexico
Crownpoint Chapter	Crownpoint, New Mexico
DSFC OEHE NAIHS	Window Rock, Arizona
Navajo Agricultural Products Industry	Farmington, New Mexico
Navajo Nation Council	Gallup, New Mexico Mentmore, New Mexico Window Rock, Arizona
Navajo Nation Department of Fish and Wildlife	Window Rock, Arizona
Navajo Nation Department of Justice	Window Rock, Arizona
Navajo Nation Department of Water Resources	Fort Defiance, Arizona
Navajo Nation Environmental Protection Agency	Window Rock, Arizona
Navajo Nation Historic Preservation Department	Window Rock, Arizona
Nenahnezad Chapter	Fruitland, New Mexico
NNEPA/PWSSP	Window Rock, Arizona
NTUA	Fort Defiance, Arizona
Office of the President of the Navajo Nation	Window Rock, Arizona
San Juan Chapter	Fruitland, New Mexico
San Juan Diné Water Users Association	Shiprock, New Mexico
Shiprock Chapter	Shiprock, New Mexico
Shiprock Planning Commission	Shiprock, New Mexico
Upper Fruitland Chapter	Fruitland, New Mexico
Pueblo Indian Tribes	
Pueblo of Acoma	Acoma, New Mexico
Pueblo of Cochiti	Cochiti Pueblo, New Mexico
Pueblo of Isleta	Isleta Pueblo, New Mexico
Pueblo of Jemez	Jemez Pueblo, New Mexico
Pueblo of Laguna	Laguna Pueblo, New Mexico
Pueblo of Nambe	Santa Fe, New Mexico
Pueblo of Picuris	Penasco, New Mexico

Tribal governments (continued)	
Businesses or agencies	**City, State**
Pueblo of Pojoaque	Santa Fe, New Mexico
Pueblo of San Felipe	San Felipe Pueblo, New Mexico
Pueblo of San Ildefonso	Santa Fe, New Mexico
Pueblo of San Juan	San Juan Pueblo, New Mexico
Pueblo of Sandia	Bernalillo, New Mexico
Pueblo of Santa Ana	Bernalillo, New Mexico
Pueblo of Santa Clara	Española, New Mexico
Pueblo of Santo Domingo	Santo Domingo Pueblo, New Mexico
Pueblo of Taos	Taos, New Mexico
Pueblo of Zia	Zia Pueblo, New Mexico
Pueblo of Zuni	Zuni, New Mexico
San Juan Pueblo	San Juan Pueblo, New Mexico
San Juan Southern Paiute Tribe	Tuba City, Arizona
Southern Ute Indian Tribe	Durango, Colorado Ignacio, Colorado
Ute Mountain Ute Tribe	
Ute Mountain Ute Tribe	Boulder, Colorado Towaoc, Colorado
Weeminche Construction Authority	Towaoc, Colorado
State Government agencies	
Colorado Attorney General	Denver, Colorado
Colorado Department of Agriculture	Lakewood, Colorado
Colorado Department of Employment	Cortez, Colorado
Colorado Department of Health	Denver, Colorado
Colorado Department of Natural Resources	Denver, Colorado
Colorado Division of Water Resources	Durango, Colorado
Colorado Division of Wildlife	Denver, Colorado Durango, Colorado
Colorado Local Affairs Department	Denver, Colorado

State Government agencies (continued)	
Businesses or agencies	**City, State**
Colorado State Parks	Arboles, Colorado Clifton, Colorado Denver, Colorado
Colorado Water Conservation Board	Denver, Colorado
Colorado Water Resources and Power	Denver, Colorado
Navajo Lake State Park	Aztec, New Mexico
New Mexico Department of Game and Fish	Navajo Dam, New Mexico Santa Fe, New Mexico
New Mexico DOH/McKinley County Health Office	Gallup, New Mexico
New Mexico Energy Minerals & Natural Res. Dept.	Santa Fe, New Mexico
New Mexico Environment Department	Santa Fe, New Mexico
New Mexico Historic Preservation Division	Santa Fe, New Mexico
New Mexico Interstate Stream Commission	Santa Fe, New Mexico
New Mexico State Parks	Navajo Dam, New Mexico
New Mexico State Senate	Bloomfield, New Mexico
Northwest New Mexico Council of Governments	Gallup, New Mexico
Office of the State Engineer	Aztec, New Mexico Denver, Colorado
State Land Office	Santa Fe, New Mexico
State of Colorado	Denver, Colorado
State of New Mexico	Santa Fe, New Mexico
Upper Colorado River Commission	Salt Lake City, Utah
Utah Department of Natural Resources	Salt Lake City, Utah
Utah Division of Wildlife	Salt Lake City, Utah
City government agencies	
City of Aztec	Aztec, New Mexico
City of Bloomfield	Bloomfield, New Mexico
City of Cortez	Cortez, Colorado
City of Durango	Durango, Colorado
City of Farmington	Farmington, New Mexico
City of Gallup	Gallup, New Mexico

City government agencies (continued)	
Businesses or agencies	**City, State**
City of Gallup/GJU	Gallup, New Mexico
Durango Area Chamber Resort Association	Durango, Colorado
Town of Bayfield	Bayfield, Colorado
Town of Ignacio	Ignacio, Colorado
Town of Kirtland	Kirtland, New Mexico
County government agencies	
La Plata County Commissioners	Durango, Colorado
McKinley County	Gallup, New Mexico
Montezuma County Commissioners	Cortez, Colorado
San Juan County	Aztec, New Mexico
Local government agencies	
Colorado Water Congress	Denver, Colorado
Water users	
Animas-La Plata Water Conservancy District	Durango, Colorado
Blanco Water Users Association	Blanco, New Mexico
Bloomfield Irrigation District	Bloomfield, New Mexico
Bloomfield Irrigation Ditch Company	Blanco, New Mexico
Colorado River Water Conservation District	Glenwood Springs, Colorado
Dolores Water Conservancy District	Cortez, Colorado
Florida Farmers and Florida Cooperative Ditches	Durango, Colorado
Florida Water Conservancy District	Durango, Colorado
Hammond Conservancy District	Bloomfield, New Mexico
Hammond Water Conservancy District	Bloomfield, New Mexico
La Plata Conservancy District	La Plata, New Mexico
La Plata Water Conservancy District	Hesperus, Colorado
Lower Valley Water Users	Kirtland, New Mexico
Mancos Water Conservancy District	Mancos, Colorado
Navajo Dam Water Users Association	Navajo Dam, New Mexico
Pine River Irrigation District	Bayfield, Colorado

Water users (continued)	
Businesses or agencies	**City, State**
San Juan County Rural Domestic	Flora Vista, New Mexico
San Juan River Dineh Water Users, Inc.	Shiprock, New Mexico
San Juan Water Commission	Farmington, New Mexico
Southwestern Water Conservation District	Durango, Colorado
Turley Ditch Company	Blanco, New Mexico
Turley-Manzanares Ditch	Blanco, New Mexico
Upper La Plata Water Users Association	La Plata, New Mexico
Water Conservancy District	Mancos, Colorado
West Hammond Water Users Association	Bloomfield, New Mexico
Utility companies	
Arizona Public Service	Fruitland, New Mexico
Colorado River Energy Distributors Association	Tempe, Arizona
Farmington Electric Utility System	Farmington, New Mexico
Public Service Company of New Mexico	Waterflow, New Mexico
Mineral companies	
BHP Minerals	Farmington, New Mexico
Bloomfield Refining Company	Bloomfield, New Mexico
Giant Industries, Inc.	Bloomfield, New Mexico
Recreation/Tourism	
Abes Motel & Fly Shop, Inc.	Navajo Dam, New Mexico
American Fisheries Society	Bethesda, Maryland
American Rivers	Washington, D.C.
Animas River Outfitters Assn.	Durango, Colorado
Artemis Wilderness Tours	El Prado, New Mexico
B-Square Ranch	Farmington, New Mexico
Born-n-Raised on the San Juan River, Inc.	Navajo Dam, New Mexico
Duranglers	Durango, Colorado Navajo Dam, New Mexico
Four Corners River Sports	Durango, Colorado
Guide Service	Navajo Dam, New Mexico

Recreation/tourism (continued)	
Businesses or agencies	**City, State**
Handy Bait Tackle Shop	Aztec, New Mexico
Mountain Waters Rafting	Durango, Colorado
Navajo Dam Enterprises – Marina	Navajo Dam, New Mexico
New Mexico Great Outdoors	Albuquerque, New Mexico
New Mexico Trout	Albuquerque, New Mexico
Outlaw River & Jeep Tours	Durango, Colorado
Recapture Lodge	Bluff, Utah
Rizutos Fly Shop	Navajo Dam, New Mexico
San Juan Flyfishing Federation	Farmington, New Mexico
San Juan Shrine Club	Farmington, New Mexico
San Juan Troutfitters	Farmington, New Mexico
Sportsman Inn	Navajo Dam, New Mexico
Trout Unlimited	Arlington, Virginia
Wild Rivers Expeditions	Bluff, Utah
Environmental groups	
Cedar Hill Clean Water Coalition	Aztec, New Mexico
Citizens Progressive Alliance	Littleton, Colorado
Clean Water Action	Denver, Colorado
Colorado River Alliance	Durango, Colorado
Earth Justice Legal Defense Fund	Denver, Colorado Washington, D.C.
Electors Concerned about Animas Water	Farmington, New Mexico
Environmental Defense Fund	New York, New York
Four Corners Action Coalition	Aztec, New Mexico
Glen Canyon Action Network	Moab, Utah
HCCA/Sierra Club	Crested Butte, Colorado
National Water Resources Association	Arlington, Virginia
National Wildlife Federation	Washington, D.C.
San Juan Audubon Society	Durango, Colorado

Environmental groups (continued)	
Businesses or agencies	**City, State**
Sierra Club	Boulder, Colorado San Francisco, California
Southern Ute Grassroots Organization	Ignacio, Colorado
Taxpayers for the Animas River	Durango, Colorado Mancos, Colorado
The Nature Conservancy	Arlington, Virginia
The Wildlife Society	Bethesda, Maryland
Media	
Albuquerque Journal	Albuquerque, New Mexico
Albuquerque Tribune	Albuquerque, New Mexico
Associated Press	Albuquerque, New Mexico
Diné River Times	Bayfield, Colorado
Four Corners Broadcasting	Durango, Colorado
Four Corners Flyer	Farmington, New Mexico
Gallup Independent	Gallup, New Mexico
Grand Junction Sentinel	Grand Junction, Colorado
KDAG – Big Dog	Farmington, New Mexico
KDGO – KISZ Radio	Durango, Colorado
KENN/KRWN Radio	Farmington, New Mexico
KKFG Radio Station	Farmington, New Mexico
KOAT ABC Action 7 News	Albuquerque, New Mexico
KOAT TV	Farmington, New Mexico
KOBF – TV	Farmington, New Mexico
KREZ – TV	Durango, Colorado
KSJE Radio	Farmington, New Mexico
KSUT Radio	Ignacio, Colorado
KTNN Radio	Window Rock, Arizona
KTRA FM	Farmington, New Mexico
KWYK-KNDN Radio Station	Farmington, New Mexico
Navajo Times	Window Rock, Arizona
Pagosa Springs Sun	Pagosa Springs, Colorado

Media (continued)	
Businesses or agencies	**City, State**
The Cortez Journal	Cortez, Colorado
The Daily Times	Farmington, New Mexico
The Durango Herald	Durango, Colorado
The Durango Telegraph	Durango, Colorado
The New Mexican	Santa Fe, New Mexico
The Southern Ute Drum	Ignacio, Colorado
Times Independent	Moab, Utah
Libraries	
Albuquerque Public Library	Albuquerque, New Mexico
Alturian Public Library	Aztec, New Mexico
Bloomfield City Library	Bloomfield, New Mexico
Colorado School of Mines Library	Golden, Colorado
Cortez Public Library	Cortez, Colorado
Denver Public Library	Denver, Colorado
Durango High School Library	Durango, Colorado
Durango Public Library	Durango, Colorado
Farmington Public Library	Farmington, New Mexico
Fort Lewis College Anthropology Department	Durango, Colorado
Fort Lewis College Library	Durango, Colorado
New Mexico State Library	Santa Fe, New Mexico
New Mexico State University Library	Las Cruces, New Mexico
San Juan College Library	Farmington, New Mexico
University of Colorado Libraries	Boulder, Colorado
University of Denver Library	Denver, Colorado
University of Northern Colorado	Greeley, Colorado
Zimmerman Library	Albuquerque, New Mexico
Schools and colleges	
Crownpoint Institute of Technology	Gallup, New Mexico
Diné College	Shiprock, New Mexico
Fort Lewis College	Durango, Colorado
New Mexico State University	Las Cruces, New Mexico

Schools and colleges (continued)	
Businesses or agencies	**City, State**
Northern Arizona University	Flagstaff, Arizona
San Juan College	Farmington, New Mexico
Southwest Open High School	Cortez, Colorado
University of New Mexico, Department of Biology	Albuquerque, New Mexico
Museums	
Denver Museum of Nature and Science	Denver, Colorado
Legal	
Greene, Meyer & McElroy PC	Boulder, Colorado
Dan Israel	Boulder, Colorado
Maynes, Bradford, Shipps & Sheftel	Durango, Colorado
Nordhaus Law Firm	Albuquerque, New Mexico Santa Fe, New Mexico
Consultants	
Archaeological Support Services	Santa Fe, New Mexico
Architectural Research Consultants	Albuquerque, New Mexico
Ayes Associates	Fort Collins, Colorado
Bio/West, Inc.	Logan, Utah
Canyonlands Field Institute	Moab, Utah
Dornbusch & Company, Inc.	Berkeley, California
Ecosystems Research Institute	Logan, Utah
El Paso Field Services	Farmington, New Mexico
EMI, Inc.	Durango, Colorado
Franson Noble & Associates	American Fork, Utah
HabiTech, Inc.	Laramie, Wyoming
Harris Water Engineering, Inc.	Durango, Colorado
Hill & Robbins PC	Denver, Colorado
Hydrosphere Resource Consultants	Boulder, Colorado
Keller-Bliesner Engineering	Logan, Utah
Kogovsck & Associates	Denver, Colorado
Landmark Geographic Services	Durango, Colorado
Mactec – ERS	Grand Junction, Colorado

Consultants (continued)	
Businesses or agencies	**City, State**
Miller Ecological Consultants, Inc.	Fort Collins, Colorado
Modrall, Sperling, Roehl, Harris & Sisk	Albuquerque, New Mexico
Parson Engineering Science	South Jordan, Utah
Water Consult	Loveland, Colorado
William J. Miller Engineers, Inc.	Santa Fe, New Mexico
Individuals	
Name	**City, State**
Debbie Abbott	Farmington, New Mexico
Robert Ahkeah	Shiprock, New Mexico
Elisa Arviso	Window Rock, Arizona
Lloyd D. Ayliffe	Broomfield, New Mexico
Robert Baker	Hesperus, Colorado
Esmerlindo J. Barela	New Mexico
David Barr	Farmington, New Mexico
Cliff Barrett	Perry, Utah
Kaibah Begay	Shiprock, New Mexico
Steven Begay	Window Rock, Arizona
Ernest Beleen	Fruitland, New Mexico
Mark Belles	Rowlett, Texas
Herb Beyale Jr.	Shiprock, New Mexico
Samuel Billison	Window Rock, Arizona
David Biser	Kirtland, New Mexico
Clayton Bond	Kirtland, New Mexico
Larry Bonney	Shiprock, New Mexico
Nate Bronson	Durango, Colorado
Bob Browning	Farmington, New Mexico
Caroline Burke	Durango, Colorado
Don Carlson	Farmington, New Mexico
Tim Chavez	Navajo Dam, New Mexico
Mark Clampett	Aztec, New Mexico

Individuals (continued)	
Name	**City, State**
Ralph E. Clark III	Gunnison, Colorado
Selva Clarke	Farmington, New Mexico
Mark Condiotti	Durango, Colorado
Cathrine Condon	Boulder, Colorado
Margie Connolly	Dolores, Colorado
Kevin R. Cook	Mancos, Colorado
Cy Cooper	Farmington, New Mexico
Gordon Dahl	Englewood, Colorado
Julia Dengel	New York, New York
Dale Diamond	Fallbrook, California
Leslie Dimmick	Farmington, New Mexico
Doug Echols	Farmington, New Mexico
Steve Ellison	Farmington, New Mexico
Annie Englert	Farmington, New Mexico
Ken Fischman	Durango, Colorado
Carroll V. Fisk	Farmington, New Mexico
Pat Flavian	Farmington, New Mexico
Kent Ford	Durango, Colorado
Jenel Franks	Farmington, New Mexico
Nell Franks	Farmington, New Mexico
Maxwell C. Freudenberg	Durango, Colorado
Raymond Fulton	Waterflow, New Mexico
Perry Garnenez	Shiprock, New Mexico
Prestene Garnenez	Fort Defiance, Arizona
Dorinda Gaston	Bloomfield, New Mexico
John Geddie	Albuquerque, New Mexico
Nancy Grief	Durango, Colorado
David Grossman	Denver, Colorado
Jana Gunnell	Gallup, New Mexico
Joseph Guttman	Philadelphia, Pennsylvania

Individuals (continued)

Name	City, State
George J. Hanosh	Grants, New Mexico
Chris Harbin	Louisville, Kentucky
Daniel B. Harper	Durango, Colorado
S. Harris	Farmington, New Mexico
Dan Heagerty	Portland, Oregon
Joe Hessbrook	Albuquerque, New Mexico
Daniel Hinds	Durango, Colorado
Gary Horner	Farmington, New Mexico
Patrick Huber	Florissant, Colorado
Sandra Hunt	Waterflow, New Mexico
Lula Jackson	Shiprock, New Mexico
Harry James	Kirtland, New Mexico
Frank Jesmer	Ignacio, Colorado
Judy Johnson	Farmington, New Mexico
Martin L. Johnson	Farmington, New Mexico
Rick Johnson	Flagstaff, Arizona
Howard Jones	Farmington, New Mexico
Jaclyn Joslin	Durango, Colorado
Lolly Jully	Shiprock, New Mexico
Elizabeth Kaime	Farmington, New Mexico
Neal Kelemen	Denver, Colorado
Tom Kilmartin	Lombard, Illinois
Steve Komadina	Corrales, New Mexico
Steve Krest	Marvel, Colorado
Tony Lee	Fruitland, New Mexico
Dale E. Lehman	Durango, Colorado
Tim Longway	Durango, New Mexico
James Maes	Navajo Dam, New Mexico
Anita Mayes	Shiprock, New Mexico
Don Miller	Farmington, New Mexico

Individuals (continued)	
Name	**City, State**
Dan Neifert	Farmington, New Mexico
Ron Nott	Farmington, New Mexico
Michael H. Paine	Farmington, New Mexico
Kathleene Parker	White Rock, New Mexico
Lee Norberto	Naqeeri, New Mexico
Evert Oldham	Flora Vista, New Mexico
Adelaide Paiz	Dulce, New Mexico
Janet Parkes	Farmington, New Mexico
Ronald Pettigrew	Durango, Colorado
Charles C. Phelan	Farmington, New Mexico
Melia Pope	Brighton, Colorado
Lori Potter	Denver, Colorado
Tracy Raymond	Shiprock, New Mexico
Janet Reed	Bloomfield, New Mexico
Ellen Roberts	Durango, Colorado
Norris Rose	Bayfield, Colorado
Tom Ross	Ignacio, Colorado
Katherine Roxlau	Albuquerque, New Mexico
Ken Rustad	Farmington, New Mexico
Dennis Rychlick	Farmington, New Mexico
John Salazar	Grand Junction, Colorado
Jim Sammie	Crownpoint, New Mexico
Bill & Janice Schnorr	Farmington, New Mexico
Christopher Scott	Denver, Colorado
Chris Seldin	Denver, Colorado
Tania Soussan	Albuquerque, New Mexico
James Spence	Farmington, New Mexico
Paul Stavely	Farmington, New Mexico
Travis Stills	Durango, Colorado
Denis Stratford	Durango, Colorado

Individuals (continued)

Name	City, State
Michael D. Sullivan	Farmington, New Mexico
Jerry A. Swingle	Durango, Colorado
Charlie Tapia	Santa Fe, New Mexico
Darcy Temple	Fort Collins, Colorado
Jack Thiel	Colorado Springs, Colorado
Mark Thoren	Wellington, Colorado
Dani Traweek	Cortez, Colorado
Bill Utton	Aztec, New Mexico
Orion J. Utton	Aztec, New Mexico
Greg Vlaming	Durango, Colorado
Louise Voelker	Durango, Colorado
Connie Weinpahl	Pagosa Springs, Colorado
Renee Wilhelm	Ignacio, Colorado
Sandy Williams	Flora Vista, New Mexico
Verna F. Wilson	Farmington, New Mexico
Don Wimsatt	Farmington, New Mexico
Jamie Wright	Thornton, Colorado

Chapter VIII

PERMITS, APPROVALS, AND REGULATORY REQUIREMENTS

INTRODUCTION

This planning report and draft environmental impact statement is intended to provide decisionmakers and the public with information regarding the environmental effects of the construction, operation, and maintenance of the proposed Navajo-Gallup Water Supply Project (proposed project), as part of the Bureau of Reclamation's (Reclamation) compliance with the National Environmental Policy Act (NEPA). In addition to NEPA compliance, a number of permits must also be obtained and/or complied with in order to implement the proposed project. Congressional authorization will be required before Reclamation can take action to construct, operate, and maintain the proposed project.

This chapter discusses the permits, approvals, and regulatory requirements necessary for the construction, operation, and maintenance of the San Juan River Public Service Company of New Mexico (SJRPNM) Alternative. When future water uses (i.e., residential and commercial developments on Tribal lands) were implemented, NEPA compliance and similar regulatory requirements would have to be met as well; however, the specific regulatory requirements would vary depending on the developments proposed. These requirements are not detailed in this chapter.

Reclamation is required to ensure compliance with the Endangered Species Act (ESA), Clean Water Act (CWA), National Historic Preservation Act (NHPA) of 1966, Migratory Bird Treaty Act, Fish and Wildlife Coordination Act (FWCA), and Bald Eagle Protection Act. At the Federal level, required permits and approval authority outside of Reclamation's jurisdiction also include compliance with the Clean Air Act (CAA). Each of these statutes has been taken into account in the preparation of this document. The State of New Mexico and the Navajo Nation may require additional State-Tribal review.

ENDANGERED SPECIES ACT

Section 7 of the ESA, as amended, states that any project authorized, funded, or conducted by any Federal agency should not ". . .jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined. . .to be critical. . ." [16 USC 1536 9(a)(2)(1998)]. Reclamation is required to consult with the U.S. Fish and Wildlife Service (Service) to determine whether any federally listed or proposed endangered or threatened species or their designated critical habitat occur in the vicinity of the proposed project. If, upon review of the existing data, Reclamation determines that these species or habitats may be affected by the proposed action, Reclamation is required to prepare a biological assessment to identify the nature and extent of adverse impacts and to recommend mitigation measures that would avoid the habitat and/or species or that would reduce potential impact to acceptable levels. If, however, Reclamation determines that no federally listed or proposed endangered or threatened species or their designated critical habitat would be affected by the proposed project, no further action is necessary.

Consultation was initiated on the proposed project during the early planning stages. Formal consultation was initiated with the submission of a final biological assessment from Reclamation to the Service on August 22, 2005. Results of the consultation (biological opinion) will be presented in the planning report and final environmental impact statement.

CLEAN WATER ACT

Reclamation would submit applications to the U.S. Army Corps of Engineers under section 404 of the CWA for activities involving the discharge of dredge or fill material into waters of the United States. Where possible, Reclamation would request authorization under existing Nationwide or Regional General Permits. In the event that an Individual 404 Permit Application is necessary, Reclamation would also request CWA section 401 (Water Quality Certification) from the State of New Mexico and the Navajo Nation Environmental Protection Agency. Section 404 permit conditions, including compensatory wetland mitigation requirements, would be incorporated as environmental commitments. Permit requirements normally include Best Management Practices to minimize and avoid impacts to water quality, wetlands, and special aquatic sites.

CULTURAL RESOURCE LAWS AND POLICIES

The NHPA, as amended, requires Federal agencies to identify cultural resources within areas of proposed Federal undertakings to assess the eligibility of such resources for inclusion in the *National Register of Historic Places* (*National Register*) and to take steps to mitigate potentially adverse effects to cultural resource sites. Section 106 of the NHPA requires Reclamation to take into account the effects of its undertakings on properties listed on, or eligible for listing on, the *National Register*, including prehistoric or historic sites, districts, buildings, structures, objects, or properties of traditional religious or cultural importance, and to afford the Advisory Council on Historic Preservation (ACHP) an opportunity to comment on the undertaking.

The criteria used to evaluate the cultural resource sites that might be affected by construction of the proposed project follow guidelines set forth by NHPA regulations for determining eligibility to the *National Register*. The process for determining the eligibility of a property must be evaluated referencing the *National Register* Criteria for Evaluation (36 CRF Part 60) in order to determine the property's eligibility to the *National Register*. The criteria are as follows:

(1) Association with events that have made a significant contribution to the broad pattern of our history

(2) Association with the lives of persons significant in our past

(3) Embodiment of the distinctive characteristics of a type, period, or method of construction, or representing the work of a master, or possessing high artistic values, or representing a significant and distinguishable entity whose components may lack individual distinction

(4) Having yielded, or having the likelihood to yield, information important in prehistory or history

All negative impacts, whether direct or indirect, to cultural resource sites that are eligible or recommended eligible or potentially eligible for inclusion on the *National Register* would be considered significant.

In accordance with ACHP procedures, Reclamation, as the lead agency, is required to consult with the appropriate State Historic Preservation Officers (SHPO), Tribal Historic Preservation Officers (THPO), affected American Indian (Indian) Tribes/Tribal Nations, and other governmental entities on the potential effects of the undertaking on *National Register* listed or eligible cultural resources.

Another applicable law and policy includes the Navajo Nation Cultural Protection Act for Tribal lands. This includes following Navajo Nation policies concerning the protection of archaeological sites and traditional cultural properties and guidelines for the treatment of historic, modern, and contemporary abandoned and in-use sites.

In and around the city of Gallup, and on other privately held lands affected by the proposed project, certain provisions of the New Mexico Cultural Properties Act apply.

A programmatic agreement would be formulated with the ACHP, the New Mexico SHPO, the Bureau of Land Management, the Bureau of Indian Affairs, the city of Gallup, and the Navajo THPO. This programmatic agreement would set forth the procedures that must be followed in order to ensure compliance with cultural resource laws and policies.

The programmatic agreement would stipulate the procedures for development, review, and implementation of mitigation plans. It would describe measures to minimize and avoid impacts to cultural resources, such as in-place preservation, monitoring, distribution of information, and public and Native American involvement. If cultural resource sites could not be avoided and protected in-place, a program to compensate for losses to sites as a result of project construction would be needed. This program would include archaeological excavations and publications and reports detailing the findings of those excavations. All work would meet Archaeological Resource Protection Act Permit requirements and the permit requirements of other applicable jurisdictions.

Under the Native American Graves Protection and Repatriation Act (NAGPRA), the Navajo Nation Policy for the Protection of Jishchaa', and State burial laws, Federal agencies must consult with potentially affected Tribal Nations and/or State agencies, depending on land status, concerning the appropriate treatment and disposition of any gravesites or human remains and cultural items that may be encountered on the proposed project. Pursuant to these laws and policies, a NAGPRA Plan would be formulated prior to project construction.

OTHER REGULATORY REQUIREMENTS

In addition to Reclamation's requirements for a Record of Decision, other Federal, State, local, or Tribal regulatory agencies may have permit or approval authority over portions of the proposed project (table VIII-1). In addition, table VIII-2 lists contracts and agreements that may apply to the SJRPNM and NIIP Amarillo Alternatives.

Federal requirements of the CWA include compliance under sections 401 and 402. Water quality certification (section 401) has recently been delegated to the Navajo Nation. The Navajo Nation Environmental Protection Agency and/or Navajo Nation would determine if a National Pollutant Discharge Elimination System (NPDES) Permit (section 402) would be needed for discharges into Navajo Nation waters.

Table VIII-1.—Federal, State, local, and Tribal permit approval and consultation requirements

Agency	Permit/action	Agency action
	Federal and Tribal	
Advisory Council on Historic Preservation	Section 106, NHPA of 1966–programmatic agreement	Provide comments to Reclamation's identification of cultural resources within areas of proposed Federal undertakings and consult with recommendations for mitigation of potentially adverse effects to cultural resource sites.
Council on Environmental Quality (CEQ)	NEPA compliance–environmental impact statement	Provide coordination with CEQ regulations (40 Code of Federal Regulations Parts 1500–1508).
Affected Indian Tribes/Tribal Nations	Secretarial Order 3175 and Indian Policy (W-6100) American Indian Religious Freedom Act of 1978, Executive Order 13007 of 1997 NAGPRA	Consult with Indian Tribal Governments on Indian Trust Assets. Identify and avoid impacts to sites sacred to the practice of Native American religion. Coordinate with Tribes/Tribal Nations. In conjunction with Tribes/Tribal Nations, involve project-area affected Tribes in developing a plan to treat Native American human remains encountered during project construction.
Affected Minority Groups and Low-Income Populations	Executive Order 12898, Environmental Justice, of 1994	Comply with Executive order.
U.S. Department of the Interior, U.S. Fish and Wildlife Service	FWCA Section 7, ESA Migratory Bird Treaty Act Bald Eagle Protection Act	Evaluate impacts; recommend mitigation for fish and wildlife habitat. Provide biological opinion on species of wildlife and plants that are federally listed; this act applies to all project features that may affect federally listed species or their critical habitats.
Department of the Treasury, Bureau of Alcohol, Tobacco, and Firearms	Explosive User's Permit	Consider issuance of permits to purchase, store, and use explosives for site preparation during construction.

Table VIII-1.—Federal, State, local, and Tribal permit approval and consultation requirements (continued)

Agency	Permit/action	Agency action
Federal and Tribal (continued)		
Environmental Protection Agency	NPDES Permit (section 402), CWA	In conjunction with States and Tribes, review and issue NPDES Permit for discharges to State waters.
	Storm Water Discharge Permit, CWA	In conjunction with States and Tribes/Tribal Nations, review and issue Storm Water Discharge Permit for activities associated with construction activities.
	Section 401, Water Quality Certification, CWA	In conjunction with States and Tribes/Tribal Nations, consider issuance of Water Use and Crossing Permits.
	Section 404(r) Certification, CWA	
Department of the Army, U.S. Army Corps of Engineers	Section 404, CWA, permit issuance	Issue authorization for discharge of dredge or fill material into waters of the United States, including wetlands.
U.S. Department of the Interior, Bureau of Reclamation	Archaeological Resource Protection Act	Conduct archaeological excavations.
U.S. Department of the Interior, Bureau of Land Management	Rights-of-way construction approval	Consider issuing approval for the construction of the proposed project.
	Regulations of mining operations and gravel pits	Consider approval of activities involving construction of borrow pits.
U.S. Department of the Interior, Bureau of Indian Affairs (BIA) (with Tribal approval)	Rights-of-way construction approval	Consider issuing approval for the construction of the proposed project.
	Regulations of mining operations and gravel pits	Consider approval of activities involving construction of borrow pits.
	Road Crossing Permits	Consider issuance of permits for construction across BIA roads.
Navajo Nation Tribal Council	Rights-of-way construction approval	Consider issuing approval for the construction of the proposed project.
Navajo Nation Environmental Protection Agency	Water quality certification, CWA	Consider issuing certification for the construction of the proposed project.
	Air Quality Permit, CAA	Consider issuing permits or waivers for construction and operation emissions to the air.

Table VIII-1.—Federal, State, local, and Tribal permit approval and consultation requirements (continued)

Agency	Permit/action	Agency action
Federal and Tribal (continued)		
Navajo Nation Fish and Wildlife Department	Wildlife coordination, Navajo Nation Endangered Species Act	Consult on wildlife impacts involved with the construction of the proposed project.
Navajo Nation Historic Preservation Office	Section 106, NHPA of 1966; NAGPRA	Provide comments to Reclamation's identification of cultural resources within areas of proposed Federal undertakings, assess the eligibility of such resources for inclusion in the *National Register,* and consult with recommendations for mitigation of potentially adverse effects to cultural resource sites.
Navajo Nation Department of Water Resources	Water use permit	Consider issuance of water use permit
Navajo Tribal Utility Authority (NTUA)	Transmission and powerlines	Consider issuance of permits for crossing and connecting to existing NTUA facilities.
Navajo chapters	Local approvals	Develop information-sharing process.
Indian Tribal Councils	Indian Self-Determination and Education Assistance Act (Public Law 638)	Consult on level of involvement for design and construction.
New Mexico		
New Mexico Bureau of Mines and Mineral Resources	Regulation of mining operations and gravel pits	Consider approval of activities involving construction of borrow pits.
New Mexico Department of Game and Fish	FWCA, State-sensitive species coordination	Make recommendations of activities involving State-listed sensitive species.
New Mexico Environment Department, Air Quality Bureau	Air Quality Permits, CAA	Consider issuance of permits or waivers for construction and operation emissions to the air.
New Mexico Environment Department, Surface Water Quality Bureau	Section 401, Water Quality Certification, CWA NPDES Permit, Section 402, CWA Storm Water Discharge Permit, CWA River, Stream Crossing Permit	Consider issuance of Water Use and Crossing Permits. Review and issue NPDES Permit for discharges to State waters. Review and issue Storm Water Permit for activities associated construction activities. Consider issuance of permits for crossing rivers, streams, and lakes in New Mexico.

