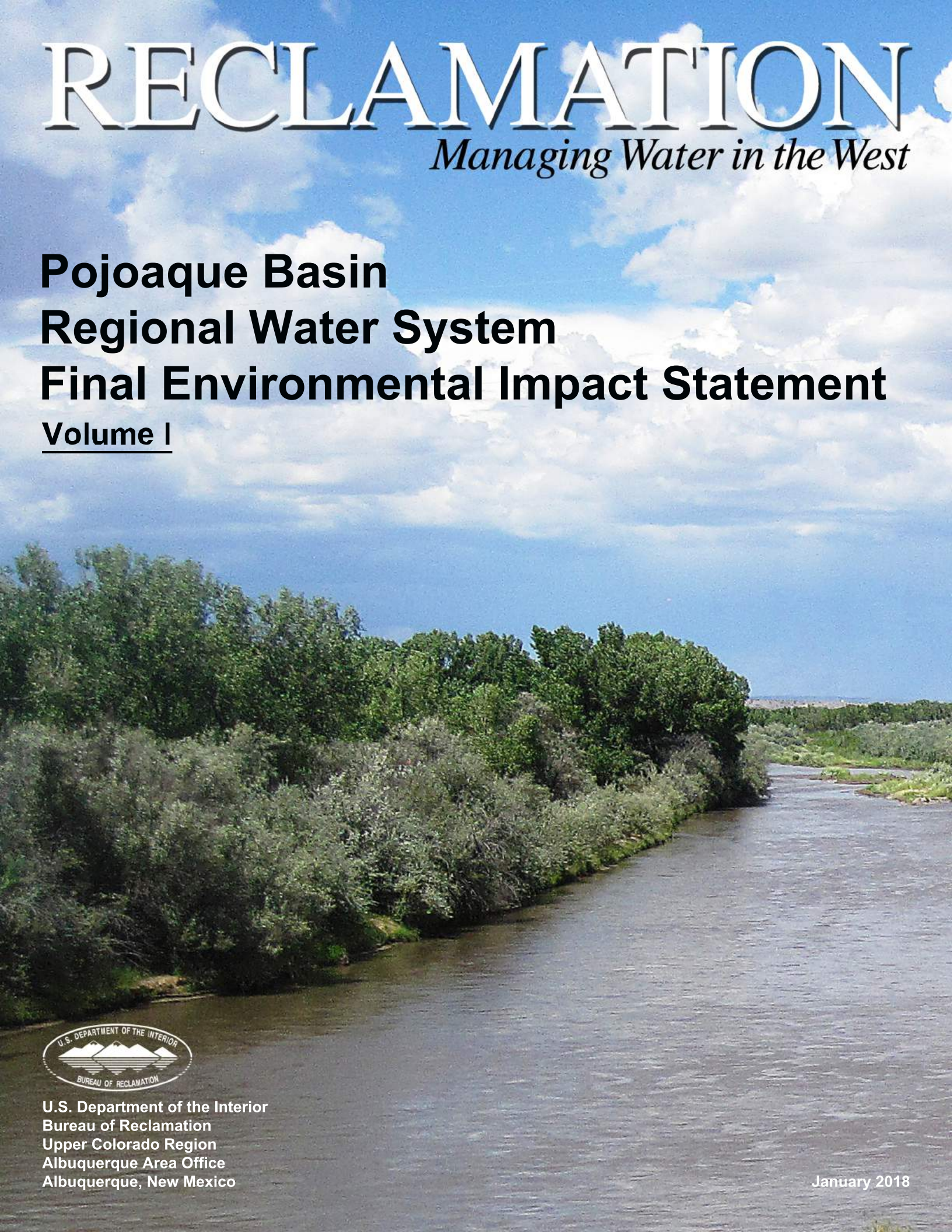
RECLAMATION

Managing Water in the West

Pojoaque Basin Regional Water System Final Environmental Impact Statement

Volume I



U.S. Department of the Interior
Bureau of Reclamation
Upper Colorado Region
Albuquerque Area Office
Albuquerque, New Mexico

January 2018

MISSION STATEMENT

Protecting America's Great Outdoors and Powering Our Future

The Department of the Interior protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities.

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

Cover Photo Credit: EMPSi

Pojoaque Basin Regional Water System
Final Environmental Impact Statement

Lead Agency:	Bureau of Reclamation, Upper Colorado Region
Responsible Official:	Department of the Interior, Secretary of the Interior
Cooperating Agencies:	Federal: U.S. Army Corps of Engineers U.S. Bureau of Indian Affairs U.S. Fish and Wildlife Service U.S. Indian Health Service Tribal (Settlement Pueblos): Pueblo de San Ildefonso Pueblo of Nambé Pueblo of Pojoaque Pueblo of Tesuque State and Local: City of Santa Fe New Mexico Department of Transportation Santa Fe County
Abstract:	The Bureau of Reclamation is proposing to provide a reliable and safe supply of treated drinking water by constructing a regional water system and associated projects in the Pojoaque Basin in north-central New Mexico. This project is in accordance with the Aamodt Litigation Settlement Act (Public Law 111–291, Title VI; 124 Stat. 3065; Settlement Act). The project is needed to reduce reliance on groundwater in the Pojoaque Basin and to allow the Settlement Pueblos to receive a portion of the water provided under the Settlement Act. The project would capture water from the Rio Grande, treat it to drinking water standards, and distribute it to residents via a series of pipes and storage tanks.
For Information Contact:	Ms. Sarah Branum, Project Manager Bureau of Reclamation, Albuquerque Area office 555 Broadway NE, Suite 100, Mail Stop ALB-707 Albuquerque, NM 87102 505-462-3591 sbranum@usbr.gov

This page intentionally left blank.