Table VIII-1.—Federal, State, local, and Tribal permit approval and consultation requirements (continued)

Agency	Permit/action	Agency action
New Mexico (continued)		
New Mexico Office of Cultural Affairs (SHPO)	Section 106, NHPA of 1966, NAGPRA	Provide comments on Reclamation's identification of cultural resources within areas of proposed Federal undertakings, assess the eligibility of such resources for inclusion in the *National Register*, and consult with recommendations for mitigation of potentially adverse effects to cultural resource sites. Coordinate on other Native American issues.
New Mexico Department of Transportation	Road Crossing Permits	Consider issuance of permits for construction across State roads.
New Mexico Office of State Engineer	Diversion and Water Use Permits	Consider issuance of permits or waivers for water users.
New Mexico Archaeological and Historic Preservation (SHPO)	Comply with State burial law	Acquire permit to perform excavations on State or private lands where burials are anticipated.
County and local agencies		
San Juan County Commissioners	Road use and crossings	Coordinate agreement.
San Juan County Planning Department	Use Permits	Consider approval of activities where use is conditional in a particular zone.
McKinley County Commissioners	Road use and crossings	Coordinate agreement.
McKinley County Planning Department	Use Permits	Consider approval of activities where use is conditional in a particular zone.
City of Gallup	Use Permits	Consider approval of activities where use is conditional in a particular zone.
County/city governments	Local approvals	Develop information-sharing process.

Table VIII-2.—Contracts, legislation, and agreements that may apply to the proposed project

Contract, legislation, or agreement	Purpose
Colorado River Compact of 1922, Public Law [P.L.] 84-485	Allocation and management of water between Upper and Lower Colorado River Basins.
Upper Colorado River Basin Compact of 1948	The compact apportions water of the Upper Basin to the States of Arizona, Colorado, New Mexico, Utah, and Wyoming and establishes certain obligations for the States of the Upper Division.
Colorado River Storage Project Act of 1956 (70 Stat. 105)	Authorized construction of Navajo Dam and Reservoir. The proposed project has potential to become a participating project of the Colorado River Storage Project (CRSP) Act.
Jicarilla Apache Tribe Water Rights Settlement Act of 1992, P.L. 106-2237	The Jicarilla Apache Nation established legal rights to San Juan River Basin water rights that are based on the (1) 33,500 acre-foot per year (AFY) diversion and 25,500 AFY depletion from Navajo Reservoir or River and (2) 6,500 AFY diversion or 6,500 AFY depletion from the San Juan-Chama Project.
The Navajo Nation Treaty of 1849	Treaty placed Navajo people under the jurisdiction of the United States and ceased hostilities and promised perpetual peace.
Treaty of 1868	Navajo Nation lands were specifically set aside in the Treaty of 1868 (15 Stat. 667). An earlier treaty, signed and ratified in 1850 (9 Stat. 974), promised the Navajo people the designation of territories for their benefit.
Navajo Indian Irrigation Project (NIIP), P.L. 87-483	P.L. 87-483 (76 Stat. 96) authorized the Secretary of the Interior to construct, operate, and maintain the NIIP and initial stages of the San Juan-Chama Project as participating projects of the CRSP and for the purposes of furnishing water for the irrigation of irrigable and arable lands and for municipal, domestic, and industrial uses, providing recreation and fish and wildlife benefits, controlling silt, and other beneficial purposes. The Navajo Nation has a Navajo Reservoir water supply contract with the United States for the delivery of water to the NIIP for the principal purpose of furnishing irrigation water to 110,630 acres of land. The San Juan-Chama Project makes the average annual diversion of about 107,524 AFY from the upper tributaries of the San Juan River possible and conveys the water into the Rio Grande Basin in New Mexico.
Secretarial Contract No. 14-06-W-269	Agreement between the United States and Navajo Tribe of Indians for delivery of water from Navajo Reservoir, dated April 10, 1976.
Navajo-Gallup Water Supply Project	The Navajo Nation and the city of Gallup signed a Memorandum of Agreement on April 17, 1998, to proceed with project planning and resolve issues related to project development.
San Juan River Basin in New Mexico Navajo Nation Water Rights Settlement	The State of New Mexico and the Navajo Nation on April 19, 2005, signed the proposed settlement agreement. The settlement agreement would resolve the claims of the Navajo Nation to the use of waters of the San Juan River Basin in New Mexico in a manner that would inure to the benefit of the Navajo Nation and the State of New Mexico. The settlement agreement will become effective if Congress passes the settlement act and the President of the United States signs the act into law. The proposed act would authorize construction and operation of the proposed project.

Ambient air quality is protected by Federal regulations under the CAA. These regulations include compliance under the New Source Performance Standards and the requirements for the Prevention of Significant Deterioration. The Federal permitting process for the CAA has been delegated to the Navajo Nation.

LIST OF PREPARERS

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GLOSSARY

A

Acre-foot: A quantity or volume of water covering 1 acre to a depth of 1 foot (43,560 cubic feet).

Active storage: The amount of storage within a reservoir used for storage and release under normal operating parameters.

Alkaline: Having a pH 7.0 or above.

Arable: Suitable for farming.

Archaic: The Archaic period in the region is typified by a change from a big-game hunting emphasis to the hunting of smaller, modern game and the intensive collection of plant foods. Most sites of this period date between 8000 and 2000 BP (Before Present).

Artifact: A human-made object.

B

Base flow: Groundwater or surface water inflow to a river segment or its tributaries that is derived from natural or artificial storage and is commonly associated with periods of low flow.

Benthic: Bottom- or depth-inhabiting.

Berm: A wall of earth along a dam.

Bioaccumulation: The uptake and retention of nonfood substances by a living organism from its environment, resulting in a build-up of the substances in the organism.

Biodiversity: The variety of life and its processes, and the interrelationships within and among various levels of ecological organization.

Biological assessment: Analysis prepared by or under the direction of a Federal agency for the purpose of identifying potential impacts of a proposed action on endangered or threatened species and their critical habitat. The analysis is provided to the U.S. Fish and Wildlife Service either for information (when it has been concluded that no effect would occur) or with a request for consultation (when a possible effect has been identified).

Biological opinion: Document that states the opinion of the U.S. Fish and Wildlife Service as to whether a Federal action is likely to jeopardize the continued existence of a threatened or endangered species or result in the destruction or adverse modification of critical habitat.

C

Candidate species: Plant or animal species not yet officially listed but which is undergoing a status review by the U.S. Fish and Wildlife Service as candidate for possible addition to the list of threatened and endangered species.

Coliform: Organisms common to the intestinal tract of humans and animals; the organisms' presence in waste water is an indicator of pollution.

Colorado pikeminnow: Formerly Colorado squawfish. The Colorado pikeminnow (*Ptychocheilus lucius*) is an endangered fish that is endemic to the Colorado River Basin.

Colorado River Compact: The 1922 Colorado River Compact apportioned the waters between the Upper and Lower Basins. The 1948 Upper Colorado River Basin Compact apportioned the waters between the Upper Basin States.

Colorado Ute Indian Water Rights Final Settlement Agreement, December 10, 1986 (Settlement Agreement): Describes Project-reserved water rights for the two Colorado Ute Tribes and details other benefits to the tribes.

Colorado Ute Indian Water Rights Settlement Act of 1988 (Public Law 100-585) (Settlement Act): Enters into law provisions of the Colorado Ute Indian Water Rights Settlement Agreement of 1986 and mandates the Tribal Development Fund and other provisions of the Settlement Agreement.

Connected actions: As defined by 40 Code of Federal Regulations 1508.25(a)(1), those actions which are interrelated with a proposed Federal action and which should be discussed in the same environmental impact statement.

Cooperating agency: Federal, State, Tribal, and local government agencies that have jurisdiction by law and special expertise with respect to all reasonable alternatives or significant environmental, social, or economic impacts associated with a proposed action that requires National Environmental Policy Act (NEPA) analysis. The Federal agency responsible for the NEPA analysis should determine whether such agencies are interested and appear capable of assuming the responsibilities of becoming a cooperating agency under 40 Code of Federal Regulations 1501.6.

Conservation: Reduction in applied water due to more efficient water use.

Cretaceous: Having the characteristics of chalk; relating to the Mesozoic era system of rocks.

Critical habitat: Defined in Section 3(5)(A) of the Endangered Species Act as: (1) the specific areas within the geographical area occupied by the species at the time it is listed, on which are found those physical and biological features (a) essential to the conservation of the species and (b) which may require special management considerations for protection; and (2) Specific areas outside the geographical area occupied by a species at the time it is listed upon a determination by the Secretary that such areas are essential for the conservation of the species.

Cubic foot per second (cfs): As a rate of streamflow, a cubic foot of water passing a reference section in 1 second of time. A measure of moving volume of water (1 cfs = 0.0283 cubic meter per second).

Cultural resources: Any buildings, sites, districts, structures, or objects significant in history, architecture, archeology, culture, or science.

Cumulative action: As defined in 40 Code of Federal Regulations 1508.25(a)(2), those actions, when viewed with other proposed actions, that have cumulatively significant impacts.

Cumulative impacts: Impacts that occur as a result of cumulative actions.

D

Depletion: To permanently remove water from a system for a specific use.

Dissolved oxygen: Oxygen that exists in water as a result of air/water mixing or aquatic photosynthesis. Sufficient quantities of dissolved oxygen in water are required to support fish and most other aquatic animals.

Diversion: Removing water from its natural course or location, or controlling water in its natural course or location, by means of a ditch, canal flume, reservoir, bypass, pipeline, conduit, well, pump, or other structure or device.

E

Effects/impacts: National Environmental Policy Act Guidelines §1508.8 state:

"Effects" include:

(a) Direct effects, which are caused by the action and occur at the same time and place.

(b) Indirect effects, which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems. Effects and impacts as used in these regulations are synonymous. Effects on natural resources (and on the components, structures, and functioning of affected ecosystems), aesthetic, historical, cultural, economic, social, or health, whether direct, indirect, or cumulative. Effects may also include those resulting from actions which may have both beneficial and detrimental effects, even if, on balance, the agency believes that the effect will be beneficial.

(c) Significant and potentially significant effects.

Endangered species: A species that is in danger of extinction throughout all or a significant portion of its range.

Endangered Species Act (ESA): Federal law that authorizes and establishes the process for the protection of habitats and populations of species threatened with extinction. The stated purposes of the Federal Endangered Species Act of 1973, as amended, are to provide conservation of the ecosystems upon which endangered and threatened species depend and to establish and implement a program to conserve these species.

Entrainment: Process by which aquatic organisms, suspended in water, are pulled through a pump or other device.

Environment: All biological, chemical, and physical factors to which organisms are exposed.

Environmental impact statement: Detailed public document required by the National Environmental Policy Act for proposed major Federal actions having a significant effect upon the human environment. It is a formal document which must follow the requirements of the National Environmental Policy Act, the Council on Environmental Quality regulations, and directives for the Federal agency responsible for the project proposal.

It focuses on a description of the affected environment and a detailed analysis of the environmental consequences of the proposed action and its alternatives. It is released to the public and other agencies for review and comment. An environmental impact statement is used by the decisionmaking official(s) to make informed decisions concerning implementation of the selected alternative. The decision is documented in a Record of Decision.

Exchange: The release of water to a stream at one location in order to increase diversion at an upstream location, while still meeting downstream demands and bypass flow needs.

F

Fecal coliform: Bacteria formed in the intestinal tracts of animals. Their presence in water or sludge is an indicator of pollution and possible contamination by pathogens.

Federal Register: Periodical published daily (Monday through Friday, except on official holidays) by the Federal National Archives and Records Administration. It provides a uniform system for making available to the public regulations and legal notices issued by Federal agencies.

Fish and Wildlife Coordination Act: The Fish and Wildlife Coordination Act and related acts express the policy of Congress to protect the quality of the environment as it affects the conservation, improvement, and enjoyment of fish and wildlife resources. Under this act, any Federal agency that proposes to control or modify any body of water, or to issue a permit allowing control or modification of a body of water, must first consult with the U.S. Fish and Wildlife Service and State Fish and Game officials.

Floatable flow: The flow rate below which a particular river-related recreation activity would cease.

Flow: Used synonymously with “streamflow.” The volume of water passing a given point per unit of time.

Footprint: An outline of defined boundaries or parameters.

Forbs: Weeds or broad-leafed plants.

G

Gap Analysis: A comparison of the distribution of elements of biodiversity with that of areas managed for their long-term viability to identify elements with inadequate representation.

Groundwater: Water contained beneath the land surface of the earth that can be collected with wells or drainage galleries, or water that flows naturally to the Earth's surface via seeps or springs.

H

Headwater: The source and upper part of a stream; water upstream of a dam.

Hypolimnion: Bottom layer of a lake with essentially uniform colder temperatures.

I

Inflow: Water that flows into a body of water.

Interstate compact: An agreement between two or more States dealing with competing demands for a water resource beyond the legal authority of one State alone to solve. Such agreements require the consent of Congress and the States.

Invertebrate: Animals lacking a spinal column.

Irretrievable commitments of natural resources: Loss of production or use of resources as a result of a decision. It represents opportunities foregone for the period of time that a resource cannot be used.

Irreversible commitments of resources: Decisions affecting renewable resources, such as soils, wetlands, and waterfowl habitat. Such decisions are considered irreversible because their implementation would affect a resource that has deteriorated to the point that renewal can occur only over a long period of time or at great expense or because their use would cause the resource to be destroyed or removed.

L

Lacustrine: Lake and reservoir wetland habitat.

Loam: A soil consisting of a mixture of clay, silt, and sand.

M

Megawatt (MW): One million watts.

Mitigation: National Environmental Policy Act Guidelines §1508.20 states: "Mitigation" includes:

(a) Avoiding the impact altogether by not taking a certain action or parts of an action.

(b) Minimizing impacts by limiting the degree or magnitude of the action and its implementation.

(c) Rectifying the impact by repairing, rehabilitating, or restoring the affected environment.

(d) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.

(e) Compensating for the impact by replacing or providing substitute resources or environments.

As used in cultural resource compliance procedures: Any treatment of historic or prehistoric property that will offset adverse effects that may result from an agency's action. As used concerning municipal and industrial water: Water delivered to industries and cities for uses, including human consumption, livestock and wildlife, recreation, and tourism development.

N

National Environmental Policy Act (NEPA): Directs Federal agencies to prepare an environmental impact statement for all major Federal actions that may have a significant effect on the human environment. NEPA states that it is the goal of the Federal Government to use all practicable means, consistent with other considerations of national policy, to protect and enhance the quality of the environment. NEPA requires all Federal agencies to consider the environmental impacts of their proposed actions during the planning and decisionmaking process.

National Pollutant Discharge Elimination System (NPDES): This permit under section 402 of the Clean Water Act (33 USC 1251 et seq.) may be required if water quality is potentially affected by proposed actions or construction of wastewater treatment plants, or other structures.

National Register of Historic Places: A federally maintained register of districts, sites, buildings, structures, architecture, archeology, and culture.

No Action Alternative: Under the National Environmental Policy Act, “no action” represents a projection of current conditions to the most reasonable future responses or conditions that could occur during the life of the project without any action alternatives being implemented. The No Action Alternative should not automatically be considered to be the same as the existing condition of the affected environment since reasonably foreseeable future actions may be taken whether or not any of the project action alternatives are chosen. Differences could result from other water development projects, land use changes, or municipal development. “No action” is therefore often described as “the future without the project.”

Nonpoint source pollution: Manmade or man-induced alteration of the chemical, physical, biological, or radiological integrity of water, originating from any source other than a point source.

Nutrients: Animal, vegetable, or mineral substances which sustain individual organisms and ecosystems.

P

Paleocene: Relating to the oldest series or epoch of the Tertiary period.

pH: Indicator of acidity. This expression of hydrogen ion concentration is typically expressed in a scale from 1 to 14, 1 being the most acidic and 14 being the most basic.

Point source pollution: Any discernible, confined, or discrete conveyance from which pollutants are or may be discharged, including, but not limited to, any pipe, ditch, channel, tunnel, conduit, well, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft.

Practicably irrigable acreage (PIA): The amount of acreage that can be practicably irrigated in consideration of physical and economic factors. The PIA standard is often used as a measure to help define Indian Tribes' claims to water that might be needed to fulfill the purposes for which their land reservations were set aside by Congress.

R

Reasonable and prudent alternative (RPA): Regulations implementing the Endangered Species Act, section 7, define reasonable and prudent alternatives as alternative actions, identified during formal consultation with the U.S. Fish and Wildlife Service, that (1) can be implemented in a manner consistent with the intended purpose of the action, (2) can be implemented consistent with the scope of the Federal agency's legal authority and jurisdiction, (3) are economically and technologically feasible, and (4) would, the Service believes, avoid the likelihood of jeopardizing the continued existence of listed species or resulting in the destruction or adverse modification of critical habitat.

Record of Decision (ROD): A written document which states the decision made, describes the environmental factors considered, the preferred plan, and the alternatives considered in the environmental impact statement.

Recreation day: Analogous to user day, which is the participation in a recreation activity at a given resource during a 24-hour period by one person.

Related actions: As defined in 40 Code of Federal Regulations 1508.25(a)(3), those actions that have similarities to a proposed action that provide a basis for evaluation together, such as common timing or geography.

Restoration/re-vegetation: Re-establishing a habitat or plant community in an area that historically supported it.

Riffle: A water habitat characterized by water flowing rapidly over a coarse substrate.

Riparian: Living on or adjacent to a water supply such as a riverbank, lake, or pond.

Riprap: Stones placed on the face of dams, stream banks, or other land surfaces to protect the surface from erosion.

S

Salmonids: The family of fish which includes trout, salmon, and char.

San Juan River Basin Recovery Implementation Program (SJRBRIP): A program required by the 1991 Biological Opinion for the Animas-La Plata Project that has the dual goals of (1) conserving populations of endangered fish species in the San Juan River consistent with recovery under the Endangered Species Act and (2) proceeding with water development in the San Juan River Basin consistent with interstate compacts, court decrees, and Federal trust responsibilities to Indian Tribes. Participants in the program include four U.S. Department of the Interior agencies (the U.S. Fish and Wildlife Service, the Bureau of Reclamation, the Bureau of Indian Affairs, and the Bureau of Land Management), two States (Colorado and New Mexico), four Indian Tribes (the Navajo Nation, the Jicarilla Apache Nation, the Southern Ute Tribe, and the Ute Mountain Ute Tribe), and water development interests in the San Juan River Basin.

Scoping: An early, open process for determining the scope of issues to be addressed and identifying the significant issues related to a proposed action. Scoping meetings are a part of the process.

Section 7 consultation: All Federal agencies are required to consult with the U.S. Fish and Wildlife Service on actions that may affect endangered or threatened species and their designated critical habitat. This consultation requirement is under section 7 of the Endangered Species Act.

Seep: A spot where groundwater oozes slowly to the surface, usually forming a pool.

Selenium: A naturally occurring trace element present in many geological formations in the West. Humans and animals require selenium in small amounts for good health, but concentrations can cause adverse reactions. The irrigation process can cause elevated selenium concentrations.

Shiprock irrigation projects: Fruitland, Hogback, Cudei, and Cambridge.

Siphon: A pipe that conveys water between two sections of a canal by dipping down across a valley or draw.

Special status species: Any species listed or proposed for listing under the Endangered Species Act (ESA). A general term for any species listed or proposed for listing as threatened or endangered under the ESA, a species considered rare, or a species of special concern under State or Tribal protection.

Spillway: A passage for water to run over an obstruction, such as a dam.

Streamflow: The volume of water passing a given point per unit of time.

Substrate: The base on which an organism lives; a substance acted upon.

Sustainability: Refers to the maintenance of a landscape and lifestyle in some agreed-upon form that includes both a space for human economic activity and a space to preserve the ecosystem under natural controls and evolution.

Swale: A wide, shallow ditch, usually grassed or paved.

T

Tailwater: Water below a dam or hydropower development.

Tertiary: Relating to the first period (Cenozoic) system of rocks, marked by the formation of high mountains.

Threatened species: A legal classification for a species that is likely to become endangered within the foreseeable future.

Topography: Physical shape of the ground surface.

Total dissolved solids (TDS): Total amount of dissolved material, organic and inorganic, contained in water.

Toxin: Poisonous substance, generally from a plant or animal.

Trace element: A trace element is one that is usually only present in "trace" or barely measurable amounts. When the name was developed, analytical chemistry was in its infancy and incapable of quantifying the amount or concentration of naturally occurring elements in soil or water other than the most common ones such as calcium, magnesium, sodium, potassium, chloride, carbon, and sulfur.

Traditional cultural property (TCP): A site or resource that is eligible for inclusion in the National Register of Historic Places because of its association with cultural practices or beliefs of a living community.

Turbidity: The scattering and absorption of light that makes the water look murky. Caused by the content and shape of matter suspended in the water.

U

Upper Basin: Those parts of the States of Arizona, Colorado, New Mexico, Utah, and Wyoming within and from which waters naturally drain into the Colorado River system above Lee Ferry, and also all parts of said States located without the drainage area of the Colorado River system that are beneficially served by water diverted from the system above Lee Ferry.

V

Vertebrate: Animal species with a spinal column.

W

Weir: A structure built across an open channel for measuring, diverting, or controlling water flow.

Wetlands: Lands including swamps, marshes, bogs, and similar areas such as wet meadows, river overflows, mud flats, and natural ponds.

> *Jurisdictional* – Subject to regulation under the Clean Water Act.
>
> *Nonjursidictional* – Subject to consideration under the U.S. Fish and Wildlife Coordination Act.

Wetted perimeter: The distance along the bottom and sides of a stream, creek, or channel in contact with the water.

Wild and Scenic Rivers Act (Public Law 90-542): The policy of this act selects certain rivers possessing remarkable scenic, recreational, geologic, fish and wildlife, historic, or other similar values, for preservation in free-flowing conditions. Those selected under recreational criteria may have undergone some diversion or impoundment in the past. Selected rivers and streams have been placed into the National Rivers Inventory by Acts of Congress; others are proposed for inclusion into the system.

Winters Doctrine: Provides that the establishment of a Indian Reservation impliedly reserves the amount of water necessary for the purposes of the reservation. Upheld by the U.S. Supreme Court.

ATTACHMENTS

Attachment

A	Memorandum of Agreement between the City of Gallup and the Navajo Nation to Cooperate on the Navajo-Gallup Water Supply Project (IGRF-33-98)
B	Resolutions of the Upper Colorado River Commission
C	Letter from Jicarilla Apache Tribe to the Bureau of Reclamation (February 16, 2001)
D	Letter from Honorable Kelsey A. Begaye, President of the Navajo Nation, and Honorable John Peña, Mayor of the City of Gallup, to Eluid Martinez, Commissioner of the Bureau of Reclamation (November 22, 2000)
E	Letter from Rick L. Gold, Regional Director, Upper Colorado Regional Office, to Honorable Kelsey A. Begaye, President of the Navajo Nation, and Honorable John Peña, Mayor of the City of Gallup (June 13, 2001)
F	Preferred Alternative
G	Screening Report
H	List of Plant Species Found in the Project Vicinity
I	List of Wildlife Found in the Project Area and Habitat Associations
J	Soil and Geology Descriptions

ATTACHMENT A

Memorandum of Agreement
(IGRF-33-98)

**RESOLUTION OF THE
INTERGOVERNMENTAL RELATIONS COMMITTEE
OF THE NAVAJO NATION COUNCIL**

Approving a Memorandum of Agreement Between the City of Gallup and the Navajo Nation to Cooperate on the Navajo-Gallup Water Supply Project

WHEREAS:

1. The Intergovernmental Relations Committee of the Navajo Nation Council is established to ensure the presence and voice of the Navajo Nation, pursuant to 2 N.N.C §822(B), and has the power to authorize, review and approve agreements between the Navajo Nation and any state authority upon the recommendation of the standing committee with oversight authority for such agreement, pursuant to 2 N.N.C. §824(B)(6); and

2. Attached to this resolution as Exhibit A is a proposed Memorandum of Agreement between the City of Gallup and the Navajo Nation to cooperate on the Navajo-Gallup Water Supply Project; and

3. The Resources Committee of the Navajo Nation Council is charged with ensuring the optimum utilization of all resources of the Navajo Nation and to protect the rights, interests and freedoms of the Navajo Nation and People, pursuant to 2 N.N.C. §693 (1995); and

4. By Resolution RCJA-13-98, attached to this resolution as Exhibit B, the Resources Committee of the Navajo Nation Council determined that the water resources of the Navajo Nation are essential to provide a permanent homeland for the Navajo people, that protection of such water resources is essential in order to protect the health, welfare and the economic security of the citizens of the Navajo Nation, that the proposed Memorandum of Agreement would provide opportunity to advance this vitally needed project and that executing this agreement is in the best interests of the Navajo Nation; and

5. The Intergovernmental Relations Committee of the Navajo Nation Council accepts the recommendation of the Resources Committee and concurs that executing the proposed Memorandum of Agreement between the City of Gallup and the Navajo Nation to cooperate on the Navajo-Gallup Water Supply Project is in the best interests of the Navajo Nation.

NOW THEREFORE BE IT RESOLVED THAT:

The Intergovernmental Relations Committee of the Navajo Nation Council authorizes the execution of the proposed Memorandum of Agreement between the Navajo Nation and the City of Gallup to cooperate on the Navajo-Gallup Water Supply Project, attached as Exhibit A.

CERTIFICATION

I hereby certify that the foregoing resolution was duly considered by the Intergovernmental Relations Committee of the Navajo Nation Council at a duly called meeting at Window Rock, Navajo Nation (Arizona), at which a quorum was present and that same was passed by a vote of 4 in favor, 2 opposed and 0 abstained, this 23rd day of February, 1998.

KABegaye

Kelsey A. Begaye, Chairperson
Intergovernmental Relations Committee

Motion: Rex Morris, Jr.
Second: Genevieve Jackson

MEMORANDUM OF AGREEMENT

Between the Navajo Nation and the City of Gallup To Cooperate on the Navajo-Gallup Water Supply Project.

WHEREAS:

1. The Navajo Nation and the City of Gallup have severe water quality and water quantity problems; and

2. During the Congressional Hearings for the proposed Navajo Indian Irrigation Project (NIIP), the New Mexico State Engineer testified that NIIP would be part of the regional water infrastructure intended to provide water from Navajo Dam to Navajo Communities in northwest New Mexico and to the City of Gallup (Hearings before the Subcommittee on Irrigation and Reclamation of the Committee on Interior and Insular Affairs, S. 3648, July 9 and 10, 1958); and

3. In the 1960's, the Bureau of Reclamation first considered a water pipeline project that would bring water to Navajo Communities in northwest New Mexico and to the City of Gallup, and the Bureau was authorized under Public Law 92-199 (approved December 15, 1971) to conduct feasibility studies for such a project; and

4. In 1984, the Bureau of Reclamation completed a draft Environmental Impact Statement for the proposed Gallup-Navajo Indian Water Supply Project which evaluated three alternative routes for a water pipeline and recommended a route parallel to Highway 666; and

5. Following public hearings in 1984 and 1985, the Navajo Nation recommended reformulation of the project to serve additional communities along Highway 371, and a revised EIS in 1985 supported the recommendation of the route along Highway 371; and

6. By letter of March 5, 1992 from Navajo Nation Vice President Marshall Plummer to Gallup Mayor George Galanis, the Navajo Nation agreed to join the City of Gallup in further discussions to evaluate the project; and

7. In 1992, discussions commenced between technical staff from the Navajo Nation and the City of Gallup to further evaluate the project; and

8. In 1992, Congress authorized $300,000 for a preliminary reassessment of the project by the Bureau of Reclamation, and in subsequent years, Congress has authorized additional funding to develop a project definition, conduct a biological assessment, and provide an assessment of alternatives; and

9. In 1995, the Navajo Nation entered into Cooperative Agreement No. 5-FC-40-17490 (authorized by RCAU-205-95 and IGRS-190-95) with the Bureau of Reclamation to engage in public meetings and technical studies related to the project; and

10. Seventeen Chapters within the preliminary project area, including Burnham, Becenti, Coyote Canyon, Crownpoint, Dalton Pass, Nageezi, Whitehorse Lake, Mexican Springs, St. Michaels, Tseyatoh, Huerfano, Lake Valley, Pueblo Pintado, Standing Rock, Twin Lakes, Whiterock, Fort Defiance, Tohatchi, and Naschitti have approved continued planning for the project; and

11. By letter of February 15, 1996 Navajo Area Director Wilson Barber, committed the Bureau of Indian Affairs to serve as the lead agency for consultation with the Fish and Wildlife Service concerning compliance with the requirements of the Endangered Species Act, and directed the Bureau of Indian Affairs-Navajo Indian Irrigation Project Office to initiate this consultation as quickly as possible.

NOW, THEREFORE, THE CITY OF GALLUP AND THE NAVAJO NATION AGREE THAT:

1. A cooperative effort by the Navajo Nation and the City of Gallup (the Parties) to proceed with the planning and development of the Navajo-Gallup Water Supply Project is in the best interests of the Parties; and

2. The Parties are committed to a project that will work conjunctively with the Navajo Indian Irrigation Project and will otherwise be developed in a manner that is consistent with the water rights of the parties; and

3. The Parties are committed to a project that will result in a fair and equitable distribution of project water between the City of Gallup and the Navajo communities; and

4. The Parties are committed to cooperatively investigate all viable alternative project configurations, including a pipeline from the San Juan River; and

5. In order to ensure that the project will be in compliance with the requirements of the Endangered Species Act, the Parties support commitment of the Bureau of Indian Affairs to engage in consultation with the Fish and Wildlife Service as quickly as possible; and

6. The Parties will work together to resolve issues affecting the implementation of the Project; and

7. The planning efforts between the Navajo Nation and the City of Gallup will be voluntary and are without prejudice to any position either party may assert in the San Juan River General Stream Adjudication, or in any other matter concerning the water resources of the Parties.

This Memorandum of Agreement was executed on this 17th day of April, 1998.

THE NAVAJO NATION

____
Thomas E. Atcitty, President

THE CITY OF GALLUP

____
George Galanis, Mayor

ATTACHMENT B

Resolutions of the Upper Colorado River Commission

RESOLUTION OF THE
UPPER COLORADO RIVER COMMISSION

Regarding the Use and Accounting of Upper Basin Water Supplied to the Lower Basin in New Mexico by the Proposed Navajo-Gallup Water Supply Project

WHEREAS, part of the State of New Mexico is within the Upper Basin and part is within the Lower Basin as defined in Article II of the Colorado River Compact (45 Stat. 1057); and

WHEREAS, New Mexico has proposed the Navajo-Gallup Water Supply Project to divert water from the Upper Basin to serve communities located within the Lower Basin in New Mexico; and

WHEREAS, New Mexico needs to provide a water supply for municipal, industrial, commercial and domestic purposes to Navajo and non-Indian communities located within the Lower Basin in New Mexico that do not have an adequate Lower Basin source of water; and

WHEREAS, Subsec tion 303(d) of Public Law 90-537, the Colorado River Basin Project Act, authorized a thermal generating plant to be located within the State of Arizona and provided that if the plant was served by water diverted from the drainage area of the Colorado River system above Lee Ferry such consumptive use of water would be a part of the consumptive use apportioned to the State of Arizona by Article III (a) of the Upper Colorado River Basin Compact (63 Stat. 31) regardless of whether the plant was located in the Upper Basin or the Lower Basin; and

WHEREAS, the states of Colorado, New Mexico, Utah and Wyoming all support the proposed Navajo-Gallup Water Supply Project, but the states are not in agreement as to whether, under the Law of the River, New Mexico may use a part of its Upper Basin apportionment to serve uses in the Lower Basin portion of New Mexico, without obtaining the consent of the other states. However, in the spirit of comity, and without prejudice to the position of any state regarding these unresolved issues, all the states support and to the extent necessary consent to the Navajo-Gallup Water Supply Project in New Mexico.

NOW, THEREFORE, BE IT RESOLVED by the Upper Colorado River Commission that the States of Colorado, New Mexico, Utah and Wyoming, support and to the extent necessary consent to the diversion of water from the Upper Basin for use in the Lower Basin solely within New Mexico via the proposed Navajo-Gallup Water Supply Project; provided, that any water so diverted by said project to the Lower Basin portion of New Mexico, being a depletion of water at Lee Ferry, shall be a part of the consumptive use apportionment made to the State of New Mexico by Article III (a) of the Upper Colorado River Basin Compact; and

BE IT FURTHER RESOLVED, that the use of any return flows which result from use of water through the Navajo-Gallup Water Supply Project within the Lower Basin shall be subject to applicable laws; and

BE IT FURTHER RESOLVED, that nothing resulting from the implementation of this Resolution shall limit the right or ability of any Upper Basin State to develop the full apportionment made to it under the Colorado River Compact and the Upper Colorado River Basin Compact; and,

BE IT FURTHER RESOLVED, that the construction and operation of, and use of water through, the Navajo-Gallup Water Supply Project shall be subject to all other applicable provisions of law; and,

BE IT FURTHER RESOLVED, that the Upper Colorado River Commission supports such Congressional action as may be necessary to authorize the Navajo-Gallup Water Supply Project.

CERTIFICATE

I, WAYNE E. COOK, Executive Director and Secretary of the Upper Colorado River Commission, do hereby certify that the above Resolution was adopted by the Upper Colorado River Commission at its Meeting held at the Half Moon Lake Resort near Pinedale, Wyoming on June 17, 2003.

WITNESS my hand this 19th day of June, 2003.

Wayne E. Cook

WAYNE E. COOK
Executive Director and Secretary

RESOLUTION OF THE UPPER COLORADO RIVER COMMISSION

Regarding the Availability of Water from Navajo Reservoir for Navajo Nation Uses within the State of New Mexico

WHEREAS, the State of New Mexico has proposed the Navajo-Gallup Water Supply Project to provide a needed renewable water supply from the San Juan River for municipal and domestic uses for Indian and non-Indian communities located within New Mexico in both the Upper Basin and the Lower Basin; and

WHEREAS, the State of New Mexico and the Navajo Nation on April 19, 2005, executed the San Juan River Basin in New Mexico Navajo Nation Water Rights Settlement Agreement (the "Settlement Agreement"), which is conditioned upon, among other things, the implementation of the Navajo Nation components of the Navajo-Gallup Water Supply Project within New Mexico; and

WHEREAS, the source of water supply for the proposed Navajo-Gallup Water Supply Project would be Navajo Reservoir and the San Juan River in New Mexico; and

WHEREAS, water from Navajo Reservoir and the San Juan River would be delivered to the proposed Navajo-Gallup Water Supply Project to meet the water demands of Navajo Nation communities in New Mexico through a proposed Settlement Contract between the United States, acting through the Secretary of the Interior, and the Navajo Nation (Appendix 4 to the Settlement Agreement); and

WHEREAS, Public Law 87-483 at section 11(a) requires that no new long-term contracts "... shall be entered into for the delivery of water stored in Navajo Reservoir or any other waters of the San Juan River and its tributaries, as aforesaid, until the Secretary has determined by hydrologic investigations that sufficient water to fulfill said contract is reasonably likely to be available for use in the State of New Mexico during the term thereof under the allocations made in articles III and XIV of the Upper Colorado River Basin compact, and has submitted such determination to the Congress of the United States and the Congress has approved such contracts"; and

WHEREAS, pursuant to Public Law 87-483, and in furtherance of the Jicarilla Apache Tribe Water Rights Settlement Act of 1992 and the Navajo Reservoir water supply contract approved by said Act, the Secretary of the Interior on February 2, 1989, approved the report on "Hydrologic Determination, 1988, Water Availability from Navajo Reservoir and the Upper Colorado River Basin for Use in New Mexico" (the "1988 Hydrologic Determination"); and

WHEREAS, the 1988 Hydrologic Determination evaluated the availability of water from the Navajo Reservoir supply for uses in New Mexico through the 2040 planning horizon; and

WHEREAS, an update and extension to the 1988 Hydrologic Determination is needed to evaluate the availability of water from the Navajo Reservoir supply through a 2060 planning horizon under the allocation of water made to the State of New Mexico by the Upper Colorado River Basin Compact for the purpose of furthering Congressional legislative approval of the Settlement Agreement, the authorization of the proposed Navajo-Gallup Water Supply Project, and the legislative approval of the proposed Settlement Contract for the Navajo Nation's project uses in New Mexico; and

WHEREAS, the proposed Settlement Contract between the United States and the Navajo Nation would provide water supplies for Navajo Nation uses in New Mexico under both the Navajo-Gallup Water Supply Project and the Navajo Indian Irrigation Project which was authorized by Public Law 87-483, and would supersede the existing Navajo Reservoir water supply contract for the Navajo Indian Irrigation Project; and

WHEREAS, the US Bureau of Reclamation has presented to the Upper Colorado River Commission for its consideration a draft hydrologic determination, dated May 2006, that evaluates the availability of water from the Navajo Reservoir supply through 2060 and shows: (1) at least 5.76 million acre-feet of water is reasonably available annually for use by the Upper Basin, exclusive of reservoir evaporation at Lake Powell, Flaming Gorge Reservoir and the Aspinall Unit reservoirs of the Colorado River Storage Project; and (2) sufficient water is reasonably likely to be available from the Navajo Reservoir supply to fulfill the proposed Settlement Contract for the Navajo Nation's uses in New Mexico under the Navajo-Gallup Water Supply Project and the Navajo Indian Irrigation Project, in addition to existing Navajo Reservoir water supply contracts for other uses, under the allocations made to New Mexico in Articles III and XIV of the Upper Colorado River Basin Compact; and

WHEREAS, the Settlement Agreement would provide at subparagraph 9.3.1: "The Navajo Nation and the United States agree that the State of New Mexico may administer in priority water rights in the San Juan River Basin in New Mexico, including rights of the Navajo Nation, as may be necessary for New Mexico to comply with its obligations under interstate compacts and other applicable law"; and

WHEREAS, the Upper Colorado River Commission supports water resource development in the Upper Colorado River Basin to enable the Upper Division States to fully develop their compact apportionments of Colorado River water while meeting compact obligations relating to the flow of the Colorado River at Lee Ferry; and

WHEREAS, it is the position of the Upper Colorado River Commission and the Upper Division States that, with the delivery at Lee Ferry of 75 million acre-feet of water in each period of ten consecutive years, the water supply available in the Colorado River

System below Lee Ferry is sufficient to meet the apportionments to the Lower Basin provided for in Articles III (a) and III (b) of the Colorado River Compact; and

WHEREAS, it is the position of the Upper Colorado River Commission and the Upper Division States that the obligation of the Upper Basin under Article III(c) of the Colorado River Compact to deliver water toward the Mexican Treaty obligation does not require the delivery at Lee Ferry of 0.75 million acre-feet of water annually; and

WHEREAS, the Upper Colorado River Commission anticipates that the Upper Division States will take all actions necessary to ensure that all Upper Basin States have access to their respective apportionments as specified in the Upper Colorado River Basin Compact; and

WHEREAS, the Upper Colorado River Commission on June 19, 2003, resolved that: (1) "the States of Colorado, New Mexico, Utah and Wyoming, support and to the extent necessary consent to the diversion of water from the Upper Basin for use in the Lower Basin solely within New Mexico via the proposed Navajo-Gallup Water Supply Project; provided, that any water so diverted by said project to the Lower Basin portion of New Mexico, being a depletion of water at Lee Ferry, shall be a part of the consumptive use apportionment made to the State of New Mexico by Article III (a) of the Upper Colorado River Compact;" and (2) "the Upper Colorado River Commission supports such Congressional action as may be necessary to authorize the Navajo-Gallup Water Supply Project."

NOW, THEREFORE, BE IT RESOLVED by the Upper Colorado River Commission, that the Commission supports Congressional action to: (1) approve the Settlement Agreement; (2) authorize the proposed Navajo-Gallup Water Supply Project; and (3) approve the proposed Settlement Contract for the Navajo Nation's uses in New Mexico from the Navajo Reservoir supply under the Navajo-Gallup Water Supply Project and the Navajo Indian Irrigation Project.

BE IT FURTHER RESOLVED, that while the Upper Colorado River Commission does not endorse all of the study assumptions used by the Bureau of Reclamation in its May 2006 draft hydrologic determination, including an assumption of a 6 percent allowable overall shortage, and specifically disagrees with the modeling assumption of a minimum Upper Basin delivery of 8.25 million acre-feet annually at Lee Ferry, the Commission supports a determination by the Secretary of the Interior that at least 5.76 million acre-feet of water is available annually for use by the Upper Basin, exclusive of reservoir evaporation at Lake Powell, Flaming Gorge Reservoir and the Aspinall Unit reservoirs of the Colorado River Storage Project.

BE IT FURTHER RESOLVED, that the Upper Colorado River Commission supports a determination by the Secretary of the Interior that sufficient water is reasonably likely to be available to fulfill the proposed Settlement Contract for the Navajo Nation's uses in New Mexico from the Navajo Reservoir supply under the Navajo-Gallup Water Supply Project and the Navajo Indian Irrigation Project, in addition to existing Navajo Reservoir water supply contracts for other uses, under the allocations made to New Mexico in Articles III and XIV of the Upper Colorado River Basin Compact.

BE IT FURTHER RESOLVED, that nothing in this Resolution, or resulting from the adoption of this Resolution, shall limit the right or ability of any Upper Basin State to develop the full apportionment made to it under the Colorado River Compact and the Upper Colorado River Basin Compact.

BE IT FURTHER RESOLVED, that a copy of this resolution be transmitted to the Regional Director, Upper Colorado Region, Bureau of Reclamation, Salt Lake City, Utah.

CERTIFICATE

I, Don A. Ostler, Executive Director and Secretary of the Upper Colorado River Commission, do hereby certify that the Upper Colorado River Commission adopted the above Resolution at its regular meeting held in Jackson Hole, Wyoming, on June 5, 2006.

WITNESS my hand this 9th day of June 2006.

Don A. Ostler

DON A. OSTLER
Executive Director and Secretary

ATTACHMENT C

Letter from Jicarilla Apache Tribe to the Bureau of Reclamation

DULCE, NEW MEXICO

THE JICARILLA APACHE T

February 16, 2001

Ms. Carol DeAngelis, Area Manager
Western Colorado Area Office
US Bureau of Reclamation
2764 Compass Drive, Suite 106
Grand Junction CO 81506-8785

RE: Your Letter Dated January 22, 2001 – Water Service Contracts from Navajo Reservoir and the Subject Meeting Held on January 29, 2001.

Dear Ms. DeAngelis:

Thank you for your letter informing the Jicarilla Apache Nation (formerly the Jicarilla Apache Tribe) of the intentions of the Navajo Nation and the City of Gallup regarding their respective requests for contracts for water from the Navajo Reservoir supply for the proposed Navajo-Gallup Water Supply Project (the Project).

As you are aware, the Nation is a cooperating agency in the San Juan River Recovery Implementation Program and has recently signed a cooperating agency agreement for the Navajo Dam Operations Environmental Impact Statement (EIS). In addition, the Nation has provided comments regarding the Supplemental EIS for the Animas-La Plata Project. In each of these processes, the Nation has expressed its desire to support the goals of these federal actions while expressing its concerns about their impacts on the Nation's ability to fully utilize its water rights under the Jicarilla Apache Tribe Water Rights Settlement Act, Pub. L. No. 102-441, 106 Stat. 2237 (1992), as modified by Pub. L. No. 104-261, 110 Stat. 3176 (1996) and Pub. L. No. 105-256, 112 Stat. 1896 (1998) (the Settlement Act).

The Nation has recently exercised its authority to subcontract to third parties in the San Juan basin by negotiating a water lease agreement with Public Service Company of New Mexico for the San Juan Generating Station formerly under contract with the Secretary of Interior. The Nation has also negotiated two additional lease agreements with "minor contractors" in the basin. These actions preserve the opportunity to develop a long term water supply for on-reservation use as determined by the Legislative Council of the Nation. They also demonstrate the

Nation's willingness to work with the agencies, water users and our neighboring tribes with interests in the San Juan basin to accomplish mutually beneficial goals under the water development constraints in the basin.

With regard to this Project, the Nation supports the goal of obtaining a high quality, reliable water supply for the Navajo communities that lack water service. We empathize with the Navajo people because the Jicarilla Apache people have similar unmet basic needs.

Accordingly, the Nation is interested in investigating the potential of subcontracting a portion of its San Juan River basin Settlement Act water rights for use in the area served by the Project. The Nation is also interested in the potential for the Project to serve a water supply need in the southwest portion of the Jicarilla Apache Reservation. We are investigating the feasibility of participating in the Project.

The Nation understands that certain threshold questions must be expeditiously addressed to assure that all parties satisfactorily benefit without delaying the schedule of the Project for Congressional actions. One of those questions is how will our plans to divert and beneficially use our Settlement Act water rights be affected if we are not participants in the Project, and conversely, how will participation in the Project support our water use plans and long-term development goals? In light of the Bureau of Reclamation's trust duty to the Nation, we request your assistance in addressing these questions.

By copy of this letter, the Nation advises the Navajo Nation and the City of Gallup of its position. The Nation intends to engage in substantive discussions with the Navajo Nation, the City of Gallup and Reclamation regarding an appropriate water supply for the project and options for serving a portion of the Jicarilla Apache Reservation through the Project infrastructure.

The point of contact for this issue is Mike Hamman, who is the Water Administrator for the Nation. He can be reached at (505) 753-0163 or by email at mikehamman@msn.com. Your interest and consideration of these matters is appreciated.

Sincerely,

Claudia J. Vigil-Muniz

Claudia Vigil-Muniz, President

Cc: Honorable Kelsey A. Begaye, President
The Navajo Nation
P.O. Box 9000
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Lester K. Taylor, Nordhaus, Haltom, Taylor, Taradash &Bladh, LLP
Susan G. Jordan, Nordhaus, Haltom, Taylor, Taradash &Bladh, LLP
Joe Muniz, Natural Resources
Kurt Sandoval, Water Commission
Mike Hamman, Water Administrator

ATTACHMENT D

Letter from Honorables Kelsey A. Begaye and John Peña to Commissioner of the Bureau of Reclamation

THE NAVAJO NATION

P O Box 9000
Window Rock, Arizona 86515
(520) 871-6000

THE CITY OF GALLUP

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Gallup, New Mexico 87301
(505) 863-1220

HON. KELSEY A. BEGAYE
PRESIDENT

HON. JOHN PEÑA
MAYOR

November 22, 2000

Eluid Martinez, Commissioner
Bureau of Reclamation
U.S. Department of the Interior
1849 C Street, N.W.
Washington, D.C. 20240

Re: Request for Contracts from Navajo Reservoir Water Supply

Dear Commissioner Martinez:

As you are aware, the Navajo Nation and the City of Gallup are collaborating on a joint effort to evaluate the feasibility of, and hopefully construct, a waterline from the San Juan River that would deliver municipal water to Navajo communities in northwest New Mexico and northeast Arizona and to the City of Gallup, New Mexico ("Navajo-Gallup Water Supply Project" or "the Project"). One of the critical elements of the on-going analysis concerns the identification of a water supply for the Project. By this letter we are requesting the Bureau of Reclamation to begin the contract process that would provide a water supply for the Project from Navajo Reservoir in the amount of 36,600 acre-feet for fifty (50) years. Specifically, we are requesting two fifty (50) year contracts, one for the Navajo Nation in the amount of 29,300 acre-feet per year and one for the City of Gallup in the amount of 7,500 acre-feet per year.

The Navajo Nation is currently in negotiations with the State of New Mexico concerning its ultimate water right entitlement in the San Juan River Basin. It is too early to speculate as to the quantities of water that a Navajo settlement might contain; however, both parties have expressed support for a settlement that includes a water supply for the Navajo-Gallup Water Supply Project. Based on the 1988 Hydrologic Determination, as refined by the Year 2000 depletion calculations, the State of New Mexico believes there is sufficient unused water in the apportionments to the Upper Colorado River Basin states that could provide a supply for the Project for at least the next fifty (50) years. The 1988 Hydrologic Determination provides an analysis of water availability through the year 2039. We believe it would be prudent, and acceptable to the Upper Basin states, to extend the 1988 Hydrologic Determination for an additional twenty (20) years. The unused apportionment in the Upper Basin should be sufficient to provide the water necessary for the Project for at least fifty (50) years.

Representatives of the Navajo Nation and the City of Gallup have had preliminary discussions with Reclamation staff concerning the proposed contracts. We believe that contracts can be authorized with various conditions that protect the existing contracts for water supplies from Navajo Reservoir and the endangered species in the San Juan River. For example, the water supply for these contracts could be conditioned upon the unused apportionments being available in the Upper Basin. Should water development occur at a faster pace than predicted in the 1988 Hydrologic Determination, the Navajo Nation and the City of Gallup would have to look elsewhere for a water supply. One possible source might be to lease water from the Jicarilla Apache Tribe.

Similarly, with respect to the protection of endangered fish species, the contract should condition the delivery of water on compliance with the Endangered Species Act and other environmental requirements. We are hopeful that the current efforts to refine the hydrologic modeling will yield additional depletions from the San Juan River for the Project. If additional depletions are not forthcoming, the Project may be forced to work with other water users to develop a depletion schedule that is consistent with the flow recommendations adopted by the San Juan River Recovery Implementation Program. Other water users may be willing to forbear their depletions during the times the water is needed for endangered species. We believe there is sufficient flexibility in the San Juan River system to protect the endangered species while moving forward with much needed water development such as the Navajo-Gallup Water Supply Project.

Mr. Commissioner, we have a limited window of opportunity to accomplish these objectives. The identification of the water supply for the project is the single most time-critical element in the preparation of the draft Environmental Impact Statement for the Project. By copy of this letter to the Western Colorado Area Office, we are evincing our intent to work collaboratively with your staff to achieve the objectives set forth in this letter. We also recognize that it will be necessary to work with the Fish and Wildlife Service to ensure that depletions made pursuant to these contracts are consistent with the flow regimes necessary to protect the endangered fish species.

We understand that you may be in Las Vegas in December for the Colorado River Water Users Association annual meeting. We know that significant demands will be placed on your time; however, we would greatly appreciate the opportunity to have our representatives provide you with a briefing at that time. Please let us know when we could meet with you at your earliest possible convenience to discuss this matter.

Thank you for your anticipated cooperation.

Sincerely,

THE NAVAJO NATION

11-22-00

Kelsey A. Begaye
President

THE CITY OF GALLUP

John Peña
Mayor

xc: Carol DeAngelis
Western Colorado Area Office, Bureau of Reclamation

Philip Mutz
New Mexico Interstate Stream Commission

Joy Nicholopoulos
Ecological Services, Albuquerque Field Office, U.S. Fish and Wildlife Service

ATTACHMENT E

Letter from Rick Gold to Honorables Kelsey A. Begaye and John Peña

United States Department of the Interior

BUREAU OF RECLAMATION
Upper Colorado Regional Office
125 South State Street, Room 6107
Salt Lake City, Utah 84138-1102

IN REPLY REFER TO:

UC-443
WTR-4.00

JUN 13 2001

Kelsey A. Begaye, President
The Navajo Nation
P.O. Box 9000
Window Rock, AZ 86515

John Pena, Mayor
The City of Gallup
P.O. Box 1270
Gallup, NM 87301

Subject: Requests for Contracts from Navajo Reservoir Water Supply

Dear President Begaye and Mayor Pena:

Thank you for your letter of November 22, 2000, to the Commissioner of Reclamation, requesting the subject contracts for the Navajo-Gallup Water Supply Project (Project). The Commissioner responded by letter of December 26, 2000, offering full support of the Project and Reclamation's assistance in the resolution of contract issues.

Prior to pursuing the water supply contracts, which are crucial for project authorization and development, we have identified the following unresolved issues which must be addressed:

1. Hydrologic Determination of water availability
2. Endangered Species Act compliance
3. National Environmental Policy Act (NEPA) compliance for the contracts and Project
4. Colorado River Basin Issues in New Mexico and Arizona
5. Congressional Authorization of the Project
6. Congressional Approval of Long-term Contracts from Navajo Reservoir

To address these issues, Reclamation desires to enter into a Memorandum of Understanding (MOU) with the Nation and City to describe and establish the responsibilities and required commitments for each organization (Reclamation, Nation and City). It may be desirable to include the Jicarilla Apache Nation (Jicarillas) in the MOU, as your Nation's and City's May 16, 2001, response to the Jicarillas, indicates the potential to use their water supplies.

To expedite development of the MOU, with a target completion this fall, each involved organization needs to designate a representative, capable of establishing acceptable organizational responsibilities and commitments. Please relay, by July 1, 2001, the name, telephone number and any other pertinent information of your designated representative to either of the Reclamation contacts given below.

Reclamation understands the urgency and importance of this Project and is committed and willing to assist in its realization. Please contact Carol DeAngelis, Area Manager of the Western Colorado Area Office at (970) 248-0690 or Rege Leach of the Western Colorado Area Office in Durango at (970) 385-6553, concerning this issue.

Sincerely,

Rick L. Gold

Rick L. Gold
Regional Director

Enclosure

cc: (all with enclosures)

Philip Mutz
New Mexico Interstate Stream Commission
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bc: Area Manager, Grand Junction, Colorado(without enclosures)
Attention: WCG-CDeAngelis

Western Colorado Area Office, Durango, Colorado (without enclosures)
Attention: WCD-RLeach

UC-406 (with enclosures)

ATTACHMENT F

Preferred Alternative

PREFERRED ALTERNATIVE

OVERVIEW

This attachment presents details of the preferred alternative, the San Juan River Public Service of New Mexico (SJRPNM) Alternative. The description of the preferred alternative includes the system's configuration and associated considerations and features, including:

- Water supply and demand
- Physical description
- Water quality and treatment
- Land requirements, damages, and rights-of-way (ROW)
- Cultural resource issues
- Environmental mitigation
- Navajo-Gallup Water Supply Project (proposed project) construction, ownership, and operation, maintenance, and replacement (OM&R) costs
- Economic analysis
- Financial analysis

Figure F-1 is a map of the proposed project area showing project area landmarks and the SJRPNM Alternative facilities. The SJRPNM Alternative would divert water from the San Juan River downstream of Fruitland, New Mexico, just above the existing Public Service Company of New Mexico (PNM) diversion structure, treat the water, and then deliver it along Highway N36 and south to Navajo chapters along U.S. Highway 491 (shown in figure F-2). Water delivery would continue to the Navajo Nation Capital at Window Rock, Arizona, and to the city of Gallup, New Mexico. Another diversion

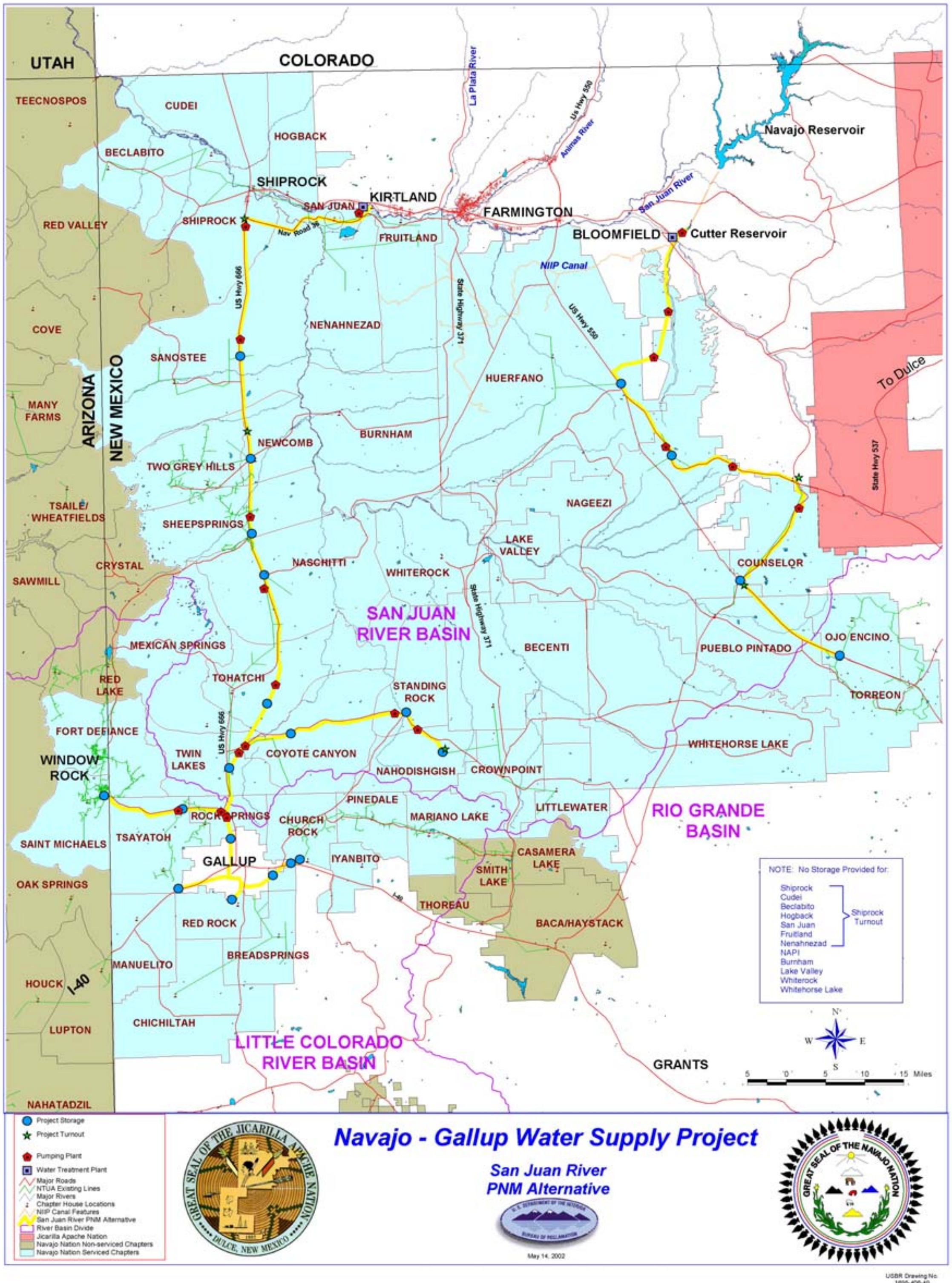

Figure F-1.—SJRPNM Alternative (preferred alternative).

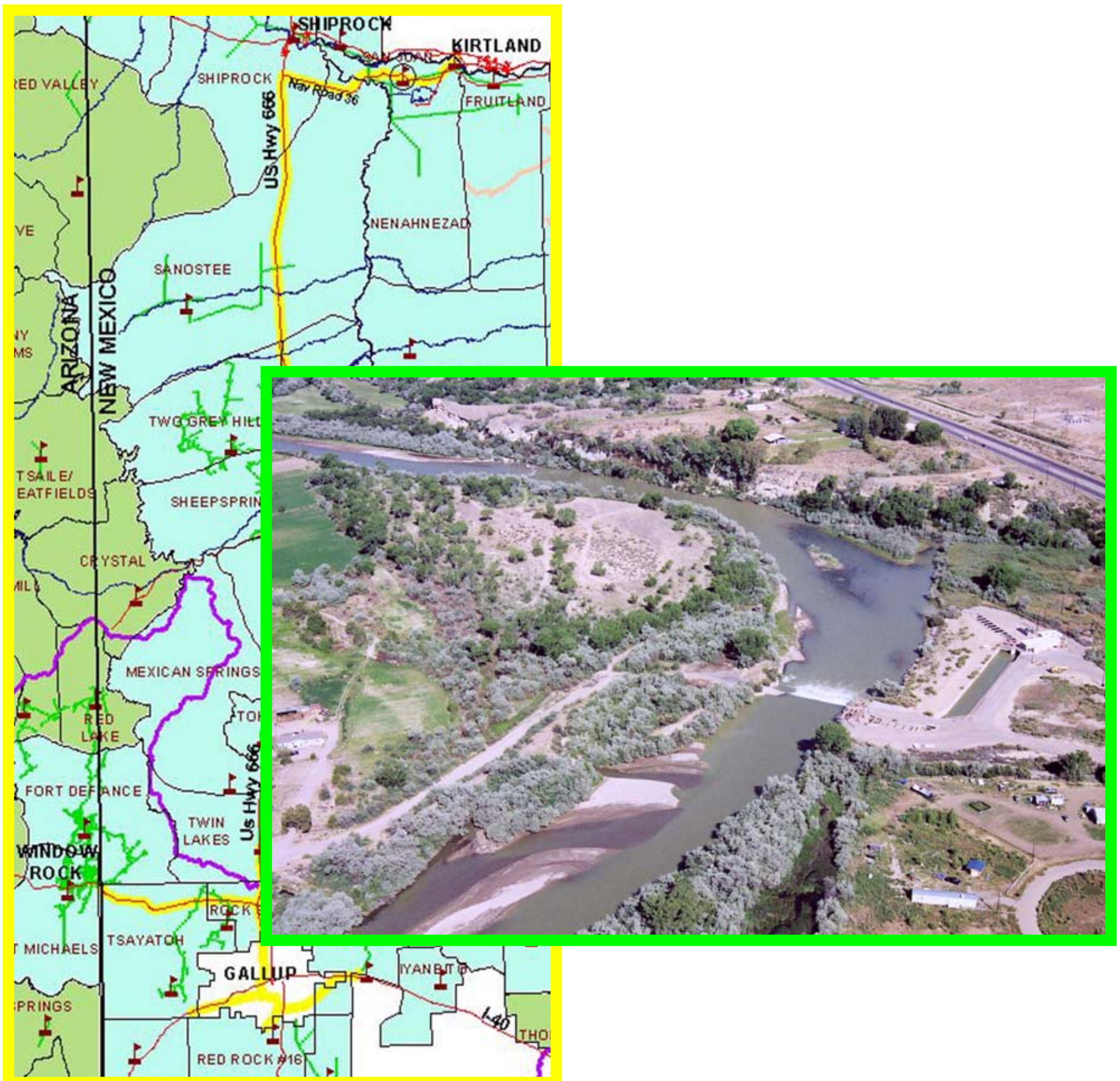

Figure F-2.—PNM Diversion Dam (project diversion point along the San Juan River).

would occur from Cutter Reservoir (figure F-3), an existing regulating reservoir on the Navajo Indian Irrigation Project (NIIP), conveying water to the eastern portion of the Navajo and the Jicarilla Apache Nations. The water would be provided to Window Rock, Arizona, and Crownpoint, New Mexico, through sublaterals. While basic design components were described in chapter IV, other components specific to the preferred alternative are described in this attachment.

TOTAL PROJECT WATER SUPPLY AND DEMAND

The proposed project is designed to divert a total of 37,764 acre-feet per year (AFY) from the San Juan River with a resulting depletion of 35,893 acre-feet to the San Juan River Basin, based on 2040 projected population with a demand rate of 160 gallons per capita per day (gpcd). The Cutter diversion would require 4,645 AFY with no return flow to the San Juan River. The PNM diversion would take the remaining 33,119 AFY of diversion, with an average return flow of 1,871 AFY. (The planned diversion and depletion by location is shown in table F-1).

It is assumed that the only return flow from the proposed project to the San Juan River would enter the river at the Shiprock waste water treatment plant. There may be some water delivery to users with individual septic systems in the Shiprock area, but the delivery is expected to be a small percentage of the total. All other deliveries would have similar losses, but the resulting return flow would be lost to evaporation or to recharging local groundwater aquifers. For water balance purposes, no return flow to the San Juan River from these other locations is expected or accounted for. Return flow to the Rio Grande or Little Colorado Rivers is highly unlikely, even though there would be discharge to the groundwater in these areas. Local groundwater storage space, together with local pumping, would limit the potential for surface discharge. Even if surface discharge does occur, the distance to the Rio Grande or Little Colorado Rivers is so great that it is unlikely that return flows would reach these rivers.

Deliveries typically vary depending on changes in demand, and the largest demand is in the summer months. The Shiprock water delivery pattern for March 1992 through February 1993, shown in table F-2, was used to determine average monthly deliveries, and return flows were assumed to follow the same distribution. The system would be designed to handle a 7-day peak demand for pumping plants and pipelines and is computed as 1.3 times the peak average monthly demand. Daily and diurnal demand peaking would be handled by the proposed project storage tanks.

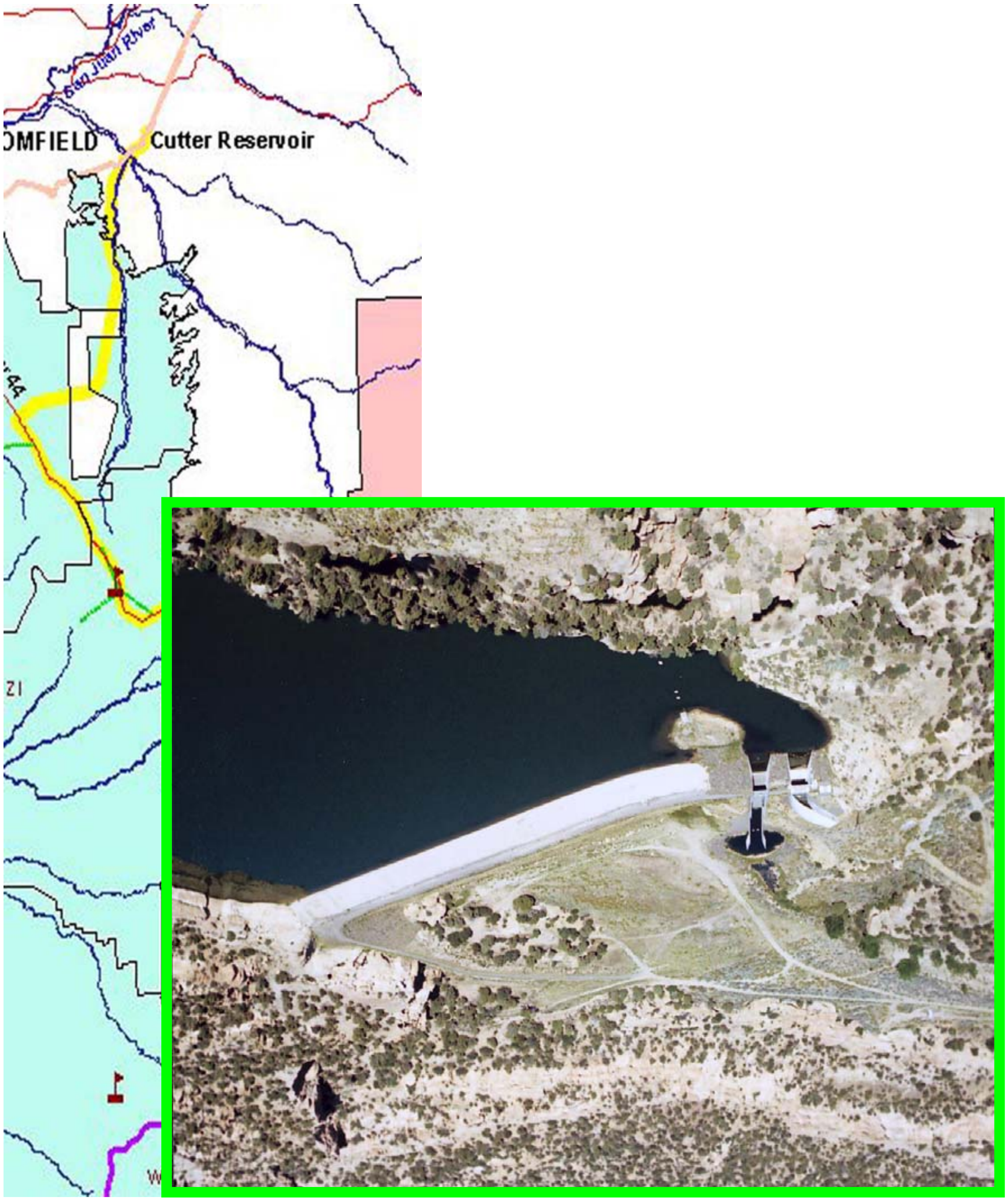

Figure F-3.—Cutter Dam and Reservoir.

Table F-1.—Project forecast 2040 demand and design capacity by service area

Location	SJR diversion (AFY)	SJR depletion (AFY)
City of Gallup, New Mexico	7,500	7,500
Jicarilla Apache Nation	1,200	1,200
Navajo Nation, New Mexico		
Central area	834	834
Crownpoint	2,473	2,473
Gallup area	4,316	4,316
Huerfano	864	864
Rock Springs	2,118	2,118
Route 491	5,366	5,366
Torreon	2,240	2,240
San Juan River	3,742	1,871
Navajo Agricultural Products Industry industrial uses	700	700
Navajo Nation, Arizona (Window Rock area)	6,411	6,411
Total Navajo Nation	29,064	27,193
Project total	37,764	35,893

Table F-2.—Monthly demand pattern for all deliveries

Month	Percent demand	Month	Percent demand
January	7	July	10
February	6	August	10
March	9	September	10
April	7	October	8
May	9	November	7
June	10	December	7

Navajo Nation

The proposed projected project water need for the Navajo Nation is a total diversion of 29,064 AFY. Of this, 6,411 AFY is for use in the Window Rock area of Arizona and 22,653 AFY is for use in the eastern portion of the reservation in New Mexico. The 22,653 AFY water would be from Navajo Reservoir (3,445 AFY) through the Cutter diversion and from the San Juan River at the existing PNM diversion dam (19,208 AFY).

Water for the proposed project's New Mexico part of the Navajo Nation (22,653 AFY) would be supplied from New Mexico State Engineer File Nos. 2849 and 3215 held by the Secretary of the Interior (Secretary). This would be administered through a long-term water supply contract between the Bureau of Reclamation (Reclamation) and the Navajo Nation.

Consumptive uses by the Navajo Nation under the proposed project within Arizona in and near Window Rock must be supplied from the apportionments or allocations of water made to the State of Arizona by compact or decree. The Colorado River System Consumptive Uses and Losses Report, 1996–2000 (Reclamation, February 2004), estimates that current consumptive uses within the Upper Basin in Arizona amount to about 38,100 AFY. Thus, there appears to be adequate unused apportionment within the 50,000 AFY of Upper Basin consumptive use apportioned to the State of Arizona by article III(a) of the Upper Colorado River Basin Compact to source the Arizona portion of the proposed project. Use of Arizona's Upper Basin apportionment in the Lower Basin in Arizona for the Navajo Nation's project uses in the Window Rock area would be consistent with the provisions of section 303(d) of the Colorado River Basin Project Act and the June 2003 Resolution of the Upper Colorado River Commission consenting to New Mexico's use of its Upper Basin apportionment in the Lower Basin in New Mexico for project uses in Gallup and surrounding areas. The Arizona Water Settlements Act (S 437 – 108th Congress, January 20, 2004, §104, Allocation of the Central Arizona Project) provides that the Secretary is to retain 6,411 acre-feet of water from the Central Arizona Project for a future water rights settlement agreement. The State of Arizona and the Navajo Nation are in the process of determining which State water would be identified and accounted for to supply project demands. A diversion permit from the State of New Mexico would be required to divert water in New Mexico. Permits and/or contracts for using the Arizona water would be required and would be dependent on which water is used to supply the proposed project demand.

Jicarilla Apache Nation

The projected project water need for the Jicarilla Apache Nation is a total diversion of 1,200 AFY. All of this water would come from Navajo Reservoir to be supplied from New Mexico State Engineer File No. 2849. This is part of the water obtained by the

Jicarilla Apache Nation through the Jicarilla Apache Nation Apache Tribe Water Right Settlement Act, Public Law 102-441, October 23, 1992. This water would be made available through the existing Settlement Contract between the Jicarilla Apache Nation and the United States.

City of Gallup, New Mexico

The city of Gallup holds no water rights in the San Juan River and would be obtaining a long-term water supply contract for 7,500 AFY of water. The city has requested a water supply contract from Reclamation. As part of water right settlement and trust responsibilities, Reclamation asked the Jicarilla Apache Nation if it would be interested in providing this need with water it holds from its water rights settlement agreement. The Jicarilla Apache Nation was interested and is in the process of discussing terms and conditions of a long-term water contract with the city of Gallup (see attachment C). A long-term water supply subcontract between the city of Gallup and the Jicarilla Apache and/or the Navajo Nation and approved by the United States would consummate this arrangement.

Physical Description

The river intake would divert 33,118 AFY of water from the San Juan River from the water pool created by the existing PNM diversion dam. Water entering the intake would pass through a self-cleaning screen and would enter a sump where low-head pumps would lift the water into settling ponds for removal of suspended sediment. From the settling ponds, the water would enter a water treatment plant to be treated to meet safe drinking water standards. The treatment plant and pumping plant would occupy approximately 18 acres of land on the north side of the river just upstream of the existing PNM diversion dam.

The treated water would be pumped into the San Juan Lateral, a buried pipeline that crosses the San Juan River and ascends a mesa south of the river. Seven relift pumping stations would be constructed along the San Juan Lateral to keep the water flowing in the pipeline. The pipeline would extend south to Ya-ta-hey, New Mexico, and would connect to spur pipelines extending to Window Rock, Arizona, Gallup, New Mexico, and Crown Point , New Mexico. Navajo communities that have an existing water distribution system would have a storage tank and a method to increase (by means of a pumping plant) the pressure for proper distribution. In the city of Gallup, one new pumping plant would be constructed, three pumping plants upgraded, five new storage tanks constructed, and 32 miles of pipeline upgraded. The upgraded Gallup Regional System would be connected to five Navajo Nation water distribution systems on the outskirts of the city.

The Cutter Lateral would be constructed to carry water from Cutter Reservoir (an existing feature of the NIIP) to the eastern portion of the Navajo and Jicarilla Apache Nations. A water treatment plant would be constructed at the base of Cutter Reservoir to deliver treated water to the relift pumps and pipeline that make up Cutter Lateral. Existing Navajo Nation water distribution systems would be connected to the pipeline and a tee with a blind flange would be provided for a future connection by the Jicarilla Apache Nation. Primary project features and their purposes are shown in table F-3.

Table F-3.—Primary project features and their purposes

Component	Purpose	Total project number
River intakes	Draw water from the San Juan River	1
River pump plants	Pump San Juan River water to treatment plant	1
Treatment plants	Treat water from San Juan River and NIIP	2
Forebay tanks	Provides water for operation of relift pumping plants	19
Pumping plants	Forces water through pipelines	24
Regulating tanks	Moderates fluctuations in system pressures	5
Community storage tanks	Provides for fluctuations in the water users' demands	25
Pipelines	Transmission of treated water to point of distribution	266.4 miles

A typical relift pumping plant has a forebay tank, pumps and motors within an enclosed building, an air chamber, and re-chlorination equipment. The forebay tank provides an adequate supply of water to minimize the number of times the pumps cycle on and off. The air chamber provides protection of the pumping plant and pipeline when the pumps are started and stopped. Re-chlorination equipment provides the required chlorine residual in the treated water. The turnout pumping plants have the same components as the relift pumping plants except that a storage tank replaces the forebay tank. Figure F-4 shows a schematic of the proposed project's order of operation.

San Juan Lateral Water Treatment and Pumping Plant

The San Juan Lateral water treatment and pumping plant would include seven ultrafiltration units, seven ultraviolet (UV) disinfection units, a 797,000-gallon water tank, two waste water ponds, two sediment drying beds, mixing and flocculation tanks, chemical storage buildings, an operation and maintenance (O&M) building, a four-unit

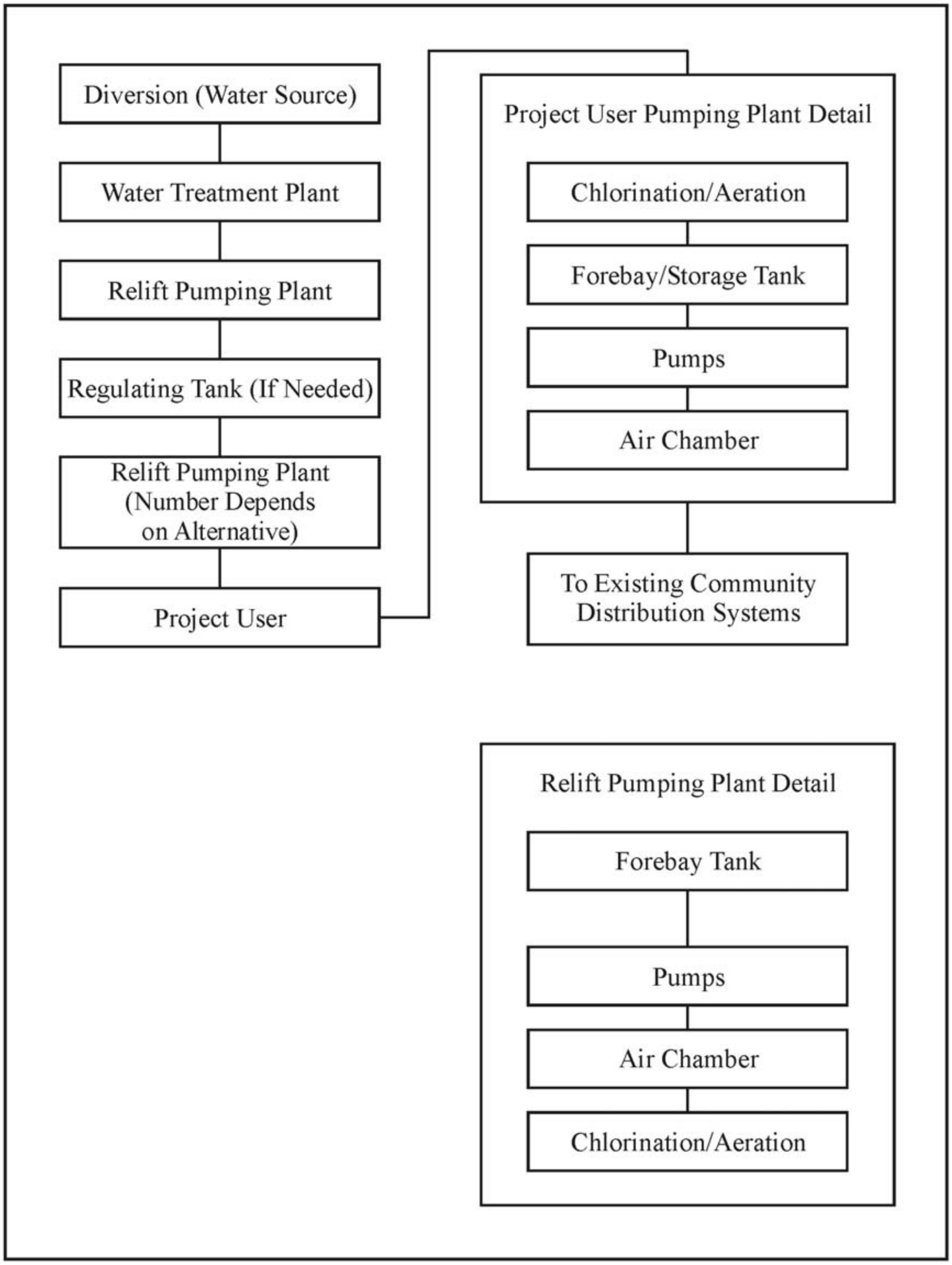

Figure F-4.—Typical schematic for the proposed project.

pumping station, and electrical control equipment. The capacity of the treatment plant would be approximately 38.25 million gallons per day (MGD) of water (59.19 cubic feet per second [cfs]).

The San Juan Lateral pumping plant would pump treated water into approximately 145 miles of buried 12- to 48-inch-diameter pipeline. From the pumping plant, the pipeline would cross the San Juan River upstream of the treatment plant and PNM diversion dam and ascend a mesa south of the river. From the mesa, the pipeline would extend west along the ROW of Navajo Highway 64 to U.S. 491. At U.S. 491, the pipeline would extend south along the highway ROW to Ya-ta-hey, New Mexico. At Ya-ta-hey, the pipeline would connect to spur waterlines extending to Window Rock and the city of Gallup. In the city of Gallup, one new pumping plant would be constructed, and three existing pumping plants, five storage tanks, and 32 miles of pipeline would be upgraded.

Seven booster pumping stations would be constructed along the San Juan Lateral. Each booster pumping station would occupy approximately 1 acre of land and would consist of a water tank, pumping plant, air chamber, chlorination building, and an electrical control structure. The San Juan Lateral would also include the construction of 17 water storage tanks, 3 water regulating tanks, junctions to the existing water supply systems, and a turnout to the NIIP and Navajo Nation chapters that do not have existing water supply systems.

The San Juan Lateral would serve the Shiprock, Burnham, Sanostee, Two Grey Hills, Newcomb, Sheep Springs, Naschitti, Tohatchi, Twin Lakes, and Mexican Springs Chapters. The Crown Point Lateral, which follows Navajo Route 9, would serve the Coyote Canyon, Standing Rock, Nahodishgish, Crown Point, Little Water, Becenti, Lake Valley, and White Rock Chapters. The Window Rock Lateral following Navajo Route 3 would serve the Rock Springs, Tsayatoh, St. Michaels, and Fort Defiance Chapters. The Gallup Junction Lateral would serve the city of Gallup, the Red Rock, Bread Springs, Chichillah, Manuelito, Church Rock, Iyanbito, Pinedale, and Mariano Lake Chapters. The proposed project would also include the construction of a new overhead electrical transmission line that parallels the San Juan Lateral pipeline and would provide power to the booster pumping stations.

The SJRPNM Alternative would also include construction of the Cutter Lateral pipeline. The Cutter Lateral would serve Huerfano, Nageezi, Counselor, Pueblo Pintado, Ojo Encino, Toreon, and the Whitehorse Chapters in the eastern portion of the proposed project area in New Mexico, and the Jicarilla Apache Nation. The Cutter Lateral would originate at Cutter Reservoir and provide up to 4,645 AFY of water to the eastern service area. This lateral would include a water treatment and pumping plant that occupies approximately 3 to 4 acres of land. The Cutter Lateral water treatment and pumping plant would be smaller than the San Juan Lateral plant, but would contain much of the same equipment. The plant would include three ultrafiltration units, three UV disinfection units, a 112,000-gallon subsurface pumping plant forebay, two waste water ponds, mixing and flocculation tanks, chemical storage buildings, an O&M building, a four-unit pumping station, and electrical control equipment. The capacity of the Cutter Lateral treatment plant would be approximately 5.39 MGD (8.34 cfs).

The Cutter Lateral pumping plant would pump treated water into approximately 89 miles of buried 10- to 24-inch-diameter pipeline. The Cutter Lateral would include the construction of five 1-acre booster pumping stations, three community water storage tanks, and two water regulating tanks. Similar to that of the San Juan Lateral, an overhead electrical transmission line would be constructed along the Cutter Lateral to power the booster pumping stations. A substation would also be constructed to provide power from an existing PNM transmission line to the newly constructed transmission line.

Cutter Dam and Reservoir

The Cutter Lateral would serve communities in the eastern portion of the Navajo and Jicarilla Apache Nations by delivering water from Cutter Reservoir via the outlet works (see figure F-3). Water in Cutter Reservoir comes from Navajo Reservoir through an existing intake structure and a series of tunnels and siphons that would be operated throughout the year under the proposed project. The Cutter water treatment plant would deliver treated water to a pumping plant, which would then pump the water into Cutter Lateral for transmission to the various communities.

Service to Municipal Subareas

The 2040 population of the Navajo communities (1990 population with 2.48 percent annual growth rate) was used with an average daily water demand of 160 gpcd to determine the average daily demand. Surface diversion required for the proposed project was the average demand minus the available groundwater sources in each of the subareas. Supporting information can be found in volume II, appendix A. Peak daily demand was computed by multiplying the surface diversion for the proposed project by a 1.3 peaking factor. The peaking factor was derived from a 7-day average in mid-July. Navajo Nation communities that have an existing water distribution system would have a storage tank and a method to increase (by means of a turnout pumping plant) the pressure for proper distribution. Delivery locations in the transmission line that do not have an existing water distribution system would be provided with a tee and a blind flange for future use. The proposed project would connect to approximately 31 existing Navajo Nation municipal systems and would provide a pressure of 70 pounds per square inch at those locations. The storage capacity for each of the municipal systems was based on the individual service area 5-day demand for the year 2020 for those communities with existing water distribution systems.

The city of Gallup and Jicarilla Apache Nation surface diversion requirements are 7,500 and 1,200 AFY, respectively, for all years in the proposed project. An independent analysis (volume II, appendix B) conducted by the city of Gallup identifies the system requirements for the city and the surrounding Navajo communities served by the Gallup Regional System. No storage is provided for the Jicarilla Apache Nation.

WATER TREATMENT CONSIDERATIONS

Water Quality

Water from the Navajo Indian Irrigation Project

The water source for the Cutter Reservoir diversion is Navajo Reservoir. The water quality parameters, shown in table F-4, indicate that the only treatment requirements are filtration and disinfection as required under the Surface Water Treatment Rule (SWTR), which is part of the Safe Drinking Water Act (SDWA). Further sampling and analysis would be required before final design and construction to verify that the data presented in table F-4 are correct, especially during low- and high-precipitation years.

Table F-4.—Water quality (NIIP source water)

Parameter	Average[1]	Design range	Secondary MCL[2]
Electrical conductivity (umhos/cm)	195	205-187	
pH	7.72	7.75 – 7.71	
Temperature (°F)	46.7	49.1 – 45.3	
Turbidity (NTU)	2.6	3.16 – 1.47	
Total suspended solids (mg/L)	1.15	1.3 – 1	
Total dissolved solids (mg/L)	154	181 – 140	500
Sulfates, SO_4 (mg/L)	32.5	38.2 – 2.29	250
Total organic carbon (mg/L)	4.47	8 – 2.29	
Chlorides (mg/L)	1.6	1.9 – 1.2	250

[1] Data from three samples collected from the Cutter diversion April 2000 to June 2000.
[2] Secondary standards or maximum contaminant levels are established by the Environmental Protection Agency for control of aesthetic qualities relating to public acceptance and includes contaminants that may affect taste, color, odor, and appearance.

San Juan River Diversion

The San Juan River, upstream of the PNM diversion, would provide water to the SJRPNM water treatment plant. Table F-5 provides water quality parameters. As shown, the water quality meets all primary standards established by the Environmental Protection Agency (EPA) for the parameters shown, resulting in the need for filtration and disinfection to meet the requirements of the SWTR. Several samples exceeded the total dissolved solids (TDS) and sulfates secondary standards. Sulfates and TDS are constituents that cannot be substantially reduced by the proposed ultrafiltration system. Further investigation is required to confirm the reduction of water quality due to the increase of TDS and sulfates associated with storm water runoff flows at the SJRPNM diversion points. Since this water cannot be treated by the proposed system, the following operation scenarios are suggested during major runoff events:

Table F-5.—Water quality (San Juan alternatives)

	PNM historic[1]		Design[2]	
Parameters	Average	Range	Range	Secondary MCL[3]
EC (umhos/cm)	538	1,102 – 276	632 – 214	
pH	8.1	8.7 – 7.7	8.7 – 7.6.	
Temperature (^{o}F)	53	71 – 32.2	75 – 33	
Turbidity (NTU)	166	1055 – 8	200 – 5.4[4]	
TSS (mg/L)	876.6	1080 – 21	262 – 21	
TDS (mg/L)	362	772 – 145	1000 – 24	500[5]
SO_4 (mg/L)	140	322 – 65	200 – 38	250
TOC (mg/L)	5.7	10.5 – 2.9	4.76 – 2.89	
Chloride (mg/L)	14	23 – 6	26.6 – 2.91	250
T. hardness (mg/L)	163	232 – 84	232 – 84	

[1] Data for PNM is based on 34 samples collected at the diversion point between February 2003 through July 1, 2005.
[2] Design value for TSS incorporates the reduction of turbidity and suspended solids by the pre-treatment settling pond.
[3] Secondary standards or MCLs are established by EPA for control of aesthetic qualities relating to public acceptance and includes contaminants that may affect taste, color, odor, and appearance.
[4] All source water with a turbidity of over 200 NTU will need to be pre-treated by diversion through the settling ponds.
[5] State of New Mexico secondary MCL for TDS is 1,000 mg/L.

Water hauling is necessary for a quality water supply in parts of the Navajo Nation.

- Significant dilution may be provided in the SJRPNM settling ponds to reduce TDS and sulfate concentrations to below maximum contaminant level (MCL) limits.

- Storage capacity in the settling ponds, waste water polishing ponds, and treated water distribution system may be adequate to temporarily stop diverting water from the San Juan River to the treatment plant during large storm events. Once the concentrations of TDS at the diversion intakes are below 500 parts per million (ppm) TDS and 250 ppm sulfate, diversion of San Juan River water can resume.

Water Treatment

The water source for the SJRPNM Alternative is surface water from the NIIP and the San Juan River. The treatment systems used to provide drinking water to the consumers must comply with the SWTR.[1] The filtration and disinfection requirements under this rule protect consumers against the potential adverse effects of exposure to Giardia lamblia, Cryptosporidium, viruses, Legionella, and heterotrophic bacteria by requiring the inactivation of 99.9 percent (3 log) for Giardia cysts and 99.99 percent (4 log) for viruses.

The inactivation of potential pathogens, as required by the SWTR, is accomplished by the use of EPA-approved technologies for filtration and disinfection methods. Newly adopted regulations to address the risk of disinfection byproducts (DBPs) include the Disinfectants - Disinfection Byproducts Rule and the Interim Enhanced Surface Water Treatment Rule, which requires continual monitoring of filtered water turbidity and routine DBP levels in the distribution system.

The relative high concentrations of total organic carbons (TOC) in samples from the NIIP and San Juan River water sources, as shown in tables F-4 and F-5, in combination with the long detention times required to convey the treated water to some of the delivery points, indicate a potential for the production of DBPs that may exceed current and future regulatory limits at the treated water service points or within the domestic water storage and distributions systems used to distribute the water to consumers. In order to determine the expected reduction in TOC concentrations by the proposed treatment system and the potential of DBPs production over time, bench scale distribution simulation studies using chloramine and free chlorine disinfection should be done. If bench scale analysis indicates that the DBP limits are exceeded, additional treatment systems to remove the DBPs before consumption may be required in some locations.

Description of the Proposed Water Treatment System

The proposed treatment system consists of enhanced coagulation, ultrafiltration, and ultraviolet disinfection to provide multiple treatment barriers for removal of organic molecules, Giardia, Cryptosporidium, and viruses. The use of chloramines to provide a disinfection residual during the conveyance of treated water from the treatment plant to the service areas will not only provide treated water that is not conducive to the formation of disinfection byproducts, but will also provide an additional disinfection barrier. Figure F-5 illustrates the proposal. Before final design and construction, a

[1] The SWTR was published in the *Federal Register* on June 29, 1989, and is promulgated by the EPA as a National Primary Drinking Water Regulation for public water systems using surface water sources or groundwater under the direct influence of surface water.

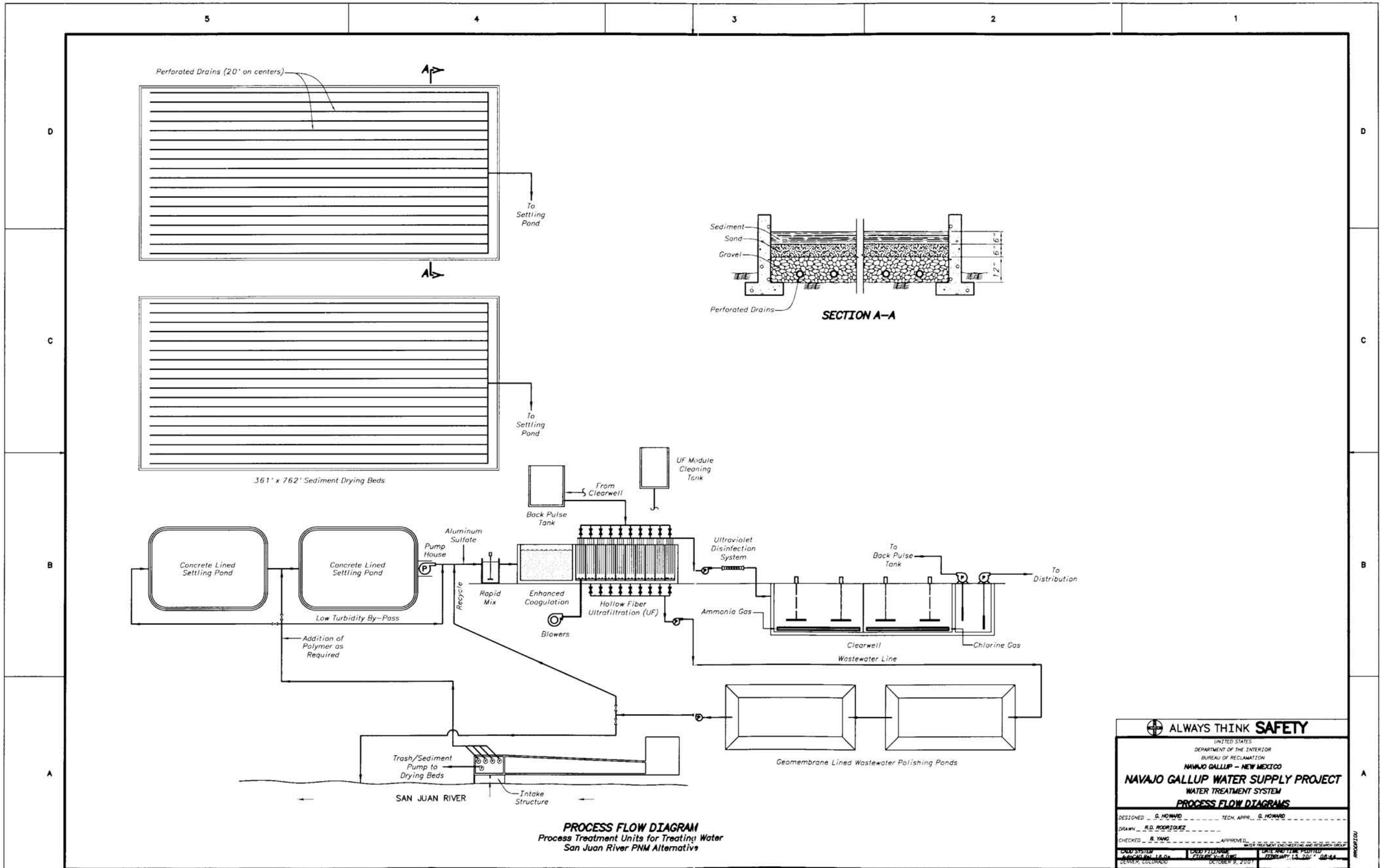
Perforated Drains (20' on centers)
To Settling Pond
To Settling Pond
361' x 762' Sediment Drying Beds
Sediment
Sand
Gravel
Perforated Drains
6"
6"
12"
SECTION A–A
Concrete Lined Settling Pond
Concrete Lined Settling Pond
Pump House
Aluminum Sulfate
Recycle
Rapid Mix
Enhanced Coagulation
Blowers
Back Pulse Tank
From Clearwell
UF Module Cleaning Tank
Hollow Fiber Ultrafiltration (UF)
Ultraviolet Disinfection System
Ammonia Gas
To Back Pulse Tank
To Distribution
Clearwell
Chlorine Gas
Wastewater Line
Low Turbidity By–Pass
Addition of Polymer as Required
Geomembrane Lined Wastewater Polishing Ponds
Trash/Sediment Pump to Drying Beds
SAN JUAN RIVER
Intake Structure
PROCESS FLOW DIAGRAM
Process Treatment Units for Treating Water
San Juan River PNM Alternative
ALWAYS THINK SAFETY
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
NAVAJO GALLUP – NEW MEXICO
NAVAJO GALLUP WATER SUPPLY PROJECT
WATER TREATMENT SYSTEM
PROCESS FLOW DIAGRAMS
DESIGNED G. HOWARD
TECH. APPR. G. HOWARD
DRAWN R.D. RODRIGUEZ
CHECKED B. YANG
APPROVED
DENVER, COLORADO
OCTOBER 9, 2001

Figure F-5

comprehensive pilot scale operation of each process will be required to verify the effectiveness and operation of each unit process and resultant water quality.

Water Treatment Plants.—The proposed water treatment plants primarily include buildings that would house most of the water treatment features already described. Figure F-5 displays the water treatment plant structures (all plant structures, except intakes, must be located above the 100-year flood plain).

Main Treatment Building – The main treatment building would be approximately 24,500 square feet with a second floor mezzanine that would be approximately 22 feet wide and 122 feet long. The proposed building would be a pre-engineered, pre-fabricated structure with metal siding and suitable insulation and ventilation to meet the building code requirements of the State of New Mexico and all other applicable code requirements. The building would house the 10-foot-tall flocculation basins, 10-foot-tall concrete tanks containing the ultrafiltration modules for each train, UV units, vacuum pumps, and internal piping. The second floor mezzanine would contain the control room for the filters and UV units, air blowers used for module cleaning, and the motor control center. The chlorine storage room and ammonia storage room would be included in the main building, but would have outside entrances and separate heating, ventilation, and air conditioning (HVAC) systems to eliminate the risk to the operators if leakage occurred in any of the cylinders. The building is designed to house the treatment system required to meet 2040 demands.

The chlorine and ammonia storage room would house the 1-ton containers of each gas along with the chlorinators and ammoniators, which would meter the gases into the clearwell for mixing. Trunnions are provided in the storage room to provide for the storage of full containers to meet a 2-month demand along with spare trunnions for storage of an equal amount of empty or full containers.

NIIP Cutter Diversion Treatment Plant – The Cutter diversion water treatment plant is a scaled-down version of the main treatment plant, with a building area of approximately 4,600 square feet. Like the larger plant, the flocculation basins would be located inside the building to protect the water from windblown sand and freezing temperatures. Due to its reduced size, all treatment components for the Cutter treatment plant would be located on a single floor.

Regional O&M Buildings – The preferred alternative (SJRPNM) includes a 2,500-square-foot regional O&M building located within the treatment plant compound. Buildings would be on a slab on grade with 15 feet eave heights. The facility would be used for spare equipment/parts storage and for maintenance areas relating to the treatment, conveyance, and pumping of water for this project.

Clear Well – The below-grade clear well would provide a detention time of 30 minutes and would include injection manifolds, baffles, and mixers to properly mix ammonia and chlorine with treated water. After chloramination, the treated water would be pumped by the service pumping station into the distribution system.

Waste Water Storage/Treatment Ponds – Water generated during the routine cleaning of the filters would flow into one of two passive treatment ponds. In these ponds, fine suspended solids filtered by the hollow fiber system would be settled out and removed from the site. After passive treatment, the water could be conveyed back into the treatment plant, discharged back into the source, or discharged to surface waters. The useful life of a pond is estimated to be between 10 to 15 years before settled sediment will need to be removed and conveyed to the sediment drying beds. Each pond would be lined with a 45 mil-thick geomembrane system to reduce the impact on regional groundwater.

Sediment Drying Beds – With the construction of a new diversion upstream of the existing PNM diversion dam, all sediment removed by the intake structure and settling ponds would have to be retained and ultimately disposed of off-site. The determination of the frequency of pond cleaning, volume of sediment, volume of dried sediment, size of required sediment drying beds, and resulting O&M costs in this report was based on one water quality sample taken during one storm event. This event occurred on August 23, 2000, and analyses indicated a turbidity reading over 23,000 Nestler Turbidity Units (NTU) units and a suspended solids loading of over 15,000 milligrams per liter (mg/L). The drying bed size and costs should be taken as preliminary as additional sampling and analysis would be required prior to design and construction. Using this data point, the lead pond would need to be dredged of sediment after every 10 days of storm runoff, and two sediment drying beds with a surface area of approximately 6 acres each would be required. When the sediment in the 10-foot-deep lead pond became 2 feet deep, approximately 130,000 cubic feet of sediment would need to be removed and placed on one of the drying beds. The excavated sediment would be applied at an approximate depth of 6 inches on the surface of each bed.[2] The system would remove water from the sediment by drainage and evaporation, reducing the water content by approximately 50 percent with a dried sediment depth of 2.5 to 3 inches. Once dried, the sludge would be removed from the top of each bed and transported to a nearby abandoned open pit coal mine for final disposal. O&M costs associated with excavation and transport of sediment collected from the settling ponds are based on two cleaning cycles per year.

Sediment Removal Ponds – The settling basins considered in this alternative are required to reduce turbidity of the San Juan River water before treatment. Most of the sediment contained in the source water would be removed by the intake and the proposed

[2] Beds consist of perforated polyvinyl chloride pipes located in a gravel under-drain system. Sand would lie on top of the gravel.

settling ponds. Each pond is designed with a 3-hour detention time providing optimum conditions for the reduction of turbidity to acceptable limits before treatment by the enhanced coagulation and ultrafiltration systems. Settling tests using San Juan River water (collected during a high turbidity of 4,266 NTU have verified that a two-pond system with each pond to provide a detention time of 3 hours would be sufficient to reduce turbidity to acceptable limits before treatment. The settling basins would have minimal effects on the quality of the water, with the exception of some dilution of high TDS and sulfate concentrations occurring during high runoff conditions. To reduce the impact of the ponds on regional groundwater through infiltration, and to avoid the need to replace the liner after each sediment removal event, each pond would be lined with 6 inches of reinforced concrete. The settling pond(s), sized to meet the hydraulic requirements for the demand year 2040, are based on a 6-hour detention time and have the following specifications:

- Influent flow rate of 38.25 MGD
- A required volume of 9,653,000 gallons in settling pond(s)
- A surface area of 1.72 acres with a 10-foot depth and 1:1 side slopes

Source water from the NIIP would not require settling basins since the water has already passed through a large surface impoundment that acts like a settling basin.

Enhanced Coagulation – In waters that have variable annual turbidity or moderate-to-high TOC concentrations, ultrafiltration systems typically include an enhanced coagulation step prior to filtration to coagulate small suspended materials in the water and increase the filtration efficiency. This process increases the removal of organic matter before disinfection to meet the requirements of the Stage 1 and Stage 2 DPB Rule. This pre-treatment process uses aluminum sulfate or other coagulants in such a manner that the type and dosage can only be determined by laboratory and field tests (assuming aluminum sulfate would be the coagulant of choice and the required concentration would be 30 mg/L).

Hollow Fiber Ultrafiltration Treatment System – Previous studies have evaluated the potential for using conventional, diatomaceous earth and microfiltration/ultrafiltration for the treatment of surface waters associated with this project. A discussion of these studies is included in volume II, appendix A, section 8.5. Based on this analysis, ultrafiltration using hollow fiber membranes along with enhanced coagulation is the proposed method for filtration due to the system's ability to treat water with varying turbidity, ability to meet current and future regulatory standards, and the ease to operate and maintain.

The hollow fiber ultrafiltration treatment system physically removes suspended particles greater than 0.1 micron in diameter by having a nominal and absolute pore size of 0.035 and 0.1 micron, respectively. Particles found in surface water that exceed this size range are easily filtered. These particles include Giardia (5–15 microns in size), Cryptosporidium (4–6 microns in size), large viruses, and large organic molecules. The continuous hollow fiber ultrafiltration system manufactured by US Filter (CMF-S) or Zenon (ZeeWeed) are bundles or cassettes of tubular membranes that filter water through microscopic holes. Designed for large-scale systems, the pre-engineered cassettes are submerged into open top concrete or steel tanks.

Ultraviolet Disinfection Units – Disinfection after ultrafiltration would be accomplished by state-of-the-art flow-through UV disinfection units that are located on the filtered water discharge line from each ultrafiltration treatment train. Each unit would consist of a stainless steel chamber containing eight UV lamps, an automatic cleaning system, a UV monitoring system, and a control cabinet. Each unit would provide a minimum UV dose of 40 microjewels per square centimeter to the filtered water before being routed to the clear well.

The proposed UV units would add an additional 3 log (99.9 percent) reduction of Giardia and Cryptosporidium and an additional 4 log (99.99 percent) reduction in viruses to the water following the ultrafiltration process. Based on this information, the unit processes of ultrafiltration and UV disinfection would provide a reduction of 9 log for Giardia and Cryptosporidium and 6 log for viruses. This reduction would far exceed the SDWA requirements.

Chloramination – The mixing of filtered and disinfected water with ammonia gas followed by chlorine gas in the clearwell would provide a chloramine residual prior to being pumped by the service water pumping plant into the treated water mains leading to the service areas. This form of residual is being used to reduce the development of DBPs that would be generated by extended contact times in the conveyance and storage facilities if a free chlorine residual was used. Other benefits of a chloramine residual include prevention of taste and odor problems and the fact that the chloramine residual would last longer in the treated water transmission line and storage system, thus eliminating the number of re-chloramination stations (Reclamation, 2002).

Other Treatment Components.—

Chloramine Booster Stations – Each pumping plant would contain a chloramine booster station that would monitor the chloramine residual of the incoming water and automatically add, as required, additional chlorine to maintain the 0.5 ppm residual to the water being pumped by the plant. The capital and O&M costs of these re-chloramination systems are included as part of the unlisted items in the water treatment cost estimate.

Water Blending – Blending of good water quality produced by the proposed surface water treatment plants with low quality groundwater presently used by the city of Gallup and many of the Navajo Nation communities may increase turbidity in the mixed water. Increased turbidity, a secondary MCL, in the blended water would decrease the aesthetic quality of the water. In order to predict and compensate for any reactions, a detailed water quality analysis for each well system is required. These data would then be used in the "Rothberg, Tamburnini & Windsor Model for Corrosion Control and Process Chemistry" or a similar model to predict turbidity formation. If the modeling determines chemical addition(s) are required to eliminate the formation of turbidity, followup laboratory verification is required. In order to provide funding for modeling and potential chemical injection systems, a 10-percent unlisted additive is included in the capital cost for each treatment system and each demand. To account for potential O&M costs of these systems, a 10 percent miscellaneous additive is provided.

Disinfection Byproduct Treatment – Included in the unlisted percentage in the capital cost for each alternative is funding for the installation of aeration systems and re-chlorination systems at each service point to remove DBPs that may be created during conveyance.

Pilot Plant Operation – Prior to final design of the selected alternative, a pilot study using the proposed treatment system would be required to optimize each treatment process and collect design data. The pilot plant should operate 24 hours a day over a minimum of 12 consecutive months to determine treatment requirements with changing water conditions. A line item providing a sum of $200,000 to fund the pilot study is included in the capital cost. The study would provide or determine:

- The most efficient chemical to use for coagulation
- Chemical injection rates based on changing water quality
- Backwash requirements and membrane cleaning requirements
- Waste water quality and production rates
- The potential for DBP formation during conveyance
- Operation requirements
- The ability of the treatment system to meet current and future regulatory standards
- Data to update capital and O&M costs
- Training for future operators on the full-scale treatment system

Operation.—The overall operational system would monitor the demands in the treated water distribution system and activate/deactivate the treatment system to maintain required water levels or pressures in the treated water storage tanks. When in operation, the water treatment system master control panel would control the local control panels (LCP) for each treatment process. During automatic operation, the water treatment master control system monitors all LCPs and provides inputs for adjustments for optimal treatment efficiency. Operators would be required to monitor operations 24 hours a day along with routine duties such as calibrations of turbidity meters, chemical injection equipment, residual monitors, inventory control, and monthly reports. This control system would be integrated into the overall project control system.

Plant Operators.—Plant operation for all treatment plants and all demands would require a total staff of six personnel (four operators, one maintenance person, and one supervisor). This staff would ensure that at least one operator was at the plant during operation with suitable maintenance and supervisory support.

Chemicals.—Chemicals required include those for routine cleaning of the hollow fiber membranes, aluminum sulfate to flocculate the small suspended particles in the source water, and chlorine and ammonia gas to form a chloramine residual to keep the water disinfected during its transport from the treatment plants to service.

Power.—The annual cost for power to operate each plant would include power to operate vacuum pumps, air compressors, UV disinfection units, low head lift pumps, lights, and HVAC units and a percentage increase for other loads required for operation of a large water treatment facility. For the Cutter diversion, a low lift pump would divert water from the waste water polishing ponds to the plant influent for recycling. Three low-head lift stations would be required for the SJRPNM component—one to transfer water from the river diversion to the settling ponds, one to transfer water from the settling ponds to the water treatment plant, and one to recycle water from the waste water ponds to the water treatment plant. To provide uninterrupted treated water, the New Mexico Environmental Department requires backup generators to be provided for all potable water treatment plants. These generators need to be rated to meet the power requirements during the average daily flow or 70 percent of the design flow.

Replacement of Equipment.—Annualized equipment replacement costs include annual replacement of UV light bulbs, the replacement of all hollow fiber cassettes every 10 years, and the replacement of mechanical equipment every 15 years. Details on the annualized cost of each are provided in volume II, appendix B.

Dredging and Disposing of Sediment.—When the settling and waste water polishing ponds contain a maximum of 2 to 3 feet of sediment, a dragline would be used to remove the sediment in the SJRPNM settling pond and each of the waste water polishing ponds. The sediment would be dried on the sand drying beds and, when dry, would be transported off-site for disposal. The estimated frequency for dredging and disposing of sediment is every 10 days of storm runoff for the SJRPNM lead settling pond and every 15 years for the waste water polishing pond.

Project Land, Rights-of-Way, Relocations, and Damages

The proposed pipeline corridor needs a 60-foot-wide permanent ROW and a 150-foot temporary ROW (the total length of the pipeline is approximately 262 miles). Of this corridor, 8 percent is allotted Navajo Land and 57 percent is Navajo Reservation Fee, and Trust Land. The remainder is divided among a number of State, Federal, and private ownerships. The distribution of the land status is shown in table F-6. Existing utility ROW will be used where possible.

Table F-6.—Land status of the Navajo-Gallup water supply pipeline

Land status	San Juan River Alternative (miles)
Main Navajo Reservation	126
Checkerboard Area	
Bureau of Land Management	39
Indian allotment	22
Navajo fee	11
Navajo Trust	12
Private	36
State	13
Other	4
Total	262

The Navajo Nation Department of Natural Resources recommended that project parameters assume that the ROW within the Navajo Nation would be donated with no direct cost. Damages and necessary relocations associated with facility construction would be a project cost. It is also assumed there would be no direct project costs for ROW on Federal and State land. The Navajo Nation requires that an appraisal of the proposed ROW be conducted. This evaluation is based on the beneficial use of the land and the value of the product in the pipeline. The fair market value of the corridor through the allotted land is between $240,000 and $480,000, and the fair market value of the corridor through Tribal Trust Land is between $14.1 and $23.5 million.

Pipeline construction.

As described in the Code of Federal Regulations 25 Part 169 – Rights-Of-Way Over Indian Lands, the Bureau of Indian Affairs (BIA) has a multi-step process for establishing ROWs across Trust Land (information on the specific procedures is available from BIA). Depending on the number of Indian land allotments crossed by the proposed project corridor, the ROW procedures may be complicated. The land affected must be appraised, the individual allotment owners must be contacted and informed, and consents for the proposed project must be obtained. This process could take 18 months or longer. The cost of this process is included in the non-contract costs associated with the proposed project.

Depending on the specific pipeline location, approximately 36 miles of the alignment could be on private land. It is assumed that there would be no direct project cost for obtaining this ROW.

The water treatment plant at the San Juan River diversion is to be located on private land. A 20-acre piece of land would be required. Six families will be re-located and their houses and land purchased at fair market value.

Cultural Resources

Although the SJRPNM Alternative is decidedly less impacting to cultural resources than the NIIP alternatives, significant impacts would result from the proposed project. An analysis predicts that approximately104 historic properties would exist in the Area of Potential Effects of the preferred alternative. Of the 104 properties, it is anticipated that approximately 83 of them would require some level of mitigative treatment—either archeological testing or full data recovery. The contract costs for performing such work (as estimated in December 2002) are estimated at $5.7 million. Other cultural resource costs include ethnographic investigations; identification and evaluation of in-use areas; non-contract (administrative) costs; consultation with Navajo Nation chapters and State, Tribal, and Federal entities; Native American Graves and Repatriation Act repatriation; unanticipated contingencies; and museum curation of cultural materials. Therefore, the total costs of a cultural resources program is estimated at approximately $11 million (based on January 2005 dollars).

Environmental Mitigation

The construction of the proposed project diversion, treatment plant, pumping plant, and pipeline within the San Juan River Valley would impact approximately 25 acres of riparian and wetland area. Assuming a 3:1 mitigation ratio, 75 acres of similar adjacent land would be purchased or a permanent ROW obtained. This land's riparian and wetland characteristics would be enhanced through land management, such as fencing, grading, weed control, and planting vegetation.

Construction of the proposed project pumping plants and storage tanks along the pipeline would impact approximately 50 acres. It is anticipated that an equal number of adjacent lands would be improved through range enhancement such as fencing, seeding, and constructing wildlife watering stations. Construction of the Cutter Lateral treatment plant and pumping plant would impact approximately 10 acres. It is anticipated an equal number of adjacent lands would be improved through seeding, fertilizing, and mulching. Pipeline construction would impact an area up to 300 feet wide along the pipeline alignment. It is anticipated this area would be re-seeded, fertilized, and mulched to restore the vegetation. This re-seeding would occur as sections of the pipeline are constructed.

CAPITAL AND OM&R

Project Construction, Ownership, and OM&R

Project facilities would be constructed through Reclamation. Ownership of all the proposed project facilities would remain with Reclamation until a point in the future when the Navajo Nation and the city of Gallup would be capable, by mutual agreement, of taking over ownership. Until facilities are transferred from Reclamation, project OM&R would be the responsibility of Reclamation through contract to the Navajo Tribal Utility Authority (NTUA) and the city of Gallup. The costs of OM&R would be paid by the NTUA and the city. This arrangement would be detailed in an agreement among the entities. It is anticipated that the entire project's ownership and OM&R responsibility would be transferred to the Navajo Nation and the city of Gallup. The Jicarilla Apache Nation would pay its share of project's OM&R costs and be party to all agreements pertaining to this proposed project's ownership and OM&R.

The appraisal design and construction cost estimate was provided by Reclamation's Denver Technical Service Center (TSC). This information was documented in the Appraisal Level Designs and Cost Estimates Report, April 2002 (volume II, appendix B). A peer review of the designs and cost estimates was performed by Boyle Engineering Corporation in February 2004. Based on results form this review and using current unit costs of materials, the TSC revised the proposed project construction cost estimate in March 2005. A summary of this March 2005 cost estimate is shown in table F-7 (based on January 2005 dollars).

Reclamation historically supports projects for construction after a feasibility report is completed, which includes a feasibility-level cost estimate. This appraisal-level cost estimate does not meet that requirement. Additional analysis, detail, and updating of the appraisal-level cost estimates presented in this draft report are needed before project construction authorization can be supported. Failure to complete this additional effort may result in reliance on a cost estimate for the proposed project that is not sufficient to characterize the expected cost. The appraisal-level design must be upgraded to feasibility level before Reclamation would begin construction. The cost of, and time for, completing this additional work would be substantial.

OM&R costs include electrical power, chemicals for water treatment, repair and replacement of components of the facilities, and personnel required to operate the system. Power costs were calculated using the January 2005 costs from the local power provider, NTUA and the Colorado River Storage Project (CRSP). This analysis also included estimating the cost using power from the CRSP, and the economic analysis used NTUA and CRSP power rates for comparison purposes. Table F-8 details the OM&R costs.

Table F-7.—Preferred alternative cost estimate

Feature	Reclamation March 2005 cost estimate ($)
Pipelines	154,504,770
Pumping plants	32,270,000
Water treatment plants	46,541,780
Tanks and air chambers	67,730,000
Transmission lines	21,761,661
Turnout structure	1,778,490
Gallup Regional System	21,000,000
Subtotal	345,586,701
Mobilization 5%	17,500,000
Unlisted items 10%	36,913,299
Subtotal	400,000,000
Contingencies 25%	100,000,000
Subtotal (field costs)	500,000,000
Noncontract costs 30%	150,000,000
Subtotal	650,000,000
New Mexico taxes on field costs (estimated at 6%)	30,000,000
Navajo Nation taxes on field costs excluding Gallup Regional System field cost of $30 million (estimated at 3%)	14,100,000
Subtotal	694,100,000
Land, relocation, and damage[1]	7,000,000
Cultural resource mitigation	11,000,000
Environmental mitigation	4,000,000
Total project cost	716,100,000

[1] The estimate includes ROW costs for the San Juan Treatment Plant only. Should it be determined that ROW for the rest of the features needs to be included in the project costs, an additional $30–60 million should be added.

Table F-8.—Yearly OM&R costs ($) (SJRPNM Alternative)

Item	San Juan Lateral	Cutter Lateral	Gallup Regional System
NTUA power costs (relift pumping plant)	4,962,000	597,000	82,000
CRSP power costs (relift pumping plant)	1,678,000	202,000	28,000
NTUA power costs (booster pumping plant)	215,000	35,000	
CRSP power costs (booster pumping plant)	73,000	12,000	—
Relift pumping plant OM&R	1,796,000	693,000	359,000
Booster pumping plant OM&R	73,000	14,000	
Canal OM&R	—	32,000	—
NTUA power cost water treatment plant	511,000	63,000	—
CRSP power cost water treatment plant	171,000	20,000	—
Water treatment OM&R	2,602,157	$1,038,750	—
NTUA water treatment, miscellaneous 10%	311,000	$110,000	
CRSP water treatment, miscellaneous 10%	277,000	$106,000	
Power transmission OM&R	630,000	Included in San Juan Lateral	
Pipeline OM&R	619,000	153,000	32,000
Total NTUA	11,719,157	2,735,750	473,000
Total CRSP	7,919,157	2,270,750	419,000
Relift pumping plant power consumption (kW)	16,219	2,026	305
Booster pumping plant power consumption (kW)	784	128	
Water Treatment Plant power consumption (kW)	1,588	224	
Total kW	18,592	2,379	305

Notes: (1) CRSP rate is 9.5 mils/kWh and demand charge of $4.04 per kW/mo.
(2) CRSP total project power cost is $ 2,184,000.
(3) NTUA rate is 20 mils/kWh and demand charge of $16.50 per kW/mo.
(4) NTUA total project power cost is $6,465,000.
(5) Cost reflects March 2005 project cost estimate with January 2005 price level.

Construction and Associated Costs

Interest During Construction

A project construction schedule was developed to support the economic analysis and help the proposed project beneficiaries plan future water supplies. The first objective of the schedule was to provide water to people in the shortest time period to get the earliest possible benefit from the proposed project. Consideration was given to constructing

Cutter Lateral first to give the operators some years of experience operating a smaller scale facility before operating the very similar but larger facilities of the San Juan Lateral.

The Cutter Lateral would be constructed first. The San Juan Lateral from Twin Lakes to Window Rock and the Gallup Regional System would be next. This section of lateral would draw groundwater from the Twin Lakes area until surface water would be available from the San Juan River. The San Juan Lateral from the San Juan River to Twin Lakes and to Crownpoint would be the last segment constructed.

A construction schedule was developed based on the assumed limitation of $60 million in appropriations annually until project completion. The schedule shown in table F-9 shows the assumed yearly expenditures by feature from project construction start to finish. The schedule was used to estimate interest accrued on potentially borrowed money during construction and to estimate when people would receive water—the start of project benefits.

Cost Allocation

The purpose of cost allocation is to assign shares of the overall project costs to the various participants. The proposed project would provide municipal water supplies to three participating groups—the Navajo Nation, the city of Gallup, and the Jicarilla Apache Nation. The overriding philosophy in allocating project costs is that the three participants are equal partners in the proposed project.

Costs are separated into capital, fixed OM&R, and variable OM&R costs. Each of these cost categories is further divided into specific project reaches and then allocated to the participating parties. The analysis assumes that construction would begin in 2008, with a construction budget of approximately $60 million per year, and full project completion by January 1, 2021. The details of the cost allocation are documented in volume II, appendix D.

In allocating costs, specific project components were separated out by those that would be dedicated for the exclusive use by any single participant; the cost of those ***dedicated components*** was assigned to the beneficiary participant. These dedicated components typically include water storage tanks and pressurization pumps at most of the major delivery points. The bulk of the proposed project cost, however, is for components that would benefit more than one participant. These joint costs were allocated among the project participants to derive each participant's share of the total costs.

Joint costs were allocated according to the following principles:

- ***Capital costs were allocated according to each participant's share of design capacity***. The idea is that the size and cost of the facilities depend upon each participant's desired capacity and not on average use or use in any particular period.

- ***Fixed OM&R costs were also allocated according to each participant's share of design capacity***. Here again, the fixed OM&R costs (staff size, dredging, equipment replacement, and pump maintenance) are primarily a function of the design capacity, not of flows in any particular period.

- ***Variable OM&R costs were allocated according to each participant's share of annual water deliveries***. The variable OM&R costs consist mainly of energy and water treatment chemical costs. These costs vary according to the water flows in any period, so the method used to allocate these costs assigns cost shares in each year according to the projected use in that year.

The proposed project envisions water deliveries at many locations along two main laterals. Every delivery changes the relative shares of the water flow that continues along the pipeline beyond the delivery point. Because, as described above, the relative share of design capacity and projected flow serve as the basis for the cost allocation, the cost allocations change after every delivery point. Therefore, each pipeline branch has been separated into specific ***reaches*** that are defined as the intervals between each two succeeding delivery points. The diversion structure and water treatment plant on each branch is also treated as a separate segment or reach. Each participant's share of design capacity on each reach was computed in order to serve as the basis for allocating capital and fixed OM&R costs.

Gallup Regional System Costs

The design work and cost estimates for the Gallup Regional System were first prepared by DePauli Engineering (DePauli Engineering and Surveying Company, 2002). Reclamation used the DePauli design but re-estimated much of the cost. Some of the Gallup Regional System components were included in Reclamation's cost estimates for the overall system (e.g., Navajo Nation chapter water storage tanks), but most components were listed separately as Gallup-specific. The components included with the other Reclamation elements were treated as part of the overall system cost allocation. The remaining items (all joint facilities) were allocating by their cost to participants based on their respective shares of design capacity. The OM&R costs were estimated as

Table F-9.—Construction schedule (cost in $ millions)
($60 million/year schedule)

	Year														
Construction phase	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**Total**
Navajo-Gallup Water Supply Project	3.92	14.03	0.28												18.23
Cutter Lateral	7.89	4.04	38.84	32.58	11.92										95.27
Twin Lakes/Window Rock	0.86	0.23				32.12	10.63								43.84
Cutter Power	1.37	0.89	2.73	8.00	8.00										20.99
San Juan Power	0.82	1.62	0.01				4.50	15.73							22.68
Gallup Regional System	2.56	3.33	1.96		32.62	27.90									68.37
San Juan Lateral		8.43	15.53	12.16					35.00	60.00	60.00	59.94	50.00		301.06
San Juan Pumping Plant		3.89	1.27				19.67	23.00							47.83
San Juan Water Treatment Plant	5.95	2.76					25.00	22.04	25.00						80.75
Cutter Water Treatment Plant	1.24	0.51		7.00	7.46										16.21
Total allocated spending	24.61	39.73	60.62	59.74	60.00	60.02	59.80	60.77	60.00	60.00	60.00	59.94	50.00	0.00	715.23
Percent distribution	3.44%	5.55%	8.48%	8.35%	8.39%	8.39%	8.36%	8.50%	8.39%	8.39%	8.39%	8.38%	6.99%	0.00%	100.00%
Interest during construction to January 1 of year 14	22.74	32.81	44.41	38.49	33.63	28.86	24.24	20.27	15.94	12.06	8.39	4.90	1.33	0.00	288.06

Note: The construction schedule assumes that annual appropriations will be indexed to keep in step with construction cost trends.

a lump sum (one each for the CRSP and NTUA energy rates). This overall annual OM&R cost was allocated to the participants based on their respective shares of design capacity.

The city of Gallup's cost of purchasing 7,500 AFY of water that would be conveyed by the proposed project is included. At this point, the city of Gallup has not reached an agreement with any water supplier, so the cost estimates may change. For purposes of this analysis, the price per acre-foot of water was estimated at $80, beginning when the city takes water in 2021. No financial cost for the water to be delivered to the Navajo and Jicarilla Apache Nation communities was included, although there may be some non-financial consideration between those two participants.

Cost of Water

In the absence of a water right settlement that establishes different terms, it is assumed that the Navajo Nation would pay for municipal and industrial water from Navajo Reservoir. These payments were estimated by Reclamation to have a present value of $108.45 per acre-foot. The Jicarilla Apache Nation presently has rights to water they intend to use in the proposed project. It is assumed that there would be no cost for their water, as described in their Navajo Reservoir water supply contract.

The city of Gallup, however, will have to pay for obtaining water from a water right holder. The present value of a tentative purchase arrangement is $20 million. Table F-10 shows how this cost translates to the levelized rate needed to cover the projected payments for water.

Table F-10.—Levelized water cost per thousand gallons (2005$)

	Navajo Nation	City of Gallup	Jicarilla Apache Nation	Project total
Present value of water costs	2,950,140	19,758,536	0	22,708,677
Annual amortization of water costs	17,051	1,145,612	0	1,316,663
Annual equivalent water deliveries (1,000 gallons)	8,935,965	2,443,875	545,437	11,925,277
Levelized cost per thousand gallons	0.02	0.47	0.00	0.11

Cost Allocation

Table F-11 summarizes the above analysis. The table addresses the capital, annual OM&R, and present value of OM&R costs for a scenario that assumes a construction budget of $60 million per year. The table combines total construction costs, including taxes for the Reclamation-designed system and for the Gallup Regional System. Allocated costs were added for environmental mitigation, cultural resources, and land acquisition, then interest during construction was added. The present value of the annual fixed plus variable OM&R costs (discounted at 5.375 percent) was calculated and estimated under both the CRSP and NTUA energy rates. All financial costs are expressed as of the beginning of the year 2021, the year in which the proposed project would be completed. Interest during construction and interest on pre-project completion water purchase fees are compiled up to January 1, 2021, and post-completion OM&R and post-completion water purchase fees are discounted to January 1, 2021. Next, the total present value of all costs, including capital, fixed OM&R, and variable OM&R costs, is shown. Table F-11 allocates these costs to each of the participants. All costs are based on January 2005 price levels.

Figures F-6 and F-7 illustrate the components of overall cost. Figure F-6 shows how total project costs are split among capital cost, interest during construction, the present value of future OM&R costs, and the present value of water cost. Figure F-7 shows how total project costs are allocated to the three project participants. Figures F-8, F-9, and F-10 show how the cost allocated to each project participant is composed of capital, interest during construction, OM&R, and water costs. Figure F-11 shows what the levelized cost per thousand gallons would be to each project participant, assuming full self-funding.

ECONOMIC BENEFIT/COST ANALYSIS

This economic analysis section is distinct from a financial analysis because an economic analysis is concerned with the generation and use of societal resources instead of the financial analyses' focus on tracing cash receipts and expenditures. Because Reclamation is overseeing the planning of the proposed project and its participants are seeking monetary support from the Federal Government, the resources of concern are those of the United States as a whole. The principal differences between this economic analysis and financial analysis are:

- Inclusion of non-cash project costs that would affect third parties (diminished power generation and increased salinity effects)

Table F-11.—Present value of total costs (2005)

Total capital costs by user				
	Navajo	**City of Gallup**	**Jicarilla Apache Nation**	**Total**
Allocated construction costs – main system	530,300,000	96,300,000	25,600,000	652,200,000
Allocated capital costs – Gallup Regional	15,700,000	25,300,000	0	41,000,000
Allocated environmental mitigation cost	3,100,000	700,000	100,000	3,900,000
Allocated cultural resources cost	8,700,000	1,900,000	400,000	11,000,000
Allocated rights-of-way cost	5,500,000	1,200,000	300,000	7,000,000
Total project capital cost before interest	563,300,000	125,400,000	26,400,000	715,100,000
Allocated interest during construction	226,900,000	50,500,000	10,600,000	288,100,000
Total project capital cost	790,200,000	175,900,000	37,000,000	1,003,100,000
Rounded values	790,000,000	176,000,000	37,000,000	1,003,000,000
Annual OM&R costs by user (at design capacity)				
CRSP rates	**Navajo**	**City of Gallup**	**Jicarilla Apache Nation**	**Total**
Allocated OM&R costs – main system	7,894,428	1,723,449	640,163	10,258,040
Allocated OM&R costs – Gallup Regional	160,000	259,000	0	419,000
Annual cost of water	171,051	1,145,612	0	1,316,663
Total allocated OM&R costs	8,225,479	3,128,061	640,163	11,993,703
Rounded values	8,200,000	3,100,000	600,000	12,000,000
NTUA rates				
Allocated OM&R costs – main system	11,105,201	2,672,307	748,114	14,525,622
Allocated OM&R costs – Gallup Regional	181,000	292,000	0	473,000
Annual cost of water	171,051	1,145,612	0	1,316,663
Total allocated OM&R costs	11,457,252	4,109,919	748,114	16,315,285
Rounded values	11,500,000	4,100,000	700,000	16,300,000

Table F-11.—Present value of total costs (2005) (continued)

Present value of total OM&R costs by user				
CRSP rates	**Navajo**	**City of Gallup**	**Jicarilla Apache Nation**	**Total**
Allocated OM&R costs–- main system	156,546,000	31,322,000	18,087,000	205,955,000
Allocated OM&R costs – Gallup Regional	2,767,000	4,459,000	0	7,226,000
Cost of water	2,950,140	19,758,536	0	22,708,677
Total allocated OM&R costs	162,263,140	55,539,536	18,087,000	235,889,677
Rounded values	162,000,000	56,000,000	18,000,000	236,000,000
NTUA rates				
Allocated OM&R costs – main system	206,675,000	47,917,000	20,967,000	275,559,000
Allocated OM&R costs – Gallup Regional	3,124,000	5,034,000	0	8,158,000
Cost of water	2,950,140	19,758,536	0	22,708,677
Total allocated OM&R costs	212,749,140	72,709,536	20,967,000	306,425,677
Rounded values	213,000,000	73,000,000	21,000,000	306,000,000
Present value of total capital and OM&R costs by user				
CRSP Rates	**Navajo**	**City of Gallup**	**Jicarilla Apache Nation**	**Total**
Capital	790,000,000	176,000,000	37,000,000	1,003,000,000
OM&R (including cost of water)	162,000,000	56,000,000	18,000,000	236,000,000
Total all costs	949,000,000	232,000,000	55,000,000	1,236,000,000
NTUA rates				
Capital	790,000,000	176,000,000	37,000,000	1,003,000,000
OM&R	213,000,000	73,000,000	21,000,000	306,000,000
Total all costs	1,003,000,000	249,000,000	58,000,000	1,309,000,000

Note: Present value of OM&R costs include fixed and variable OM&R costs incurred for partial water delivery before project completion.

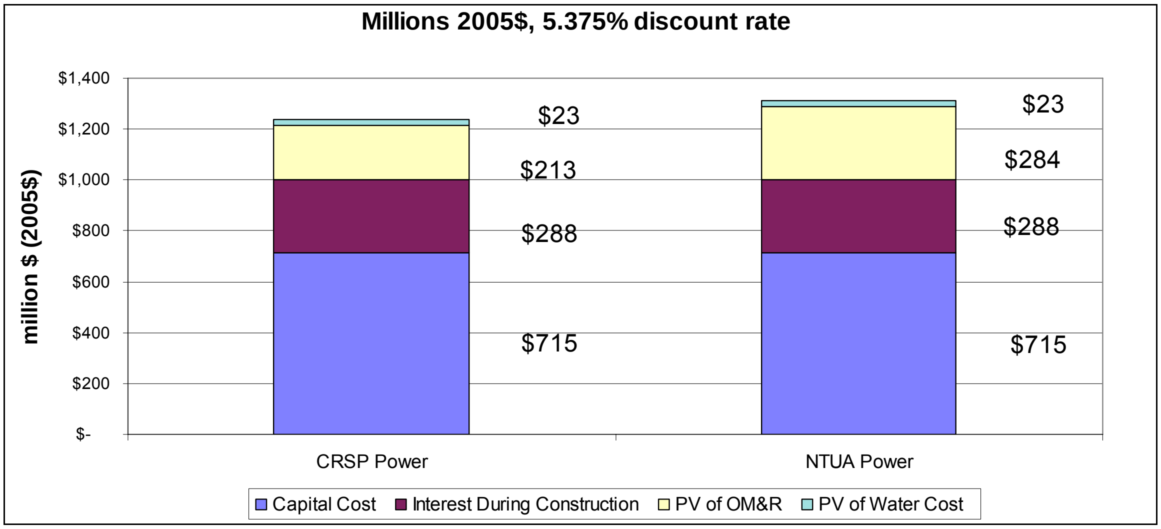

Figure F-6.—Total project cost by category.

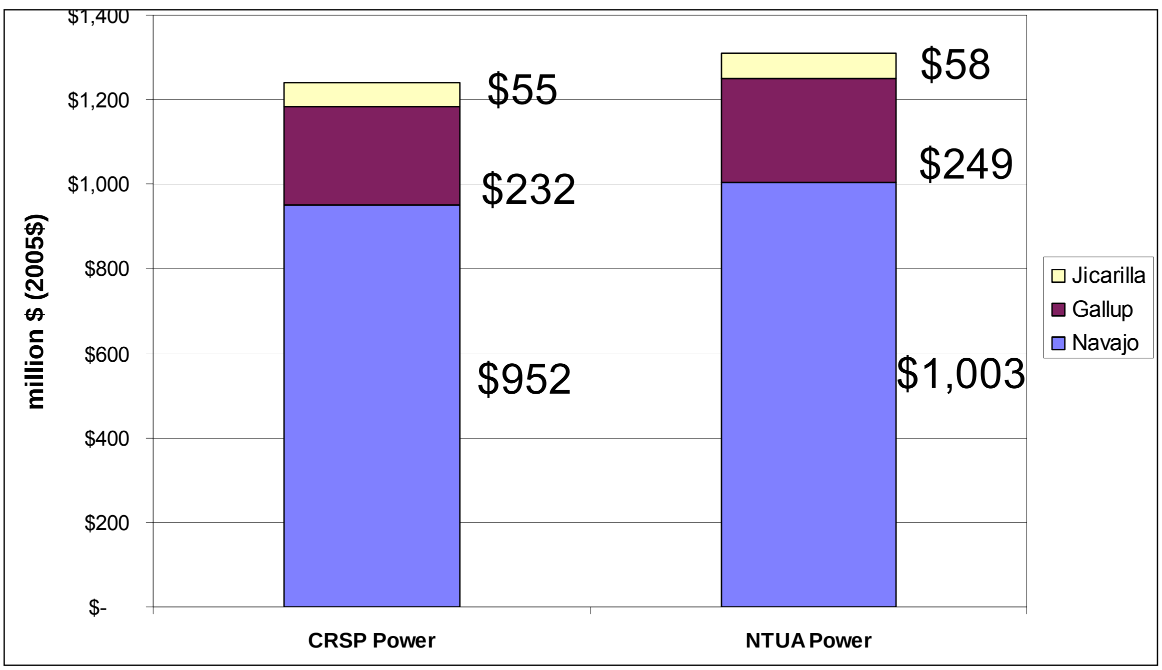

Figure F-7.—Allocation of total costs to participants.

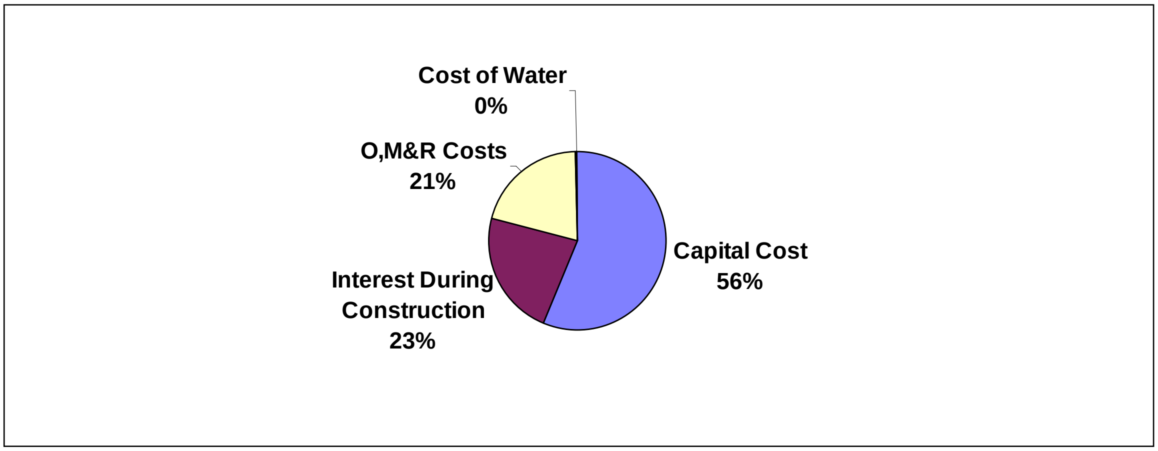

Figure F-8.—NTUA power rates (breakdown of Navajo costs).

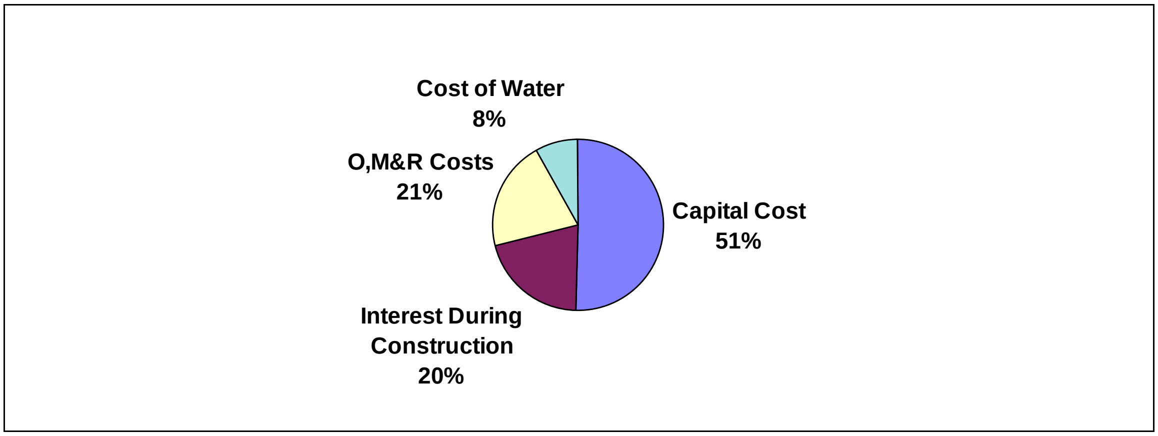

Figure F-9.—NTUA power rates (breakdown of Gallup costs).

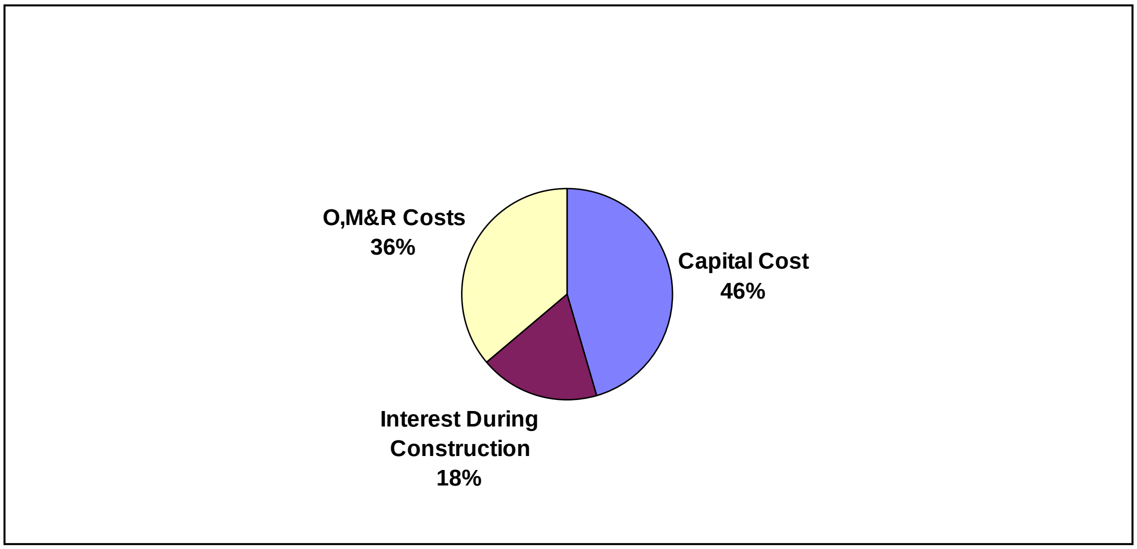

Figure F-10.—NTUA power rates (breakdown of Jicarilla costs).

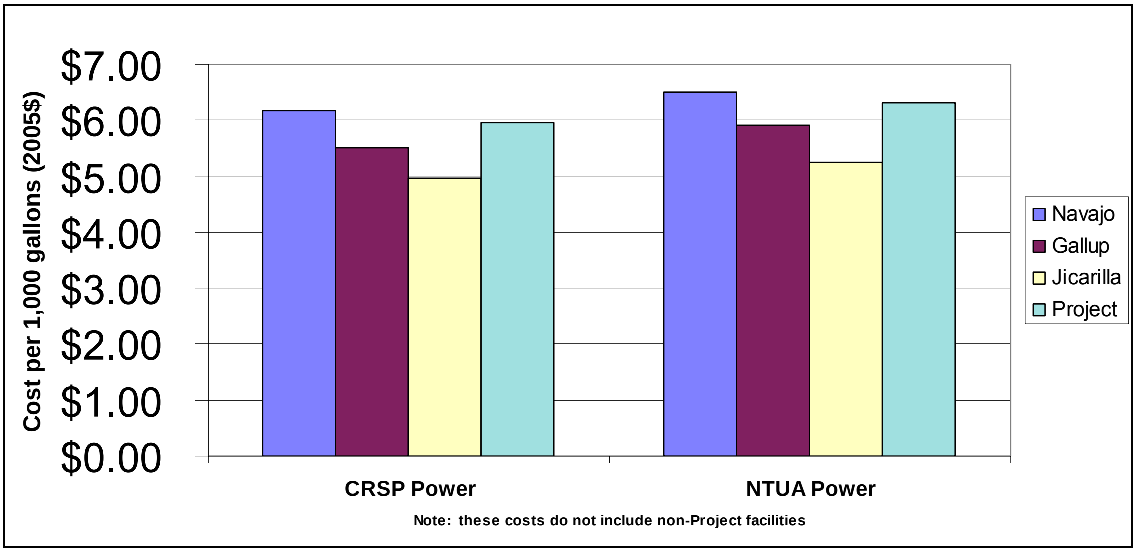

Figure F-11.—Cost per thousand gallons (Federal financing at 5.375%, full repayment).

- Exclusion of project cash costs that do not represent use of scarce national resources (use of otherwise unemployed people for construction workforce)

- Exclusion of project transfer payments that do not represent use of scarce national resources (taxes paid on construction spending)

The proposed project would principally benefit people in the northwest corner of New Mexico by providing water to which they otherwise would not have access or could only have access at a relatively higher costs. The measure of the benefits to the city of Gallup and to the Navajo Nation members who would be supplied by the proposed project is the willingness of these beneficiaries to pay for project water. The city of Gallup's willingness to pay was estimated from data on the current use of water by people in communities throughout the Mountain States. The Navajo people's willingness to pay was estimated from data on their spending for piped water service when available and on spending to haul water when no service is available.

Benefits to the Jicarilla Apache Nation were estimated from the cost of the next cheapest alternative source of water for the area of the reservation to be served by the proposed project. The Indian Health Service identifies the availability of a community water supply as critical for maintaining the health of Indian people. This report roughly estimates the indirect health benefits to Navajo people that would accrue from the provision of a clean water supply.

The completion of the water supply project would also provide infrastructure that is a necessary prerequisite to economic development and poverty relief on the reservations. While it is uncertain how much economic development would be encouraged by the proposed project, it is clear that the lack of a reliable water supply presently poses a significant constraint to most types of economic development. Table F-12 summarizes the economic costs and benefits associated with the proposed project. The details of this analysis are presented in volume II, appendix D.

Ability to Pay

Ability to pay in a water supply context refers to the affordability of a water system. A common measure of ability to pay for water services is utility payments as a percent of median household income (EPA Prioritizing Drinking Water Needs, 1999). The EPA, for example, uses 2.5 percent of median household income (MHI) to determine whether water treatment options to comply with clean water standards are affordable and should be required.

Table F-12.—Summary of project economic benefits and costs
(million 2005$, 5.375% discount rate)

	Direct	Direct plus other
Benefits		
Gallup willingness to pay	269	269
Navajo willingness to pay	1,037	1,037
Jicarilla avoided cost	54	54
Construction employment	183	183
Indirect and induced employment	0	87
Health benefits	0	318
Reverse outmigration	0	+
Economic development	0	+
Total benefits	1,543	1,948
Costs		
Project construction	944	944
Distribution system construction	38	38
OM&R	283	283
Gallup water cost	20	20
Navajo water cost	20	20
Power generating cost	9	9
Salinity increase cost	17	17
Total costs	1,331	1,331
Benefit/cost ratio	1.16	1.46

Note: The benefit/cost ratio greater than 1.0 indicates that the anticipated project benefits are greater than cost and, thus, that the proposed project represents a beneficial use of national resources.

Legislation proposed in the 109th Congress allows the Secretary to determine the Federal share of construction costs based on an analysis of per capita income, MHI, poverty rate, ability to raise revenues, the strength of the balance sheet and the existing cost of water, all relative to regional averages (109S 897, Section 106(f) (2)); however, the bill does not specify any threshold for these measures.

Given this lack of a basis for determining affordability, it may be useful to show the average percentage of MHI that the project participants would pay for water under various assumptions about the respective participant's share of capital cost. These percentages are determined by dividing the estimated annual household cost of project water to the MHI shown in table F-13.

Table F-13.—Median household income

	Navajo Nation	City of Gallup	Jicarilla Apache Nation
1999 median household income (1999$)	20,005	34,868	26,750
2005 median household income (2005$)	23,807	41,247	30,620

Source: 1999 MHI from U.S. Census Bureau, "2000 Census of Population and Housing" indexed to 2005$ with U.S. Bureau of Labor Statistics, "Consumer Price Index;" annual growth rates from U.S. Census Bureau, "1990 Census of Housing" and "2000 Census of Population and Housing," Dornbusch and Associates.

The affordability percentages for different levels of participant capital cost repayment are shown by adjusting the capital portion of the levelized cost. Figure F-12 shows these affordability percentages for capital repayment ratio scenarios ranging from 0 percent repayment to 100 percent. Finally, figure F-12 also compares these affordability percentages to the benchmark 2.5 percent of MHI. These benchmarks are based on EPA judgments of the affordable portion of household income used to pay for a water supply.

Figure F-12 shows that all three project participants could pay project OM&R and a portion of the capital costs without exceeding the EPA threshold of 2.5 percent.

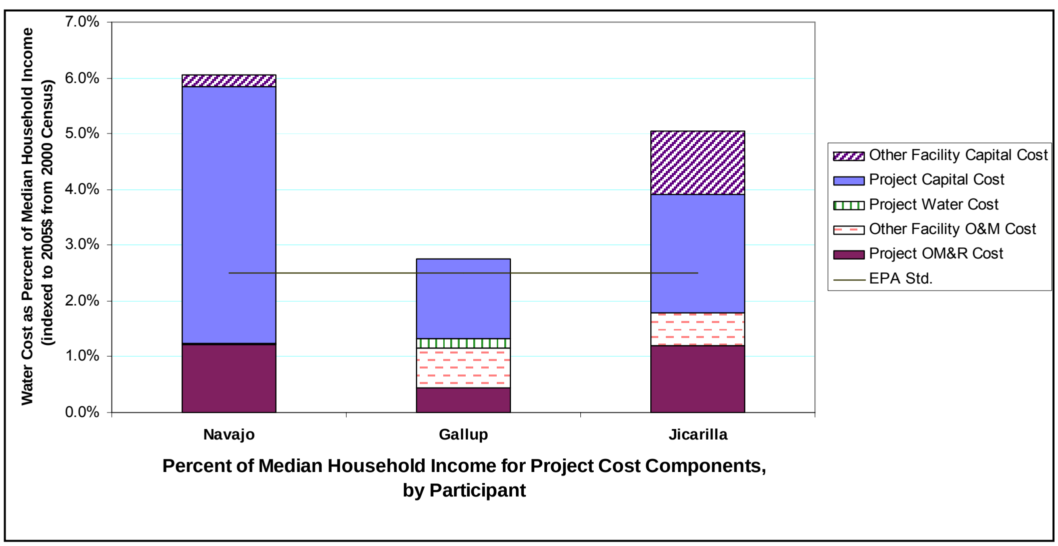

Figure F-12.—Water costs as a percent of median household income (NTUA power rates).

ATTACHMENT G

Screening Report

SCREENING REPORT

PURPOSE

This screening report summarizes the alternatives that were considered for (1) addressing the Navajo-Gallup Water Supply Project (proposed project) need, (2) screening methodology, and (3) reasons that some alternatives were eliminated. The purpose of the screening analysis was to focus subsequent analyses on alternatives that had the best chance of achieving the project goal with the fewest significant negative impacts, including cost. The goal of the proposed project (the alternatives) is to provide an adequate water supply for projected 2040 population growth and economic development in the eastern section of the Navajo Nation, city of Gallup, and the Teepee Junction area of the Jicarilla Apache Reservation.

SCREENING PROCESS

Some options were eliminated from consideration before the screening process began because, among other reasons, they would not have the ability to adequately and reliably provide the amount of quality water necessary for the projected population growth and they would be too costly. For example, under conditions affecting the Navajo Nation and the city of Gallup, most of the aquifers previously investigated were found to be unable to meet long-term municipal development because of the harmful impacts of continued over-drafting of the groundwater. It is assumed these groundwater sources would be used, where possible, in conjunction with surface water to meet the long-term water demand. On the Jicarilla Apache Reservation, previous planning efforts included investigating the possibility of diverting water from the Navajo River and pumping water to southern parts of the reservation. However, a pipeline project from these sources was found to be too costly.

For the overall project area, such nonstructural options as water conservation, water re-use, conjunctive use of groundwater, and aquifer storage were considered but eliminated. Water re-use and groundwater recharge would not provide additional water supplies. Water conservation is already maximized in the proposed project area and all of the alternatives assume water conservation will continue. In addition, the nonstructural alternatives would not supply enough water for future use. Action alternatives for both 2020 and 2040 capacities were evaluated even though only the 2040 alternatives meet the proposed project need. This was done to help answer questions relating to decreasing the cost of the proposed project by reducing its size.

The set of alternatives that went through a formal screening process were developed in part with public input (scoping meetings), informal public contacts, coordination with other entities, and interagency consultations. A project Steering Committee has been in existence since the early 1990s to guide the proposed project's development and is composed of representatives and their technical experts from the Navajo and Jicarilla Apache Nations, city of Gallup, State of New Mexico, North West New Mexico Council of Governments, Navajo Tribal Utility Authority (NTUA), Indian Health Service, Bureau of Indian Affairs, and the Bureau of Reclamation (Reclamation). The steering committee contributed to the screening process.

The screening process began with the evaluation of eight alternatives. Six of the alternatives were structural, including the San Juan River Public Service Company of New Mexico (SJRPNM), San Juan River Infiltration, Navajo Indian Irrigation Project (NIIP) Moncisco, NIIP Coury Lateral, NIIP Cutter, and NIIP Amarillo Alternatives' configurations. The other two alternatives were the nonstructural Water Conservation Alternative and the National Environmental Policy Act (NEPA)-required No Action Alternative. The plan selection process, or screening, included two categories of screening criteria: the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (Principles and Guidelines*) four tests of viability and nine factors covering the four accounts: national economic development (NED), regional economic development (RED), environmental quality (EQ), and other social effects (OSE). Within the two categories of screening criteria, there were four independent screening analyses (or steps) to arrive at the final alternative scoring and ranking.

First, all eight alternatives were initially screened using the *Principles and Guidelines'* four tests of viability (acceptability, efficiency, effectiveness, and completeness), including the six structural alternatives at the year 2040 design capacity and the smaller year 2020 design capacity. The six 2020 design capacity alternatives and the two nonstructural alternatives, Water Conservation and No Action, did not meet the four tests of viability and, as a result, were eliminated from further screening. The No Action Alternative is required by NEPA to be analyzed in the planning report/draft environmental impact statement. The result was that the six 2040 design capacity alternatives were carried forward for a more detailed comparison for screening.

The next level of screening, in part to meet the *Principles and Guidelines*' four account requirements, included a comparison of the total costs of each alternative as measured by its present worth, or cost-per-acre-foot of water value. The *Principles and Guidelines* require Reclamation to evaluate the effects of the alternatives in the areas of the four accounts, particularly NED. The alternative chosen must maximize economic benefits. Analysis of the SJRPNM and NIIP Amarillo Alternatives showed that they had the greatest economic benefit of the six alternatives.

Nine screening factors were developed by the project Steering Committee to be used in the next two screening stages. The alternatives were screened by nine broad-ranging factors that relate to the broader *Principle and Guidelines'* four tests of viability and four accounts definitions. Another analysis screened the alternatives by only four of the environmental factors out of the nine total factors. The result was that only two alternatives scored well enough to be carried further into the impact analysis in chapter V—the SJRPNM and NIIP Amarillo Alternatives. Of those two, the SJRPNM Alternative had the best overall score. The NIIP Amarillo Alternative had very comparable present worth values to the SJRPNM Alternative and actually scored higher, assuming the use of locally available NTUA electric rates.

SCREENING CRITERIA AND PROCESS

The screening criteria included an initial screening for meeting the four tests of viability. The result was that the six action alternatives were carried forward for a more detailed screening or comparison. The next level of screening included a comparison of the total costs of each alternative as measured by its present cost-per-acre-foot value. The other screening process included screening the alternatives using the factors by assigning rating numbers, weights, scores, and then finally ranking the alternatives' results.

The Principle and Guidelines

Four Tests of Viability

The *Principles and Guidelines* describe four overarching tests of viability to be considered for each alternative. The tests assess the completeness, effectiveness, efficiency, and acceptability of the alternative plans. Alternatives that met a minimum standard under all four tests were considered viable plans and were investigated in greater detail.

> ***Completeness –*** This factor measures the extent to which a given alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planned effects. This may require relating the plan to other types of public or private plans if the other plans are crucial to realization of the contributions to the objective.

Effectiveness **–** This factor measures the extent to which an alternative plan alleviates the specified problems and achieves the specified opportunities.

Efficiency **–** This factor measures the extent to which an alternative plan is the most cost-effective means of alleviating the specified problems and realizing the specified opportunities and is consistent with protecting the Nation's environment.

Acceptability **–** This factor measures workability and viability of the alternative plan with respect to acceptance by State and local entities and the public and compatibility with existing laws, regulations, and public policies.

Table IV-3 displays the results of applying the four tests of viability to the eight alternatives. The No Action and Water Conservation Alternatives did not meet the *Principles and Guidelines*' four tests of viability; therefore, the Water Conservation Alternative was screened out and the No Action Alternative was retained solely to meet NEPA plan formulation requirements. Additionally, although the year 2020 design capacities for the six structural alternatives are not shown in table IV-3, they were found to be incomplete, ineffective, and unacceptable because they did not meet the proposed project's objective of providing a municipal and industrial water supply for the year 2040.

The Four Accounts

The four accounts specified in the *Principles and Guidelines* are used to evaluate information on the effects of viable plans—NED, EQ, RED, and OSE accounts. Each account describes particular aspects of anticipated effects of the viable alternatives on the economy and environment.

The NED account measures changes in the economic value of the national output of goods and services, while the RED account gauges changes in the distribution of regional economic activity. The EQ account measures significant effects on natural and cultural resources, and the OSE account measures effects from perspectives that are relevant but not reflected in the other three accounts. The *Principles and Guidelines* require that the plan chosen must maximize net NED benefits as the preferred alternative, or else Reclamation must obtain an exception from the Secretary of the Interior to formulate a plan to meet other needs. The economic benefits of each alternative are essentially the same; therefore, the alternative with the smallest present worth value (also referred to as the total project cost measured in terms of cost per acre-foot of water) would represent the alternative that maximized NED benefits.

Comparison of Total Costs

The next level of screening included a comparison of the total costs (capital, construction, and operation, maintenance, and replacement [OM&R] costs) of each alternative as measured by its present worth per acre-foot. This process satisfies requirements for the NED—the most critical of the four *Principles and Guidelines'* accounts. The present worth analysis was done using the following conditions:

(1) 50-year life of the proposed project

(2) An interest rate of 6.37 percent

(3) OM&R cost estimates using Colorado River Storage Project (CRSP) and NTUA power rates

(4) Construction costs at October 2001 price levels

Results of the comparative analysis, displayed in table IV-4, show the alternatives ranked from highest to lowest cost, including their total estimated costs. Results of this comparative analysis show that the SJRPNM and NIIP Amarillo Alternatives have the lowest present worth. The SJRPNM Alternative is the lowest using CRSP power rates, and the NIIP Amarillo Alternative is the lowest using NTUA power rates. The economic benefits of all the 2040 alternatives are essentially equal for this project; therefore, the present worth is considered reflective of the NED account.

Screening Factors

Alternatives were weighted for each screening factor for comparing the alternatives in a consistent manner. The factors are defined in this section, and the weighting process is described in the next section. The nine factors identified for comparing and screening the alternatives are:

(1) Capital cost per acre-foot of delivered water

(2) OM&R cost per acre-foot of delivered water

(3) Impacts to endangered species

(4) Impacts to environmental resources (aquatic, wildlife, vegetation, land use, and recreation; endangered species are excluded)

(5) Impacts to cultural resources

(6) The quality of drinking water provided

(7) Social/economic impacts

(8) Acceptability to project beneficiaries

(9) Risks associated with construction, implementation, and operation and maintenance

Definitions and components of the nine factors are shown in table G-1.

Alternative Ranking Process

Two screening analyses were conducted independently for the 6-year 2040 structural alternatives—a weighting of all nine evaluation factors and another conducted for only four of the nine factors, referred to as the environmental factors (endangered species, environmental resources, socioeconomics, and cultural resources). The environmental factors were evaluated independently to help identify the least environmentally impacting alternative primarily for NEPA requirements.

Within each of the two screening analyses there were four primary steps to arrive at the overall ranking of alternatives from high to low impacts that incorporated the nine factors:

Step 1 (Rating) Each alternative was assigned a numerical rating (1–12) for each factor by technical experts from the Steering Committee, with 12 being the least impacting or costly based on the nine (or four environmental) factors.

Step 2 (Weighting) Each factor was given a weight of importance by the same group.

Step 3 (Scoring) The nine (or four environmental) factors' products of each alternative rating and each factor weight were added together to produce the alternative's overall score.

Step 4 (Ranking) The rating of each alternative was multiplied by the weight of each of the nine (or four environmental) factors.

Table G-1.—Definitions and components of the nine screening factors

1. Capital cost[1]				
Construction	Land, relocation, and associated damage	Environmental mitigation	Protection of cultural resources	
2. OM&R				
Personnel		Power	Material and equipment	
3. Endangered species				
Endangered aquatic resources[2] Colorado pikeminnow Razorback sucker		*Wildlife resources* Southwestern willow flycatcher Bald eagle Golden eagle Ferruginous hawk nesting habitat	*Vegetation resources* Number of populations of Mesa Verde cactus disturbed or removed	
4. Environmental resources				
Aquatic Native and trout fisheries Aquatic insects Zooplankton Others dependent on lotic and lentic habitats	*Land use* Physical size of land used for the proposed project	*Vegetation* Upland area disturbed Upland area removed Riverine habitat disturbed Riparian shrub removed Number of bisti fleabane populations potentially disturbed Aztec gilia acres removed Number of San Juan milkweed populations disturbed and removed	*Wildlife resources* Potential to remove large cottonwoods used by raptors Area required for structures for potential raptor nesting/feeding habitats Miles of transmission line	*Recreation* *Tailwater fishing* Flyfishing Wade-fishing Dory fishing Commercial guide and outfitting Others *River recreation* Fishing Rafting Commercial guiding and outfitting *Reservoir recreation*
5. Cultural resources[3]				
Historic or archaeological resources and traditional cultural properties (TCPs) Culturally significant landscapes Prehistoric and historic archaeological sites and isolated artifacts or features Historic structures Human burials Sacred sites Areas of important cultural value to existing communities (TCPs)				

Table G-1.—Definitions and components of the nine screening factors (continued)

6. Drinking water quality[4]			
Total dissolved solids		Contamination from other sources (waste water, etc.)	Sulfates (salts)
7. Socioeconomics[5]			
Construction Temporary infusion of money into the local economy		*Drinking water availability* Would be a positive impact to areas that do not currently have adequate supplies Positive health and economic impacts expected	
8. Acceptability			
Cost	Political acceptability	Impacts to existing resources and infrastructure	Full supply of water and maintaining continuous operations
9. Risk			
Constructability Standard/typical construction methods Proven technology Availability of field conditions Geologic formations Safety to the public Availability of technology High degree of unknowns such as geologic formations, permeability of river gravels, foundation conditions for a dam, rock encountered during construction, saturated conditions			*Reliability* Dependence on NIIP infrastructure Ability to deliver water without interruption Control of changing conditions over time Quantity of mechanical and electrical equipment Water quality (sediment)

[1] The cost level for comparison was October 2001 and was broken down into cost per acre-foot so that the 2020 and 2040 alternatives could be compared.

[2] Measured in miles of critical habitat that would experience increased flows and the change in average minimum flows for each alternative.

[3] Cultural resources are physical or other expressions of human activity and, if eligible for inclusion in the *National Register of Historic Places*, are protected under the National Historic Preservation Act of 1966, as amended in 1992, and may also be protected under the Native American Graves and Repatriation Act of 1990; the American Indian Religious Freedom Act; Executive Order 12007, Protection of Native American Sacred Sites; and other State, agency, or Tribal laws and policies.

[4] Sedimentation was not considered because it can be handled by the treatment process.

[5] Factors that impact the social setting or economy.

Step 1 – Alternative Rating Process

(1) *Capital Costs Factor* – Each alternative was assigned a rating from 1–12, with the least cost per acre-foot rated 12 and the most cost per acre-foot rated 1.

(2) *OM&R* – Same as (1).

(3) *Endangered Species* – Aquatic, wildlife, and endangered species were considered. Effect values were assigned for each resource, and all resources were weighted equally.

(4) *Environmental Resources* – Aquatic resources (30 percent), land use (5 percent), wildlife (20 percent), vegetation (25 percent), and recreation (20 percent) were considered (the respective weight given to each of the resources is shown in parentheses).

(5) *Cultural Resources* – The cultural resource evaluation used the density of sites, which included archaeological, ethnographic, and in-use sites for comparison of alternatives. The alternative with the least site disturbance was given a rating of 12, and the alternative with the most disturbance was given a rating of 1.

(6) *Drinking Water Quality* – The alternatives providing the best quality of drinking water were given a rating of 12, and the alternatives providing the worst quality of drinking water were given a rating of 1. Water from Navajo Reservoir is of better quality water than water from the San Juan River downstream of the reservoir.

(7) *Socioeconomic* – These are factors that impact social structure or economy of the beneficiaries of the proposed project. Water delivery to the proposed project area is the same for each alternative, and the construction impacts are nearly the same with each alternative. All of the alternatives providing water to the same area and the same quantity would be rated the same. All alternatives were therefore rated the same.

(8) *Acceptability* – This was the project Steering Committee's concept of the preferred alternative. The components of this factor considered were political supportability, impact to existing resources and infrastructure, and compatibility with the future planned development. One rating was given to each alternative, with 12 being the most acceptable and 1 being the least acceptable.

(9) *Risk* – Reliability and constructability were the criteria used with equal weighting. Risk included those variables or unknowns in each alternative that could prevent the complete construction or the continued operation after construction of the proposed project. The alternative with the least risk was given a 12 rating, and the alternative with the most risk was given a 1 rating.

Step 2 – Factor Weight Assignment Process

A weight or percentage of importance was assigned to each of the nine (or four environmental) factors. Importance was assigned based on the factors' relative anticipated importance or impacts if the alternative was implemented. The combined weights totaled 100 percent. This was done for the nine factors as well as the four environmental-only factors; two independent analyses were completed for comparison purposes. The weighting for each factor is shown in table G-2.

Table G-2.—Factor weights

Criteria	Combined weight factors (percentages)	Environmental factors only (percentages)
Capital costs	20	0
OM&R	20	0
Endangered species	20	30
Environmental resources	20	30
Acceptability	2	0
Risk	10	0
Water quality	2	0
Socioeconomics	3	20
Cultural resources	3	20
Total percent	100	100

Step 3 – Scoring: Alternative Rating Multiplied by Factor Weights

This step involved multiplying the alternative ranking (1–12) by the assigned weights to get the numeric score for each alternative for that specific factor. The numeric score for each of the nine (or four) factors was added together to get the total score for each alternative, as shown in chapter IV, tables IV-5 (alternative selection criteria) and table IV-6 (alternative comparison for environmental factors).

Step 4 – Alternative Ranking

This step involved comparing the total alternative scores against each other, with the highest score being the most preferred alternative. The alternatives were rated against each other in a combined resource rank (see tables IV-5 and IV-6).

SCREENING RESULTS

To summarize the options and alternatives originally considered:

- Six structural alternatives to provide surface water supply to meet year 2020 needs were evaluated.
- Six structural alternatives to provide surface water supply to meet year 2040 needs were evaluated.
- Water conservation was considered as a stand-alone alternative.
- Alternatives using groundwater were considered.
- Other water management techniques were considered and water re-use and aquifer storage were considered in combination with the other alternatives.

Water users in the proposed project area currently have a very low consumptive use of water and will have to continue to conserve with or without a new water supply. Both water availability and water cost will force continued water conservation. Therefore, water conservation alone is not a complete alternative, but was part of all alternatives considered.

The proposed project area's groundwater resources are not adequate to provide long-term water needs and, therefore, cannot provide for a complete stand-alone alternative. The existing sustainable groundwater supply is assumed to be needed along with a surface water supply to meet future needs. Alternatives were designed assuming future use of available groundwater.

Water management techniques, like waste water re-use and aquifer storage, are not complete alternatives, but could provide better management of existing water resources. It is expected such techniques would be used by the project beneficiaries to efficiently manage their water.

The alternatives sized to meet year 2020 water demands were evaluated only for comparison of costs. As expected, the unit costs for smaller-sized alternatives were higher in addition to not meeting the proposed project's long-term water supply purpose. In addition, these alternatives were not acceptable to the project beneficiaries. As a result, they were not carried into the screening process.

The six structural alternatives sized for the year 2040 water demands were taken through the complete screening process, and:

(1) All six alternatives met the *Principles and Guidelines'* four tests of viability.

(2) Present worth (NED) analysis showed the SJRPNM and NIIP Amarillo Alternatives were the highest ranked (least costly).

(3) The nine screening factors revealed that the SJRPNM Alternative was the highest ranked out of the six.

(4) Environmental factor screening (four of the total nine factors) revealed the SJRPNM Alternative, again, was the highest ranked (least impacting to the environment).

The conclusion of this analysis is that the SJRPNM Alternative ranked higher in the overall combined analysis. The NEPA analysis described in chapter V looks at the SJRPNM and NIIP Amarillo Alternatives in comparison with the No Action Alternative.

ATTACHMENT H

Vegetation

VEGETATION

A VEGETATION CLASSIFICATION AND LAND COVER LEGEND FOR VEGETATION RESOURCES WITHIN THE NAVAJO-GALLUP WATER SUPPLY PROJECT AREA[1]

Barren – This classification includes bare soils or areas with vegetation cover less than 25 percent, typically with very light-colored soils. Dark soils may be classified as rock outcrop or a vegetation classification with cover as low as 10 percent.

Basin/Playa – This vegetation classification includes drainage basins, playas, and stock tanks. Small features may not be identified, and features lacking water or with very shallow water may be identified as barren soils. Features with substantial vegetation may be identified as wetland or lowland/swale grassland vegetation.

Great Basin Broadleaf Deciduous Desert Scrub – Shrub dominated by broadleaf deciduous shrubs that are cold and drought tolerant. The major cover types are four-wing saltbush (*Atriplex canescens*) and rubber rabbitbrush (*Chrysothamnus nauseosus*), with lesser amounts of shadscale (*Atriplex confertifolia*) and winterfat (*Ceratoides lanata*) cover types. Big sage (*Artemisian tridentada*) may be present, but is not dominant. Herbaceous cover is variable, ranging from very sparse to grassy. Characteristic species are Indian ricegrass (*Oryzopsis hymenoides*), and western wheatgrass (*Agropyron smithii*), mallow (*Sphaeralcea parvifolia*). This vegetation classification is found at elevations from 3500 to 7200 feet.

*Great Basin Foothill-Piedmont Grasslan*d – Grasslands of mountain foothills, mesa tops, and piedmont slopes. Major cover types are Galleta (*Hilaria jamesii*) and Indian ricegrass. Shrubs are common and include four-wing saltbush, greene rabbitbrush (*Chrysothamnus greenii*), and big sage. This vegetation classification is found at elevations from 4500 to 7200 feet.

[1] Developed from the report entitled "*A Vegetation Classification and Land Cover Legend for Application to New Mexico Gap Analysis*" produced by the New Mexico Cooperative Fish and Wildlife Resource Unit (Muldavin et al., 1996).

Great Basin Lowland/Swale Grassland – Swale and basin bottom grasslands make up this classification type. The primary component is alkali sacaton (*Sporobolus airoides*), and vegetation diversity is low. Occasionally, four-wing saltbush, big sage, and giant sacaton (*Sporobolus giganteus*) occur. This vegetation type is found from 3500 to 7200 feet in elevation and often occurs in a matrix with desert scrub and open conifer woodlands.

Great Basin Microphyllous Desert Scrub – Small-leaved, cold- and drought-tolerant shrubs dominate this vegetation classification. Big sagebrush, black sagebrush (*Artemisia nova*), and Bigelow's sagebrush (*Artemisia begelovii*) are the major species. Four-wing saltbush (*Atriplex canescens*), shadscale (*Atriplex confertifolia*), greasewood (*Sarcibatus vermiculatus*), and winterfat are also common. Herbaceous cover ranges from very sparse to grassy. Common forbs include Indian ricegrass, western wheatgrass, and mallow (*Sphaeralcea* sp.). This vegetation classification is found from 5250 to 7200 feet in elevation.

Irrigated Agriculture – Cultivated fields with cash crops such as alfalfa, corn, melons, and irrigated pastures comprise this cover type. This classification may also include remnants of native riparian vegetation in river valleys or plowed fields. The Gap Analysis[2] vegetation data may underestimate the area covered by this habitat type because some areas have been recently converted to agriculture.

Mid-Grass Prairie – Grasslands dominated by grasses generally greater than 1.5 feet and less than 3 feet tall, but may be grazed much shorter. The major cover types are sideoats gramma (*Bouteloua curtipendula*), New Mexico needlegrass (*Stipa neomexicana*), western wheatgrass, little bluestem (*Schizachyrium scoparium*), and sand dropseed (*Sporobolus cryptandrus*). Other common subdominant grass species include vine-mesquite grass (*Panicum obtusum*), plains lovegrass (*Eragrostis intermedia*), and plains bistlegrass (*Setaria macrostachya*). Important forbs include slender scurfpea (*Psoralea tenuiflora*) and white prairie clover (*Petalostemon candidum*). This vegetation classification ranges in elevations from 4000 to 8000 feet.

Riverine/Lacustrine – Rivers, streams, and lakes are included in this cover type. Streams and rivers less than 98 feet in width will exhibit breaks or not be recognized. Very small, dry, weedy, or shallow ponds may not be mapped.

Rock Outcrop – This vegetation classification bare surfaces only if substantial bare surface is facing skyward. It also may include areas of bare soils.

[2] A comparison of the distribution of elements of biodiversity with that of areas managed for their long-term viability to identify elements with inadequate representation.

Rocky Mountain/Great Basin Closed Conifer Woodland – Woodlands dominated by rounded crown, low-statured conifers that form moderately closed to moderately open canopies (>60 percent) canopy cover. The major cover type is pinyon pine (*Pinus edulis*). Junipers (*Juniperus monospermua*, *J. osteosperma*, *J. scopulorum*, and *J deppeana*) are common canopy associates. The undergrowth is variable with elements not only from the Rocky Mountains, but also the Great Basin biogeographic province. Some communities are dominated by shrubby oaks (*Quercus gambelii*, *Q. undulate*, *Q. grisea*, *Q. turbinella*) or other shrubs such as mountain mahogany (*Cercocarpus montanus*) and big sage. Other communities are distinctly grassy and, at higher elevations, are commonly dominated by cool-season grasses such as western needlegrass (*Stipa Columbiana*), Scribner needlegrass (*Stipa scribnerii*), Arizona fescue (*Festuca arizonica*), and mutton bluegrass (*Poa fendleriana*). At lower elevations, warm-season grasses such as blue grama (*Bouteloua gracilis*) or sand bluestem (*Andropogon hallii*) can predominate. Common forbs are wholeleaf paintbrush (*Castilleja integra*), skyrocket (*Ipomopsis aggregate*), trailing fleabane (*Erigeron flagellaris*) and Colorado four o'clock (*Mirabilis multiflora*). This vegetation classification ranges in elevation from 6500 to 8000 feet.

Rocky Mountain/Great Basin Open Conifer Woodland – This vegetation classification is characterized by low-growing, round-crowned conifers. Junipers are often dominant, with canopy cover from 25 to 50 percent. This habitat type also includes very open stands, often referred to as savanna, with 10 to 25 percent canopy cover. Undergrowth is primarily warm-season grasses such as purple three awn (*Aristida longiseta*), blue gramma (*Bouteloua gracilius*), and galleta. In some communities, shrubs such as snakeweed (*Gutierrezia sarothrae*), big sage, winterfat, and rabbit brush (*Chrysothamnus* sp.) are well represented. James' wild buckwheat (*Eriogonum jamesii*) and stemless woollybase (*Hymenoxys acaulis*) are common forbs. This vegetation classification is found at elevations from 4000 to 8000 feet.

Rocky Mountain Montane Deciduous Scrub – Cold-tolerant, deciduous broadleaf shrubs characterize this vegetation classification. Major species include mountain mahogany (*Cercocarpus montanus*), gambel oak (*Quercus gambelii*), and wavyleaf oak (*Q. undulate*). Other associated species include snowberry (*Synporicarpos oreophilus*), buckbrush (*Ceanothus fendleri*), rose (*Rosa* sp.), scrub liveoak (*Q. turbinella*) and scrub gray oak (*Q. grisea*). Undergrowth is variable, and common small-leaved, cold- and drought-tolerant shrubs dominate this vegetation classification. Big sagebrush, black sagebrush (*Artemisia nova*), and Bigelow's sagebrush (*A. bigelovii*) are the major species. Four-wing saltbush, shadscale, greasewood (*Sarcobatus vermiculatus*), and winterfat are also common. Herbaceous cover ranges from very sparse to grassy. Common forbs and grass species include fringed brome (*Bromus ciliatus*), sideoats grama (*Bouteloua curtipendula*), green sprangletop (*Leptochloa dubia*), and Louisiana sagewort (*Artemisia ludoviciana*). Rocky Mountain montane deciduous scrub occurs at elevations from 6000 to 9000 feet.

Rocky Mountain Lower Montane Conifer Forest – Forests dominated by rounded crown conifers that form open to closed canopies. This vegetation classification in New Mexico is represented by the ponderosa pine (*Pinus ponderosa*) cover type; other tall conifers are usually accidental. Low-stature conifers, such as pinyon pine and junipers, and broadleaf trees such a gambel oak can occur in the subcanopy. Undergrowth is highly variable depending on moisture conditions and degree of canopy closure. Common shrubs include big sage, snowberry (*Symphoricarpos oreophila*), waveyleaf oak, gambel oak, and woodrose (*Rosa woodsii*). Grasses and forbs include Ross sedge (*Carex rossii*), mutton bluegrass, junegrass (*Koeleria pyramidata*), paintbrush (*Castilleja rotundifolia*), purple geranium (*Geranium caespitosum*), and meadowrue (*Thalictrum fendleri*). Under more open canopies, undergrowth tends to be more grassy and dominated by such species as screwleaf muhly (*Muhlenbergia virescens*), mountain muhly (*M. Montana*), and Arizona fescue. This vegetation classification is found at elevations from 6500 to 9000 feet.

Rocky Mountain Upper Mountain Conifer Forest – Forests dominated by conical-crowned conifers that generally form closed canopies (occasional open canopies do occur). The major cover types are Douglas fir (*Psuedotsuga menziesii*), white fir (*Abies concolor*), and blue spruce (*Picea pungens*). Undergrowth is variable, ranging from sparse and moss dominated, to shrubby and forb rich, and is luxuriant in cover. Common species include Rocky Mountain maple (*Acer glabrum*), snowberry, mountain spray (*Holodiscus dumosus*), Canada violet (*Viola Canadensis*), pale geranium (*Geranium richardsonis*), elk sedge (*Carex geyeri*), and fringed brome (*Bromus ciliatus*). Elevations range from 8000 to 10,000 feet.

Rocky Mountain Subalpine and Montane Grassland – Mid- to high-elevation grasslands dominated by species associated with the Rocky Mountain biogeographic province. These grasslands are mapped in a limited, scattered distribution among the highest mountain tops of the State. Elevations usually exceed 10,000 feet.

Rocky Mountain Subalpine Conifer Forest – Closed-canopied forests dominated by evergreen needle-leaved, conical-crowned conifers. The major cover types are Englemann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*). Douglas fir and white fir can be significant successional components in the stands. Undergrowth can range from being exceedingly sparse and low diversity (mostly moss) to luxuriant and rich in species. Common characteristic species include myrtle huckleberry (*Vaccinium myrtillus*), thimbleberry (*Rubus parviflorus*), foeny sedge (*Carex foenea*), forest fleabane (*Erigeron eximius*), Jacob's ladder (*Polemonium pulcherriumum*), osha (*Ligusticum porteri*), and twinflower (*Linnaea borealis*). Elevations for this vegetation classification range from 9500 to 12,000 feet.

Short-Grass Steppe – This vegetation classification is dominated by grasses generally less than 1.5 feet tall. Blue gramma and hairy gramma (*Bouteloua hirsute*) are the principal species. Other co-dominate grasses include purple threeawn, western wheatgrass, and galleta. Shrubs such as winterfat, prairie prickly pear (*Opuntia phaeacantha*), and yucca (*Yucca* sp.) may also be present. Common forbs include milkvetch (*Astragalus* sp.), buckwheat (*Eriogonum* sp.), curly gumweed (*Grindella squarrosa*), and prairie coneflower (*Helianthus petiolaris*). Short-grass steppe is found at elevations from 4000 to 7500 feet.

Southwestern Plains and Forested/Shrub Wetlands – Vegetation dominated by woody species primarily associated with the interior Southwest and Plains biogeographic provinces. The Southwestern and Plains Broadleaf Forest includes forests dominated by broadleaf, cold deciduous trees. Major cover types are fremont cottonwood (*Populus fremontii*), plains cottonwood (*P. sargentii*), Arizona walnut (*Juglans major*), netleaf hackberry (*Celtis reticulate*), and Arizona sycamore (*Platanus wrightii*). Southwestern and Plains Shrub Wetlands include shrublands dominated by cold deciduous shrubs. Major cover types in coyote willow (*Salix exigua*) and seepwillow (*Baccharis glutinosa*). Russian olive (*Elaeagnus angustifolia*) and saltcedar (*Tamarix* spp.) are major exotic cover types. Elevation for this vegetation classification ranges from 3000 to 7000 feet.

Urban Vegetated – Includes areas classified as vegetative cover within the urban boundary. Most agriculture and riparian vegetation retained their original classification.

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Scientific Name	Common Name	Farmington to Shiprock	Hogback to Gallup	Cutter Dam to Starlake
Abronia fragrans	fragrant sand verbena	X	X	X
Aegilops cylindrica	jointed goatgrass		X	X
Agropyron cristatum	crested wheatgrass	X	X	X
Agrostis stolonifera	redtop		X	X
Allionia incarnata	trailing four o'clock	X		
Allium macropetalum	largeflower onion		X	
Allium sp.	wild onion	X		
Alopecurus aequalis	shortawn foxtail		X	
Alyssum minus	small alyssum	X	x	
Amaranthus blitoides	prostrate pigweed	X	X	
Amaranthus retroflexus	redroot pigweed	X	X	
Ambrosia acanthicarpa	bur ragweed	X	X	X
Ambrosia trifida	giant ragweed	X		
Amelanchier utahensis	Utah serviceberry		X	X
Andropogon gerardii	big bluestem		X	X
Androstephium breviflorum	purple funnel-lily	X	X	
Apocynum cannabinum	dogbane		X	
Arabis sp.	rockcress	X	X	X
Arctium minus	burdock		X	
Arenaria fendleri	fendler sandwort			X
Aristida purpurea	purple threeawn	X	X	X
Artemisia bigelovii	Bigelow sagebrush	X	X	X
Artemisia dracunculus	terragon		X	X
Artemisia filifolia	sand sagebrush		X	X
Artemisia frigida	fringed sagebrush		X	X
Artemisia ludoviciana	Louisiana wormwood	X	X	X
Artemisia nova	black sagebrush		X	X
Artemisia spinescens	budsage	X	X	
Artemisia tridentata	big sagebrush	X		X
Asclepian speciosa	showy milkweed	X	X	X
Asclepias involucrata	dwarf wilkweed			X
Asclepias sanjuanensis	San Juan milkweed	X	X	
Asclepias subverticillata	whorled milkweed	X	X	X
Asparagus officinalis	asparagus	X		
Aster falcatus	prairie aster	X		
Aster occidentalis	western aster	X		
Astragalus amphioxys	crescent milkvetch	X	X	X
Astragalus calycosus	torrey milkvetch	X	X	
Astragalus ceramicus	painted milkvetch	X	X	X
Astragalus emoryanus	emory milkvetch		X	
Astragalus flavus	yellow milkvetch		X	X
Astragalus fucatus	Hopi milkvetch	X	X	
Astragalus kentrophyta	spiny milkvetch		X	X
Astragalus lentiginosus	freckled milkvetch		X	X
Astragalus lonchocarpus	great rushy milkvetch	X		X
Astragalus mollissimus	wooly locoweed	X	X	X

Scientific Name	Common Name	Farmington to Shiprock	Hogback to Gallup	Cutter Dam to Starlake
Astragalus newberryi	newberry milkvetch		X	
Astragalus nuttallianus	small-flowered milkvetch	X	X	X
Astragalus praelongus	stinking milkvetch		X	
Astragalus proximus	Aztec milkvetch			X
Astragalus sabulonum	gravel milkvetch	X	X	
Atriplex canescens	four-wing saltbush	X	X	X
Atriplex confertifolia	shadscale	X	X	X
Atriplex corrugata	mat-saltbush	X	X	
Atriplex powellii	Powell orach	X	X	
Atriplex saccaria	stalked orach	X	X	X
Atriplx gardneri	castle valley saltbush	X	X	
Atriplx obovata	New Mexico saltbush	X	X	
Avena fatua	oats	X	X	
Bahia dissecta	cutleaf		X	
Bassia hyssopifolia	five-hook bassia	X	X	X
Bouteloua barbata	sixweeks grama	X	X	X
Bouteloua curtipendula	sideoats grama		X	
Bouteloua eriopoda	black grama		X	
Bouteloua gracilis	blue grama	X	X	X
Brickellia longifolia	longleaf brickelbush	X		X
Brickellia microphylla	rough brickellbush			X
Brickellia oblongifolia	mohave brickellbush			X
Bromus anomalus	nodding brome	X		X
Bromus inermis	smooth brome	X	X	
Bromus japonicus	Japanese brome	X	X	X
Bromus tectorum	cheatgrass	X	X	X
Calochortus flexuosus	straggling mariposa		X	
Calochortus nuttallii	sego lily		X	
Camissonia scapoidea	Paiute suncup		X	
Capsella bursa-pastoris	shepherds purse	X		
Cardaria draba	whitetop		X	
Carduus nutans	musk thistle	X	X	
Carex sp.	sedge	X		X
Castilleja chromosa	common paintbrush	X	X	X
Castilleja integra	wholeleaf paintbrush			X
Castilleja linariifolia	narrowleaf paintbrush	X	X	X
Cenchrus longispinus	field sandbur	X	X	
Centaurea repens	russian knapweed	X	X	X
Ceratoides lanata	winterfat	X	X	X
Cercocarpus montanus	mountain mahogany			X
Chaenactis stevioides	stevia dusty-maiden	X	X	X
Chamaesaracha coronopus	green false nightshade		X	X
Chenopodium fremontii	fremont goosefoot		X	X
Chenopodium leptophyllum	narrowleaf goosefoot	X	X	X

Scientific Name	Common Name	Farmington to Shiprock	Hogback to Gallup	Cutter Dam to Starlake
Chloris virgata	feather fingergrass	X	X	
Chorispora tenella	musk-mustard	X	X	X
Chrysothamnus greenei	Greene rabbitbrush	X	X	X
Chrysothamnus linifolius	spreading rabbitbrush	X		X
Chrysothamnus nauseosus	rubber rabbitbrush	X	X	X
Chrysothamnus viscidiflorus	viscid rabbitbrush		X	X
Cichorium intybus	chickory	X	X	
Cirsium arvense	Canada thistle	X		
Cirsium undulatum	gray thistle			X
Clematis ligusticifolia	white virgins-bower		X	
Cleome serrulata	Rocky Mountain beeplant		X	X
Cleomella palmeriana	Rocky Mountain stickweed		X	
Collinsia parviflora	blue-eyed mary	X		X
Comandra umbellata	bastard toadflax		X	X
Convolvulus arvensis	bindweed	X		X
Conyza canadensis	horseweed	X	X	X
Cordylanthus wrightii	wright birdsbeak			X
Coryphantha vivipara	purple ballcactus	X	X	
Coryphantha vivipara	ball cactus			X
Cowania mexicana	cliffrose		X	X
Crepis occidentalis	western hawksbeard			X
Cryptantha cinerea	James cryptanth	X	X	X
Cryptantha confertifolia	golden cryptanth			X
Cryptantha crassisepala	plains cryptanth	X	X	X
Cryptantha flava	yellow cryptanth			X
Cryptantha flavoculata	yellow-eye cryptanth			X
Cryptantha fulvocanescens	yellow-hair cryptanth			X
Cryptantha gracilis	slender cryptanth			X
Cuscuta sp.	dodder		X	
Cymopterus acaulis	plains spring-parsley	X		
Cymopterus bulbosus	onion spring-parsley		X	
Cymopterus purpurascens	widewing spring-parsley	X		
Cynodon dactylon	bermuda grass	X	X	
Dactylis glomerata	orchard grass	X	X	
Dalea lanata	wooly dalea		X	
Dalea oligophylla	western prairie-clover		X	X
Delphinium andersonii	anderson larkspur	X	X	X
Descurainia pinnata	pinate tansy-mustard	X	X	
Descurainia sophia	flixweed tansy-mustard	X	X	X
Dicora brandegei	brandegee sandplant		X	
Distchilis spicata	desert saltgrass	X	X	
Dithyrea wislizenii	spectacle pod	X	X	X
Draba cuneifolia	wedgeeaf	X		X
Dracocephalum parviflorum	common dragonhead	X	X	

Scientific Name	Common Name	Farmington to Shiprock	Hogback to Gallup	Cutter Dam to Starlake
Dyssodia papposa	pappose glandweed	X	X	X
Echinocereus fendleri	fendler strawberrycactus		X	
Echinocereus triglochidiatus	hedgehog cactus		X	X
Echinochola crus-galli	barnyard grass	X		
Elaeagnus angustifolia	Russian olive	X	X	X
Eleocharis palustris	creeping spikerush	X		X
Elymus canadensis	Canada wildrye	X	X	X
Elymus elongatus	tall wheatgrass	X	X	
Elymus repens	quackgrass	X	X	
Elymus smithii	western wheatgrass	X	X	X
Elymus trachycaulus	slender wheatgrass	X	X	X
Ephedra cutleri	cutler joint-fir		X	X
Ephedra torreyana	torrey joint-fir	X	X	X
Ephedra viridis	Mormon tea	X	X	X
Equisetum arvense	meadow horsetail	X		
Equisetum hyemale	common scouringrush	X		
Eremopyrum triticeum	annual wheatgrass	X	X	X
Eriastrum diffusum	spreading eriastrum	X	X	X
Erigeron bellidiastrum	pretty daisy		X	
Erigeron divergens	spreding daisy	X	X	X
Erigeron flagellaris	trailing daisy			X
Erigeron pulcherrimus	basin daisy			X
Eriogonum alatum	winged buckwheat		X	X
Eriogonum cernuum	nodding buckwheat		X	X
Eriogonum corymbosum	corymb buckwheat		X	X
Eriogonum divaricatum	spreading buckwheat	X	X	X
Eriogonum gordonii	gordon buckwheat	X	X	
Eriogonum jamesii	james buckwheat		X	X
Eriogonum leptocladon	sand buckwheat		X	X
Eriogonum leptophyllum	slenderleaf buckwheat	X	X	X
Eriogonum microthecum	slender buckwheat	X	X	
Eriogonum salsuginosum	smooth buckwheat	X	X	
Eriogonum shockleyi	shockley buckwheat	X		
Eriogonum umbellatum	sulfur buckwheat			X
Eriogonum wetherillii	wetherill buckwheat		X	
Erioneuron pulchellum	fluffgrass	X	X	
Erodium cicutarium	storksbill	X	X	X
Erysimum asperum	pretty wallflower			X
Erysimum capitatum	western wallflower			X
Euphorbia fendleri	fendler spurge	X	X	X
Euphorbia glyptosperma	ridgeseeded spurge		X	
Euphorbia parryi	parry spurge	X	X	X
Evolvulus nuttallianus	nuttall evolvulus	X		X
Festuca octoflora	sixweeks fescue	X	X	X

Scientific Name	Common Name	Farmington to Shiprock	Hogback to Gallup	Cutter Dam to Starlake
Forestiera pubescens	New Mexico desert olive	X	X	
Frankenia jamesii	james frankenia	X	X	
Fraxinus anomala	singleleaf ash		X	
Fraxinus cuspidata	flowering ash		X	
Gaillardia pinnatifida	Hopi blanketflower	X	X	X
Gaillardia pulchella	blanketflower		X	
Gaura coccinea	scarlet gaura		X	
Gaura parviflora	willow gaura	X	X	
Gilia aggregata	scarlet gilia			X
Gilia formosa	Aztec glia			X
Gilia gunnisonii	gunnison gilia		X	
Gilia haydenii	hayden gilia		X	X
Gilia leptomeria	slender gilia	X		X
Gilia multiflora	blue starflower			X
Glycyrrhiza lepidota	licorice	X	X	
Grindelia squarosa	curly gumweed	X	X	
Gutierrezia sarothrae	broom snakeweed	X	X	X
Halogeton glomeratus	halogeton	X	X	X
Haplopappus armerioides	thrifty goldenweed			X
Haplopappus drummondii	drummond goldenweed		X	X
Haplopappus spinulosus	spiny goldenweed		X	X
Helianthus annuus	common sunflower	X	X	
Helianthus petiolaris	prairie sunflower	X	X	X
Heterotheca villosa	hairy goldenaster	X	X	X
Hilaria jamesii	galleta	X	X	X
Hilaria rigida	big galleta		X	
Hordeum jubatum	foxtail barley	X	X	X
Hordeum murinum	rabbit barley		X	
Hordeum pusillum	little barley	X	X	X
Hymenopappus filifolius	hyalineherb	X	X	X
Hymenoxys acaulis	stemless woolybase	X	X	X
Hyoscyamus niger	henbane		X	
Ipomopsis longiflora	whiteflower false gilia			X
Iva axillaris	poverty weed		X	
Juncus balticus	wire rush	X		X
Juncus ensifolius	swordleaf rush	X		
Juncus sp.	rush		X	
Juniperus osteosperma	Utah juniper	X		X
Kochia scoparia	summer-cypress	X	X	X
Lactuca serriola	prickly lettuce	X	X	
Lappula occidentalis	western stickseed	X	X	X
Lathyrus sp.	sweetpea		X	
Lepidium montanum	pepperweed		X	
Lepidium perfoliatum	peppergrass			X

Scientific Name	Common Name	Farmington to Shiprock	Hogback to Gallup	Cutter Dam to Starlake
Leptodactylon pungens	granite prickly gilia	X		X
Lesquerella fendleri	fendler bladderpod			X
Lesquerella sp.	bladderpod	X		
Leucelene ericoides	rose-heath	X	X	X
Linum perenne	blue flax		X	
Linum puberulum	plains flax	X	X	X
Lithospermum incisum	showy stoneseed		X	X
Lupinus pusillus	dwarf lupine	X	X	X
Lycium pallidum	pale wolfberry	X	X	X
Lygodesmia grandiflora	showy rushpink	X	X	X
Machaeranthera canescens	hoary aster	X	X	X
Machaeranthera grindelioides	gumweed aster		X	X
Machaeranthera tanacetifolia	tansyleaf aster	X	X	
Malcomia africana	African mustard		X	
Malocothrix sonchoides	sow-thistle desert dandelion		X	
Malva neglecta	common mallow	X	X	
Marrubium vulgare	common horehound	X	X	X
Medicago lupulina	black medick	X	X	X
Medicago sativa	alfalfa	X	X	
Melilotus albus	white sweetclover	X	X	
Melilotus officinalis	yellow sweetclover	X	X	X
Mentzelia albicaulis	stickleaf	X	X	X
Mentzelia pumila	dwarf stickleaf	X	X	X
Microsteris gracilis	slender false phlox	X		X
Mirabilis linearis	narrowleaf umbrellawort	X	X	X
Mirabilis multiflora	Colorado four o'clock		X	X
Monolepis nuttalliana	povertyweed		X	X
Muhlenbergia pungens	sandhill muhly	X	X	X
Muhlenberia asperifolia	scratchgrass muhly	X	X	X
Munroa squarrosa	alse buffalograss	X	X	X
Nama hispidum	bristly nama		X	X
Oenothera caespitosa	morning lily	X	X	X
Oenothera pallida	pale evening primrose	X	X	
Oneothera albicaulis	whitestem evening primrose		X	X
Opuntia phaeacantha	engelmann prickly pear		X	X
Opuntia polycantha	pricklypear cactus	X	X	X
Opuntia whipplei	whipple chola cactus	X	X	X
Orobanache fasciculata	cluster cancerroot	X	X	
Orobanche ludoviciana	broomrape			X
Oryzopsis hymenoides	indian ricegrass	X	X	X
Oxytropis lambertii	lambert locoweed	X		X
Penstemon angustifolius	narrowleaf penstemon	X	X	X
Penstemon breviculus	narrow mouth penstemon			X
Penstemon eatonii	eaton penstemon		X	

Scientific Name	Common Name	Farmington to Shiprock	Hogback to Gallup	Cutter Dam to Starlake
Petalostemon purpureum	prairie-clover		X	
Petradoria pumila	rock goldenrod			X
Phacelia crenulata	torrey scorpionweed	X	X	X
Phacelia integrifolia	crenateleaf scorpionweed	X	X	X
Phleum pratense	timothy	X	X	X
Phlox hoodii	carpet phlox			X
Phlox longifolia	longleaf phlox	X		X
Phoradendron juniperinum	juniper mistletoe			X
Phragmites australis	common reed	X	X	X
Physalis sp.	ground cherry	X	X	
Physaria newberryi	newberry twinpod		X	X
Pinus edulis	pinyon			X
Plantago lanceolata	buckhorn plantain	X	X	X
Plantago major	broadleaf plantain	X	X	X
Plantago patagonica	wooly plantain	X	X	X
Platyschkuhria integrifolia	oblongleaf bahia	X	X	X
Poa annua	annual bluegrass		X	X
Poa fendleriana	muttongrass			X
Poa palustris	fowl bluegrass	X		
Poa pratensis	Kentucky bluegrass	X		
Poliomintha incana	purple sage		X	
Polygonum aviculare	knotweed	X	X	X
Polypogon monspeliensis	rabbitfoot grass	X	X	X
Populus acuminata	lanceleaf cottonwood	X		
Populus fremontii	fremont cottonwood	X	X	X
Portulaca oleracea	purslane	X	X	X
Psoralidium lanceolatum	dune scurfpea	X		X
Puccinellia distans	weeping alkaligrass		X	X
Puccinellia nuttalliana	nuttall alkaligrass		X	X
Purshia tridentata	antelope bitterbrush		X	X
Quercus gambelii	gambel oak		X	X
Ranunculus cymbalaria	marsh buttercup	X	X	
Ranunculus testiculatus	bur buttercup	X		X
Ratibida columnifera	prairie coneflower	X	X	
Rhus aromatica	skunkbush sumac	X	X	
Rumex crispus	curled dock	X	X	X
Rumex hymenosepalus	canaigre dock		X	X
Salix exigua	coyote willow	X	X	X
Salix sp.	willow	X		
Salsola iberica	tumbleweed	X	X	X
Sarcobatus vermiculatus	greasewood	X	X	X
Schoencrambe linifolia	flaxleaf plains mustard			X
Scirpus pungens	common threesquare	X		X
Sclerocactus cloveriae	clover fishhook cactus			X

Scientific Name	Common Name	Farmington to Shiprock	Hogback to Gallup	Cutter Dam to Starlake
Sclerocactus mesa-verde	Mesa Verde cactus		X	
Sclerocactus parviflorus	devil's claw	X	X	
Senecio douglasii	Douglas groundsel	X	X	X
Senecio multilobatus	Uinta groundsel	X		X
Senecio spartioides	broom groundsel	X	X	X
Setaria glauca	yellow bristlegrass	X		
Setaria verticillata	bur bristlegrass		X	
Sisymbrium altissimum	tumbling mustard	X	X	X
Sitanion hystrix	squirreltail grass	X	X	X
Solanum elaeagnifolium	silverleaf nightshade		X	
Solanum rostratum	buffalobur	X	X	
Solanum triflorum	cutleaf nightshade	X	X	
Solidago canadensis	goldenrod	X		
Sonchus oleraceus	common sow-thistle	X		X
Sophora stenophylla	silvery sophora		X	
Sorghum halepense	johnson grass		X	
Sphaeralcea coccinea	common globemallow	X	X	X
Sphaeralcea fendleri	fendlers globemallow			X
Sphaeralcea parviflora	nelson globemallow	X	X	
Sporobolus airoides	alkali saccaton	X	X	X
Sporobolus contractus	spike dropseed	X	X	X
Sporobolus cryptandrus	sand dropseed	X	X	X
Sporobolus flexuosus	mesa dropseed	X		
Sporobolus giganteus	giant dropseed	X	X	X
Stanleya pinnata	prince's plume		X	X
Stephanomeria exigua	annual wirelettuce	X		X
Stipa comata	needle and thread grass	X	X	X
Stipa neomexicana	New Mexico feathergrass		X	X
Streptanthella longirostris	blackpod nippletwist			X
Streptanthus cordatus	heartleaf twistflower			X
Suaeda torreyana	torrey seepweed	X	X	X
Swertia utahensis	Utah swertia			X
Tamarix ramosissima	saltcedar	X	X	X
Taraxacum officinale	common dandelion	X	X	X
Tetradymia canescens	gray horsebrush		X	X
Thelesperma megapotamicum	Hopi tea greenthread	X	X	X
Thelypodiopsis aurea	durango tumblemustard		X	X
Townsendia annua	annual townsendia		X	X
Townsendia incana	hoary townsendia	X	X	X
Tragia ramosa	noseburn		X	
Tragopogon dubius	yellow salsify	X	X	X
Tragopogon pratensis	goatsbeard		X	
Tribulus terrestris	puncture vine	X		
Triglochin maritima	maritime arrowgrass			X

Scientific Name	Common Name	Farmington to Shiprock	Hogback to Gallup	Cutter Dam to Starlake
Tripterocalyx carneus	wooton sand verbena	X	X	
Typha latifolia	broad-leaved cattail	X		X
Ulmus pumila	Chinese elm	X	X	
Verbascum thapsus	wooly mullein	X		
Verbena bipinnatifida	Dakota vervain			X
Verbena bracteata	prostrate vervain	X		X
Wyethia scabra	rough mulesears		X	
Xanthium strumarium	cocklebur	X	X	X
Yucca angustissima	narrow-leaved yucca	X		X
Yucca bacata	broadleaf yucca			X
Yucca harimaniae	Harriman yucca	X		X

ATTACHMENT I

List of Wildlife Found in the Project Area and Habitat Associations

Species	Common Name	Habitat Types			
		Riparian	Arid	P/J	P/P
Accipiter cooperii	Cooper's hawk	x		x	x
Accipiter gentilis	goshawk			x	x
Accipiter striatus	sharp shinned hawk	x	x	x	x
Aquila chrysaetos	golden eagle		x	x	
Buteo jamaicensis	red-tailed hawk		x	x	x
Buteo lagopus	rough-legged hawk		x		
Buteo regalis	ferruginous hawk		x	x	
Buteo swainsoni	Swainson's hawk	x	x		
Cathartes aura	turkey vukture		x	x	x
Circus cyancus	marsh hawk		x	x	
Falco columbarius	merlin			x	
Falco mexicanus	prairie falcon			x	
Falco peregrinus	peregrine falcon	x	x	x	
Falco sparverius	American kestrel	x	x	x	x
Haliaeetus leucocephalus	bald eagle		x		
Pandian haliaeetus	osprey		x		
Alectoris graeca	chukar		x		
Callipepla squamata	scaled quail		x	x	
Dendragapus obscurus	blue grouse				x
Lophortyx gambelii	Gambel's quail	x	x	x	
Phasianus colchicus	ring-necked pheasant	x	x		
Meleagris gallopavo	turkey		x		
Actitus macularia	spotted sandpiper				x
Actitus macularia	spotted sandpiper	x			
Bartramia longicauda	upland plover		x		
Capella galinego	common snipe		x		
Catoptrophorus semipalmatus	willet		x		
Charadrius alexandrius	snowy plover		x		
Charadrius semipalmatus	semipalmated plover	x			
Charadrius vociferous	killdeer		x		
Childonias niger	black tern		x		
Crocethia alba	sanderling		x		
Ereunetes mauri	western sandpiper	x			
Erolia bairdii	Baird's sandpiper	x			
Erolia melanotos	pectoral sandpiper		x		
Erolia minutilla	least sandpiper		x		
Eupoda montana	mountain plover	x	x		
Himantopus mexicana	black-necked stilt	x			
Larus argentatus	herring gull		x		
Larus atricilla	laughing gull		x		
Larus californicus	California gull		x		
Larus delawarensis	ring-billed gull	x			
Larus philadelphia	Bonaparte's gull	x			
Larus pipixcan	Franklin's gull		x		
Limnodromus scolopaceus	long-billed dowitcher	x			

Species	Common Name	Habitat Types			
		Riparian	Arid	P/J	P/P
Limosa fedoa	marbled godwit	x			
Lopipes lobatus	northern phalarope	x			
Numenius americanus	long-billed curlew	x			
Recurvirostra americana	American avocet	x			
Squatarola squatarola	black-bellied plover	x	x		
Steganopes tricolor	Wilson's phalarope	x			
Sterna caspia	Caspian tern		x		
Sterna forsteri	Forster's tern		x		
Sterna hirundo	common tern		x		
Totanus flavipes	lesser yellowlegs	x			
Totanus melanoleucus	greater yellowlegs	x			
Tringa solitaria	solitary sandpiper	x			
Xema sabini	Sabine's gull		x		
Coccyzus americanus	yellow-billed cuckoo	x			
Columba fasciata	band-tailed pigeon	x		x	x
Columba livia	rock dove		x	x	
Geococcyx californianus	road runner		x	x	x
Scardafella inca	Inca dove		x		
Zenaidura macroura	mourning dove	x	x	x	
Aegolius acadius	saw-whet owl				x
Asio flammeus	short-eared owl		x		
Asio otus	long-eared owl	x		x	
Athene cunicularia	burrowing owl		x		
Bubo virginianus	great-horned owl	x			
Glaucidium gnoma	pygmy owl			x	x
Otus asio	screech owl	x		x	x
Otus flammeolus	flammulated owl				x
Strix occidentalis	spotted owl			x	x
Tyto alba	barn owl		x	x	
Chordeiles minor	common nighthawk	x	x	x	x
Phalaenoptilus nuttallii	poorwill		x	x	x
Aeronautes saxatalis	white-throated swift	x		x	x
Archilochus alexandri	black-chinned hummingbird	x		x	
Cypseloides niger	black swift		x		
Selasphorus platycercus	broad-tailed hummingbird	x		x	x
Selasphorus rufus	rufous hummingbird	x	x	x	x
Stellula calliope	calliope hummingbird				x
Megaceryle alcyon	belted kingfisher	x			
Colaptes auratus	common flicker	x			x
Melanerpes erythrocephalus	red-headed woodpecker	x			
Melanerpes formicivorus	acorn woodpecker				x
Melanerpes lewis	Lewis woodpecker	x		x	x
Picoides pubescens	downy woodpecker	x		x	x
Picoides tridactylus	northern 3-toed woodpecker				x

Species	Common Name	Habitat Types			
		Riparian	Arid	P/J	P/P
Picoides villosus	hairy woodpecker	x		x	x
Sphyrapicus thyroideus	Williamson's sapsucker			x	x
Sphyrapicus varius	yellow-bellied sapsucker	x		x	x
Agelaius phoeniceus	red-winged blackbird	x		x	x
Aimophila cassinii	Cassin's sparrow		x		
Amphispiza belli	sage sparrow		x		
Amphispiza bilineata	black-throated sparrow		x		
Anthus spinoletta	water pipit	x		x	x
Aphelocoma coerulescens	scrub jay			x	
Bombycilla cedrorum	cedar waxwing			x	
Bombycilla garrula	bohemian waxwing			x	
Calamospiza melanocorys	lark bunting		x		
Carpodacus cassinii	Cassin's finch			x	x
Carpodacus mexicanus	house finch		x		x
Catherpes mexicanus	canon wren		x	x	x
Certhia familiaris	brown creeper			x	x
Chondestes grammacus	lark sparrow		x	x	
Cinclus mexicanus	dipper	x		x	x
Cistothorus palustris	long-billed marsh wren	x	x	x	x
Contopus pertinax	Coues' flycatcher			x	x
Contopus sordidulus	western wood pewee	x		x	x
Corvus brachyrhynchos	common crow	x		x	x
Corvus corax	common raven			x	x
Cyanocitta cristata	blue jay		x		x
Cyanocitta stelleri	Steller's jay			x	x
Dendroica auduboni	yellow-rumped warbler			x	x
Dendroica caerulescens	black-throated blue warbler			x	
Dendroica graciae	Grace's warbler			x	x
Dendroica magnolia	magnolia warbler				x
Dendroica nigrescens	black-throated gray warbler			x	
Dendroica occidentalis	hermit warbler			x	x
Dendroica palmarum	palm warbler			x	
Dendroica petechia	yellow warbler	x		x	x
Dendroica townsendi	Townsend's warbler	x		x	x
Dendroica virens	black-throated green warbler				x
Dumetella carolinensis	gray catbird		x	x	
Empidonax difficilis	western flycatcher	x		x	x
Empidonax hammondii	Hammond's flycatcher	x			x
Empidonax oberholseri	dusky flycatcher				x
Empidonax trailii	willow flycatcher	x			x
Empidonax wrightii	gray flycatcher		x	x	
Eremophila alpestris	horned lark		x		
Euphagus cyanocephalus	Brewer's blackbird	x	x		
Geothlypis trichas	common yellowthroat	x			

Species	Common Name	Habitat Types			
		Riparian	Arid	P/J	P/P
Guiraca caerulea	blue grosbeak		x	x	
Gymorhinus cyanocephalus	pinon jay			x	
Hesperiphona vespertina	evening grosbeak			x	x
Hirundo rustica	barn swallow		x		
Hylocichla guttata	hermit thrush	x			x
Hylocichla ustulata	Swainson's thrush	x		x	x
Icteria virens	yellow-breasted chat	x	x		
Icterus glabela	northern oriole		x		
Icterus parisorum	Scott's oriole		x	x	
Iridoprocne bicolor	tree swallow	x		x	x
Junco caniceps	gray-headed junco			x	x
Junco oreganus	dark-eyed junco	x		x	x
Lanius excubitor	northern shrike		x		
Lanius ludovicianus	loggerhead shrike		x	x	
Leucosticte australis	brown-capped rosy finch	x			
Leucostricte atrata	black rosy finch	x		x	x
Leucostricte tephrocotis	gray-crowned rosy finch	x		x	x
Loxia curvirostra	red crossbill				x
Maietilta varia	black and white warbler			x	
Melospiza lincolnii	Lincoln's sparrow	x			
Melospiza melodia	song sparrow		x		
Mimus polyglottus	mockingbird		x	x	x
Molothrus ater	brown-headed cowbird	x		x	x
Myadestes townsendi	Townsend's solitaire			x	x
Myiarchus cinerascens	ash-throated flycatcher		x	x	x
Nucifraga columbiana	Clark's nutcracker				x
Nuttalornis borealis	olive-sided flycatcher	x			x
Oporonis tolmiei	MacGillivray's warbler	x			x
Oreoscoptes montanus	sage thrasher		x		
Parus atricapillus	black-capped chickadee	x		x	x
Parus gambeli	mountain chickadee	x		x	x
Parus inornatus	plain titmouse			x	
Paserina amoena	lazuli bunting		x	x	
Passer domesticus	house sparrow		x	x	
Passerculus sandwichensis	savannah sparrow		x		
Passerella iliaca	fox sparrow		x		
Passerina cyanea	indigo bunting		x	x	
Perisoreus canadensis	gray jay				x
Petrechelidon pyrrhonata	cliff swallow		x		
Pheuticus ludovicianus	rose-breasted grosbeak			x	
Pheuticus melanocephalus	black-headed grosbeak	x			x
Pica pica	black-billed magpie	x	x	x	x
Pipilo chlorurus	green-tailed towhee	x	x		
Pipilo fuscus	brown towhee		x	x	

Species	Common Name	Habitat Types			
		Riparian	Arid	P/J	P/P
Piplio erythrophtalmus	rufous-sided towhee	x	x		
Piranga flava	hepatic tanager				x
Piranga ludoviciana	western tanager	x		x	x
Piranga olivacea	scarlet tanager	x			x
Pocecetes gramineus	vesper sparrow		x		
Polioptila caerulea	blue-gray gnatcatcher		x	x	
Progne subis	purple martin				x
Psaltriparus minimus	common bushtit	x		x	x
Quiscalus mexicanus	great-tailed grackle	x			
Quiscalus quiscula	common grackle	x			
Regulus calendula	ruby-crowned kinglet			x	x
Regulus satrapa	golden-crowned kinglet				x
Riparia riparia	bank swallow		x	x	
Salpinetes obsoletus	rock wren			x	x
Sayornis nigricans	black phoebe		x		
Sayornis phoebe	eastern phoebe		x		
Sayornis saya	Say's phoebe		x		
Seirus noveberacensis	northern waterthrush	x			
Seiurus aurocapillus	ovenbird			x	
Setophaga ruticilla	American redstart			x	
Sialia currocoides	mountain bluebird			x	x
Sialia mexicana	western bluebird	x		x	x
Sialia sialis	eastern bluebird			x	
Sitta canadensis	red-breasted nuthatch	x		x	x
Sitta carolinensis	white-breasted nuthatch	x		x	x
Sitta pygmaea	pygmy nuthatch	x		x	x
Spinus lawrencei	Lawrence's goldfinch	x			
Spinus pinus	pine siskin	x			x
Spinus psaltris	lesser goldfinch	x			
Spinus tristis	American goldfinch	x	x	x	
Spiza americana	dickcissel		x		
Spizella arborea	tree sparrow		x	x	
Spizella breweri	Brewer's sparrow			x	
Spizella passerina	chipping sparrow	x		x	x
Stelgidopteryx ruficollis	rough-winged swallow	x			
Sturnella magna	eastern meadowlark	x	x		
Sturnella neglecta	western meadowlark	x	x		
Sturnus vulgaris	starling		x		x
Thryomanes bewickii	Bewick's wren	x		x	x
Toxostoma bendirei	Bendire's thrasher		x	x	
Toxostoma rufum	brown thrasher		x		
Trachycineta thalassina	violet-green swallow				x
Troglodytes aedon	house wren	x		x	x
Turdus migratorius	American robin	x		x	x

Species	Common Name	Habitat Types			
		Riparian	Arid	P/J	P/P
Tyrannus tyrannus	eastern kingbird	x			
Tyrannus vericalis	western kingbird		x	x	
Tyrannus vociferans	Cassin's kingbird	x		x	x
Vermivora celata	orange-crowned warbler				x
Vermivora luciae	Lucy's warbler	x	x		
Vermivora ruficapilla	nashville warbler			x	
Vermivora virginiae	Virginia's warbler	x		x	x
Vireo gilvus	warbling vireo	x		x	x
Vireo olivaceus	red-eyed vireo			x	
Vireo solitarius	solitary vireo	x		x	x
Vireo vicinior	gray vireo			x	
Wilsonia pusilla	Wilson's warbler	x	x		
Xanthocephalus xanthocephalus	yellow-headed blackbird	x			
Zonotrichia	white-crowned sparrow	x		x	
Zonotrichia guerula	Harris' sparrow		x		
Podiceps auritus	horned grebe		x		
Podiceps caspicus	eared grebe		x		
Aechomophorus occidentalis	western grebe		x		
Podilymbus podiceps	pied-billed grebe	x			
Pelecanus erythrorhynchos	white pelican		x		
Phalacrocorax auritus	double-crested cormorant	x			
Ardea herodias	great blue heron	x			
Butorides striatus	green heron		x		
Casmerodius albus	great egret		x		
Leucophoyx thula	snowy egret		x		
Nycticorax nycticorax	black-crowned night heron	x			
Ixobrychus exilis	least bittern		x		
Botaurus lentiginosus	American bittern	x			
Plegadis chihi	white-faced ibis	x			
Olor columbianus	whistling swan	x			
Branta canadensis	Canada goose		x		
Anser albifrons	white-fronted goose	x			
Chen hyperborea	snow goose		x		
Anas platyrhynchos	mallard		x		
Anas strepera	gadwall		x		
Anas acuta	pintail		x		
Anas carolinensis	green-winged teal	x			
Anas discors	blue-winged teal	x			
Anas cyanoptera	cinnamon teal		x		
Mareca americana	American wigeon	x			
Spatula clypeata	northern shoveler	x			
Aix sponsa	wood duck		x		
Aythya americana	redhead		x		
Aythya collaris	ring-necked duck	x			

Species	Common Name	Habitat Types			
		Riparian	Arid	P/J	P/P
Aythya valisineria	canvasback		x		
Aythya affinis	lesser scaup		x		
Bucephala clangula	common goldeneye	x			
Bucephala islandica	Barrow's goldeneye	x			
Bucephala albeola	bufflehead		x		
Melanitta perspicillata	surf scooter		x		
Oxyura jamaicensis	ruddy duck		x		
Lophodytes cucullatus	hooded merganser	x			
Mergus merganser	common meganser	x			
Mergus serrator	red-breasted merganser	x			
Ictinia mississippiensis	Mississippi kite	x			
Rallus limicola	Virginia rail		x		
Porzana carolina	sora		x		
Gallinula chloropus	common gallinule	x			
Fulica americana	American coot	x			
Notiosorex crawfordi	desert shrew		x	x	
Sorex merriami	merriam shrew		x	x	
Sorex nanua	dwarf shrew				x
Sorex vagrans	vagrant shrew				x
Antrozous pallidus	pallid bat	x	x	x	x
Eptesicus fuscus	big brown bat	x		x	x
Euderma maculata	spotted bat			x	x
Lasiurus borealis	red bat			x	x
Lasionycteris noctivagans	silver-haird bat	x	x	x	x
Lasiurus cinereus	hoary bat	x		x	x
Myotis californicus	California myotis	x	x	x	x
Myotis evotis	long-eared myotis				x
Myotis leibii	small-footed myotis		x	x	x
Myotis lucifugus	little brown myotis	x	x	x	x
Myotis subulatus	small-footed myotis	x	x	x	x
Myotis thysanodes	fringed myotis	x	x	x	x
Myotis velifer	cave myotis		x	x	
Myotis volans	long-legged myotis	x	x	x	x
Myotis yumanensis	Yuma myotis	x	x	x	
Pipistrellus hesperus	western pipistrel	x	x	x	x
Plecotus townsendi	Townsend's big-eared bat	x	x	x	x
Tadarida brasiliensis	Mexican free-tailed bat	x	x	x	
Tadarida macrotis	big free-tailed bat	x	x	x	
Sylvilagus audubonii	desert cottontail rabbit	x	x	x	
Sylvilagus floridanus	eastern cottontail rabbit			x	x
Sylvilagus nuttali	Nuttall's cottontail rabbit	x			
Lepus californicus	blacktail jackrabbit	x	x	x	x
Ammospermophilus leucurus	w.t. antelope g. squirrel	x	x		
Castor canadensis	beaver		x		

Species	Common Name	Habitat Types			
		Riparian	Arid	P/J	P/P
Cynomis gunnisoni	Gunnison's prairie dog	x	x	x	x
Dipodomys ordi	Ord's kangaroo rat		x	x	
Dipodomys spectabilis	banner-tailed kangaroo rat		x		
Erethizon dorsatum	porcupine	x	x	x	x
Eutamias dorsalis	cliff chipmunk			x	x
Eutamias minimus	least chipmunk				x
Eutamias quadrivittatus	Colorado chipmunk			x	x
Microtus pennsylvanicus	meadow vole		x		
Microtus montanus	mountain vole				x
Microtus mexicanus	Mexican vole			x	x
Microtus longicaudus	long-tailed vole				x
Mus musculus	house mouse		x	x	
Neotoma albigula	white-throated woodrat		x	x	x
Neotoma cinerea	bushy-tailed woodrat			x	x
Neotoma mexicana	Mexican woodrat			x	x
Neotoma stephensi	Stephen's woodrat			x	
Ondatra zibethica	muskrat		x		
Onychomys leucogaster	northern grasshopper mouse		x	x	
Perognathus flavus	silky pocket mouse		x	x	
Perognathus flavescens	plains pocket mouse		x	x	
Peromyscus boylei	brush mouse			x	
Peromyscus crinitus	canyon mouse			x	
Peromyscus difficilis	rock mouse			x	
Peromyscus leucopus	white-footed mouse			x	
Peromyscus maniculatus	deer mouse	x	x	x	x
Peromyscus truei	pinon mouse		x	x	
Reithrodontomys megalotis	western harvest mouse	x	x	x	x
Sciurus aberti	Abert's squirrel				x
Spermophilus spilosoma	spotted ground squirrel		x		
Spermophilus variegatus	rock squirrel		x	x	
Tamiasciurus hudsonicus	red squirrel				x
Thomomys bottae	Botta's pocket gopher	x	x	x	x
Thomomys talpoides	northern pocket gopher				x
Bassariscus astutus	ring-tailed cat		x	x	
Canis latrans	coyote	x	x	x	x
Felis concolor	mountain lion	x		x	x
Lynx rufus	bobcat	x	x	x	x
Lytra canadensis	river otter		x		
Martes americana	marten				x
Mephitis mephitis	striped skunk	x	x	x	x
Mustela frenata	long-tailed weasel	x	x	x	x
Mustela nigripes	black-footed ferret		x	x	x
Mustela vison	mink		x		
Procyon lotor	raccoon	x	x	x	x

Species	Common Name	Habitat Types			
		Riparian	Arid	P/J	P/P
Spilogale putorius	western spotted skunk	x	x	x	x
Taxidea taxus	badger	x	x	x	x
Urocyon cinereoargenteus	gray fox	x	x	x	x
Ursus americanus	black bear	x		x	x
Vulpes macrotis	kit fox		x		
Vulpes vulpes	red fox		x	x	x
Antilocapra americana	pronghorn antelope		x		
Cervus canadensis	elk			x	x
Odocoileus hemionus	mule deer	x	x	x	x
Ambystoma tigrinum	tiger salamander	x	x	x	x
Bufo cognatus	great plains toad	x	x	x	
Bufo punctatus	red-spotted toad	x	x		
Bufo woodhousei	Woodhouse's toad	x	x	x	
Hyla arenicolor	canyon treefrog			x	
Pseudacris triseriata	chorus frog	x	x	x	x
Rana catesbeiana	bullfrog		x		
Rana pipiens	leopard frog	x			x
Scaphiopus bombifrons	plains spadefoot	x	x		x
Scaphiopus hammondi	western spadefot	x	x	x	
Scaphiopus intermountainus	great plains spadefoot		x	x	
Arizona elegans	glossy snake		x		
Cnemidophorus inornatus	little striped whiptail		x		
Cnemidophorus tigris	western whiptail	x	x	x	
Cnemidophorus velox	plateau whiptail	x	x	x	
Coluber constrictor	racer	x	x	x	x
Crotalis atrox	western diamondback			x	
Crotalis grahamiae	mountain patch-nosed snake			x	
Crotalis viridis	western rattlesnake		x	x	x
Crotophytus collaris	collared lizard		x	x	
Crotophytus wislezenii	leopard lizard		x		
Diadophis punctatus	ring-necked snake			x	x
Elaphe guttata	corn snake	x	x	x	x
Eumeces multivirgatus	many-lined skink	x		x	x
Holbrookia macualata	esser earless lizard		x		
Hypsiglena torquata	night snake			x	
Lampropeltus getulus	common kingsnake	x	x	x	x
Lampropeltus triangulum	milk snake				x
Masticophis flaggellum	coachwhip			x	
Masticophis taeniatus	striped whipsnake		x	x	
Opheodrys vernalis	smooth green snake	x			
Phrynosoma douglassi	short horned lizard		x	x	x
Pituophis melanoleucus	gopher snake	x	x	x	x
Rheinocheilus lecontei	long-nosed snake	x	x		
Sauromalus obesus	chuckwalla		x	x	

Species	Common Name	Habitat Types			
		Riparian	Arid	P/J	P/P
Sceloporus graciosus	sagebrush lizard		x	x	
Sceloporus magister	desert spiny lizard	x	x	x	
Sceloporus undulatus	eastern fence lizard	x	x	x	x
Tantilla planiceps	western black-headed snake	x	x	x	
Thamnophis crytopsis	black-necked garter snake	x			
Thamnophis elegans	western terrestrial garter	x	x	x	x
Thamnophis sirtalis	common garter snake	x			
Urosaurus ornatus	tree lizard		x	x	x
Uta stansburiana	side-blotched lizard		x		
Xantusia vigilis	desert night lizard		x	x	

ATTACHMENT J

Soil and Geology Descriptions

SOIL AND GEOLOGY DESCRIPTIONS

SOILS GREAT GROUPS WITHIN THE NAVAJO-GALLUP WATER SUPPLY PROJECT AREA

Cambothids

Cambothids are the Aridisols that:

(1) Have a cambic horizon that has its upper boundary within 100 centimeters of the soil surface

(2) Have a soil temperature regime warmer than cryic

(3) Do not have a duripan or an argillic, calcic, natric, petrocalcic, gypsic, petrogypsic, or salic horizon that has its upper boundary within 100 centimeters of the soil surface

These are the Aridisols with the least degree of soil development. These soils have a cambic horizon within 100 centimeters of the soil surface. They may have other diagnostic horizons, such as a petrocalcic, gypsic, or calcic horizon, but the upper boundary of these horizons must be below 100 centimeters of the soil surface. These soils are the most common Aridisols in the United States.

Haplargids

Haplargids are the Argids that:

(1) Do not have a duripan or a petrocalcic, petrogypsic, gypsic, or calcic horizon that has an upper boundary within 150 centimeters of the soil surface

(2) Do not have a natric horizon

(3) Have a densic, lithic, or paralithic contact within 50 centimeters of the soil surface, or

a. A clay increase of less than 15 percent (absolute) within a vertical distance of 2.5 centimeters either within the argillic horizon or at its upper b boundary, or

b. An argillic horizon that does not extend to 150 centimeters from the soil surface, has a clay decrease with increasing depth of 20 percent or more (relative) from the maximum clay content, or has either (1) hue of 10YR or yellower or chroma of 4 or less in the matrix of all horizons between depths of 100 and 150 centimeters or (2) hue of 10YR or yellower and value, moist, of 4 or more or value, dry, of 4 or less in less than 50 percent of the matrix

These are the Argids that have an argillic horizon but do not have a duripan or a petrocalcic, petrogypsic, calcic, gypsic, or natric horizon. These soils commonly have calcium carbonate accumulations within or below the argillic horizon. Haplargids commonly occur on late-Pleistocene surfaces or sediments.

Torriorthents

Torriorthents are the Orthents that have an aridic (or torric) moisture regime and have a soil temperature regime warmer than cryic. These are the dry Orthents of cool to hot, arid regions. They have an aridic (or torric) moisture regime and a temperature regime warmer than cryic. Generally, they are neutral or calcareous and are on moderate to very steep slopes. A few are on gentle slopes. Many of the gently sloping soils are on rock pediments, are very shallow, have a sandy-skeletal particle-size class, or are salty. Others are on fans where sediments are recent but have little organic carbon. The vegetation on Torriorthents commonly is sparse and consists mostly of xerophytic shrubs and ephemeral grasses and forbs. The vegetation on a few of the soils is saltgrass. Torriorthents are used mainly for grazing. They are extensive in the Western United States.

Torrifluvents

Torrifluvents are the Fluvents that have an aridic (or torric) moisture regime and a soil temperature regime warmer than cyric. These are the Fluvents of arid climates. Most of them have a high pH value and are calcareous, and a few are somewhat salty. The soils are subject to flooding, but most are not flooded frequently or for long periods. The larger areas that have a favorable topography and are close to a source of water commonly are irrigated. The natural vegetation on the Torrifluvents in the United States consisted mostly of grasses, xerophytic shrubs, and cacti, but in some parts of the world, the only vegetation on the soils has been irrigated crops because the sediments accumulated while the soils were being cultivated.

Torripssaments

Torripsamments are the Psamments that have an aridic (or torric) moisture regime and a soil temperature regime warmer than cryic. These are the cool to hot Psamments of arid climates. They have an aridic (or torric) moisture regime and a temperature regime warmer than cryic. Many of these soils are on stable surfaces, some are on dunes, some are stabilized, and some are moving. Torripsamments consist of quartz, mixed sands, volcanic glass, or even gypsum, and may have any color. Generally, they are neutral or calcareous and are nearly level to steep. The vegetation consists mostly of xerophytic shrubs, grasses, and forbs. Many of these soils support more vegetation than other soils with an aridic moisture regime, presumably because they lose less water as runoff. Some of the soils on dunes support a few ephemeral plants or have a partial cover of xerophytic and ephemeral plants. The shifting dunes may be devoid of plants in normal years. Most of the deposits are of late-Pleistocene or younger age. These soils are used mainly for grazing. They are extensive in the Western United States.

Table J-1.—Soil map unit classifications within the project area

Map unit name	Slope (%)	Depth (inches)	Erosion[1] hazard	Land capability classification[2]	Project[3] features
Aquima-Hawaikuh silt loams	1–5	>60	1 to 2	3e & 6c	m
Badland			4	8	c
Badland-Genats complex[4]	35–60	20–40	3 to 4	7e	m
Badland-Rock complex			4	8	p
Benally fine sandy loam	1–5	>60	1 to 2	7s	a
Benally loamy sand	1–3	>60	1	6c	a
Breadsprings and Nahodish soils	0–2	>60	1	6c	m
Brimham-Benally-Genats association	0–45	20–60	1 to 3	7c & 7e	m
Buckle fine sandy loam	1–8	>60	1 to 2	6c	m
Buckle-Gapmesa-Barboncito complex	1–6	10–60	1 to 2	6c	m
Calladito-Elias association	1–6	>60	1 to 2	7e & 7s	c
Camac-Kimbeto-Badland association	0–50	20–40	1 to 4	7e & 7s	p
Chinde loam	0–5	>60	1 to 2	7s	a
Councelor-Eslendo-Calladito complex	2–25	5–60	1 to 3	6c & 7e	c
Doak-Shiprock complex	1–8	>60	1	7c	m
Doakum-Betonnie complex	1–8	>60	1 to 2	6c	c
Fajada-Huerfano-Benally Complex	1–5	10–60	1 to 2	7c & 7s	m
Farb-Chipeta-Rock outcrop complex	2–30	5–20	1 to 4	7e & 7s	m
Farb-Rock outcrop-Badland complex	2–25	5–10	1 to 4	7s	a, m, p
Gyptur very fine sandy loam	0–3	40–60	1	7s	a, m, p
Hamburg clay loam	0–1	>60	1	6s	m
Jeddito-Escavada association	0–3	>60	1	6e & 7c	m
Jeddito loamy fine sand	0–2	>60	1	7c	m
Kimbeto-Huerfano complex	1–4	10–60	1	7c & 7s	a, m
Kimbeto loamy fine sand	0–4	40–60	1	7c	M
Littlehat-Persayo-Badland complex	3–45	10–40	1 to 4	7s	a, p

Table J-1.—Soil map unit classifications within the project area (continued)

Map unit name	Slope (%)	Depth (inches)	Erosion[1] hazard	Land capability classification[2]	Project[3] features
Littlehat-Persayo-Nataani complex	1–15	10–40	1 to 2	7c & 7s	a, m, p
Mesa fine sandy loam	1–4	>60	1 to 2	7c	M
Nageezi loamy fine sand	1–6	>60	1 to 2	7c	P
Norkiki-Kimnoli complex	1–8	5–40	1 to 2	7c & 7s	M
Notal-Escavada-Riverwash association	0–1	>60	1 to 4	6e & 7c	a, p
Notal-Hamburn complex	0–2	>60	1	6c & 7c	M
Notal sandy clay loam	0–1	>60	1	7c	a, m, p
Persayo-Fordbutte association	1–10	10–40	1 to 2	7c & 7s	m
Ravola very fine sandy loam	1–3	>60	1	7c	a, m, p
Razito-Shiprock complex	3–8	>60	1 to 2	7c	m
Rehobeth silty clay loam	0–1	>60	1	6c	m
Riverwash-Escawetter association	0–1	>60	1 to 4	7c	m
Shiprock-Farb complex	1–5	5–60	1 to 2	7c & 7s	m
Sparank-San Mateo-Zia complex	0–3	>60	1	6c	m
Starlake clay	1–3	>60	1	7s	c
Suwanee loam	0–1	>60	1	6c	m
Tsosie-Councelor-Blancot fine sandy loams	1–3	>60	1	6c	c
Tsebitai very fine sandy loam	1–3	>60	1	7c	a, m
Wingrock – rock outcrop association	4–15	>60	1 to 4	7c	m
Werito loam	1–3	20–40	1	7s	m
Zia sandy loam	1–5	>60	1 to 2	6c	m

[1] Erosion hazards: 1 = slight, 2 = moderate, 3 = severe, 4 = very severe.
[2] Land capability classification: See table J-2 for definitions.
[3] Project features: a = Amarillo, c = Cutter, m = main, p = PNM laterals.
[4] A complex is a map unit where both soils are of roughly equal dominance.

Table J-2.—Land capability definitions[1]

Land capability classification	Class description
3	Soils in Class 3 have severe limitation that reduce the choice of plants or require special conservation practices, or both. When used for cultivated crops, the conservation practices are usually more difficult to apply and to maintain. They may be used for cultivated crops, pasture, woodland, range, or wildlife food and cover.
6	Soils in Class 6 have severe limitations that make them generally unsuited to cultivate and limit their use largely to pasture or range, woodland, or wildlife food and cover. Physical conditions of these soils are such that it is practical to apply range or pasture improvements, if needed, such as seeding, liming, fertilizing, and water control with contour furrows, drainage, diversions, or water spreaders.
7	Soils in Class 7 have severe limitations that make them unsuited and restrict their use largely to grazing, woodland, or wildlife. Physical conditions of these soils are such that it is impractical to apply pasture or range improvements.
8	Soils and landforms in Class 8 have limitations that preclude their use for commercial plant production and restrict their use to recreation, wildlife, water supply, or aesthetic purposes. Badlands, rock outcrops, sandy beaches, river washes, mine tailings, and other nearly barren lands are include in Class 8.
Capability subclass	**Subclass description**
c	Climatic limitations – Made up of soils where the climate (temperature or lack of moisture) is the only major hazard or limitation in their use.
e	Erosion – Made up of soils where excess water is the dominant hazard or limitation in their use. Erosion susceptibility and past erosion damage are the major soil factors for placing soils in this subclass.
s	Soil limitation – Includes, as the name implies, soils that have such limitations as shallowness of rooting zones, stones, low moisture-holding capacity, low fertility difficult to correct, salinity, and sodium.

[1] Taken from the National Soils Survey Handbook, Part 622—Ecological and Interpretive Groups (Natural Resource Conservation Service, 2001).

GEOLOGIC MAP UNITS WITHIN THE PROJECT AREA

Alluvium (Holocene) – Stream-deposited clay, silt, sand, and gravel on valley floors and in lowest terraces. Includes some fan and sheetwash alluvium. As much as 10 meters thick.

San Jose Formation (Eocene) – Sandstone, shale, and minor conglomerate. Divided into three units in some areas (Baltz, 1967). Thickness as much as 600 meters.

Nacimiento Formation (Paleocene) – Gray to olive-gray shale; minor interbedded sandstone in southwest, but in northeast nearly one-half of formation is sandstone. Grades into the Animas Formation to the north. Thickness as much as 580 meters.

Ojo Alamo Formation (Paleocene) – Brown crossbedded sandstone containing spherical-pebble conglomerate composed of quartzite and chert clasts near base. Grades laterally into the lower part of the Animas Formation to the north. Contains abundant petrified wood. Thickness of 25–65 meters.

Undivided (Upper Cretaceous) – Undivided.

Kirkland and Fruitland Formations (Upper Cretaceous) – Undivided.

> *Kirkland Shale* – Upper most part is grayish mudstone, claystone, and sandstone; medial part is Farmington Sandstone Member; and lower part is greenish-gray mudstone and claystone (Mytton, 1979). Thickness of 25–30 meters.
>
> *Fruitland Formation* – Gray, brown, and black mudstone and shale; yellowish-brown, crossbedded sandstone; and coal. Thickness of 25–45 meters.

Pictured Cliff Sandstone (Upper Cretaceous) – Upper part is yellowish-gray to grayish-orange marine sandstone; lower part is interbedded, brown sandstone and gray shale. Thickness 0–78 meters.

Cliff House Sandstone – Tan, fine- to medium-grained marine sandstone and minor shale; mapped separately in southwestern part of area. Thickness of 12 meters near Tierra Amarilla to about 420 meters near Bloomfield (subsurface).

Meneffe Formation – Tan and brown sandstone, gray and brown claystone and shale, coal, and layers of large ironstone and limestone concretions; mapped separately in southwestern part of area, but not in central part. Thickness ranges from 4 meters near Chama to about 450 meters near Chaco Culture National Historic Park.

Point Lookout Sandstone – Tan and brown marine sandstone and lesser amount of gray shale; mapped with Mesaverde Group; not mapped separately. Thickness ranges from 12 meters near Tierra Amarilla to 46 meters near Chaco Culture National Historic Park.

Crevasse Canyon Formation – Coal-bearing units are Ditco and Gibson Coal Members; other members are Bortiett Barren, Dalton Sandstone, and Borrego Pass Sandstone (or Lentil).

Gallup Sandstone – Generally regressive marine sandstone, Turonian.

Mancos Shale (Upper Cretaceous) – Composed of three members. Undivided near Nacimiento Mountains. Total thickness ranges from 570–770 meters.

Morrison Formation (Upper Jurassic) – Grayish-orange, fine- to medium-grained sandstone, greenish-gray and red mudstone, red claystone, and some conglomerate in upper part. Thickness of about 270 meters.

San Rafael Group (Middle Jurassic) – Consists of Entrada Sandstone, Todilto, and Summerville Formations; Bluff Sandstone and locally Zuni Sandstone (or only Acoma Tongue of Zuni).

Chinle Group (Upper Triassic) – Consists of four members. Thickness of 210–430 meters.

> *Upper Shale Member* – Interbedded, variegated red, green, and maroon shale and red siltstone and lenticular sandstone. Thickness 150–200 meters.
>
> *Poleo Sandstone Lentil* – Greenish-gray, very fine- to coarse-grained, micaceous conglomeratic sandstone with subordinate green and reddish-maroon shale and minor pellet limestone. Thickness of 7–80 meters.
>
> *Salitral Shale Tongue* – Maroon shale with subordinate green shale and, locally, some very coarse-grained, green calcareous sandstone. Thickness of 100–110 meters.
>
> *Agua Zarca Sandstone Member* – White to light-buff, fine- to coarse-grained, very thick-bedded quartzose sandstone, conglomerate, and conglomeratic sandstone. Thickness of 1–40 meters.