Pojoaque Basin Regional Water System
Final EIS

Volume 1 – Final EIS

Executive Summary

Chapter 1. Purpose of and Need for Action

Chapter 2. Description of Alternatives

Chapter 3. Affected Environment

Chapter 4. Environmental Consequences

Chapter 5. Public Involvement, Consultation, and Coordination

Chapter 6. List of Preparers

Chapter 7. References

Chapter 8. Glossary

Chapter 9. Index

Volume 2 – Appendices

Appendix A. Screening Criteria Memo

Appendix B. Alternatives Figures

Appendix C. Aquifer Storage and Recovery Reports

Appendix D. Visual Simulations

Appendix E. Pojoaque Basin Regional Water System Environmental Investigation Report

Appendix F. Economic Impact Analysis Methodology

Appendix G. Supplemental Socioeconomic Baseline Conditions

Appendix H. Air Technical Report

Appendix I. Water Resources Technical Report

Appendix J. Pojoaque Basin Regional Water System Biological Assessment and U.S. Fish and Wildlife Service Concurrence Letter

Volume 3 – Draft EIS Comment Summary and Response Report

This page intentionally left blank.

Table of Contents

Executive Summary ES-1

ES.1 Introduction ES-1
ES.2 Project Description ES-1
ES.3 Setting ES-2
ES.4 Purpose of and Need for Action ES-4
ES.5 Other Objectives of the Project and Connected Actions ES-4
ES.6 Federal Decisions to Be Made ES-5
ES.7 Summary of Changes Between the Draft EIS and the Final EIS ES-5
ES.8 Regional Water System Alternatives ES-6
ES.8.1 Preferred Alternative ES-7
ES.8.2 Alternative A, No Action ES-8
ES.8.3 Alternative B, HKM Implementable Alternative ES-8
ES.8.4 Alternative C ES-12
ES.8.5 Alternative D ES-13
ES.8.6 Alternative E (Preferred Alternative) ES-13
ES.8.7 RWS Alternatives Considered but Eliminated from Detailed Study ES-14
ES.9 Connected Actions ES-14
ES.9.1 Rio Pojoaque Irrigation Improvement Project Alternatives ES-14
ES.9.2 Rio Tesuque Channel Modification Project Alternatives ES-16
ES.9.3 Pueblo de San Ildefonso Future Projects Alternatives ES-17
ES.10 Environmental Consequences and Summary Impacts ES-18
ES.10.1 Surface Water and Groundwater ES-18
ES.10.2 Water Quality ES-18
ES.10.3 Air Quality and Climate Change ES-18
ES.10.4 Vegetation ES-19
ES.10.5 Wetlands and Floodplains ES-19
ES.10.6 Aquatic Resources ES-19
ES.10.7 Federally Listed Threatened and Endangered Species ES-20
ES.10.8 Cultural Resources ES-20
ES.10.9 Indian Trust Assets ES-20
ES.10.10 Land Use ES-21
ES.10.11 Solid and Hazardous Materials ES-22
ES.10.12 Socioeconomic Resources ES-22

CHAPTER 1 Purpose of and Need for Action 1-1

1.1 Introduction 1-1
1.2 Project Description 1-1
1.3 Purpose of and Need for Action 1-2
1.4 Other Objectives of the Project and Connected Actions 1-3
1.5 Project Background 1-3
1.6 Description of the General Project Area 1-4
1.7 Federal Decisions to be Made 1-7
1.8 Other Related Actions 1-7
1.9 Public Involvement 1-9

1.10 Summary of Changes Between the Draft EIS and the Final EIS 1-9
1.10.1 General Changes 1-10
1.10.2 Changes to Chapter 1 1-10
1.10.3 Changes to Chapter 2 1-10
1.10.4 Changes to Chapter 3 1-13
1.10.5 Changes to Chapter 4 1-14
1.10.6 Changes to Chapter 5 1-14
1.11 Document Organization 1-14

CHAPTER 2 Description of Alternatives 2-1

2.1 Introduction 2-1
2.2 Alternatives Development and Screening Process 2-1
2.3 Common Features of the RWS Action Alternatives 2-2
2.3.1 RWS Components 2-2
2.3.2 Construction 2-11
2.3.3 Other Common Features of All RWS Action Alternatives 2-13
2.4 Summary Comparison of Alternatives 2-14
2.5 Preferred Alternatives and Selected Alternatives 2-27
2.6 RWS Alternatives Considered in Detail 2-27
2.6.1 Alternative A, No Action 2-28
2.6.2 Alternative B: HKM Implementable Alternative 2-29
2.6.3 Alternative C 2-44
2.6.4 Alternative D 2-55
2.6.5 Alternative E (Preferred Alternative) 2-64
2.7 Rio Pojoaque Irrigation Improvement Project Alternatives 2-76
2.7.1 Alternative RP-A—No Action 2-76
2.7.2 Common Features of the Action Alternatives 2-76
2.7.3 Summary Comparison of Action Alternatives 2-76
2.7.4 Alternative RP-B 2-78
2.7.5 Alternative RP-C (Preferred Alternative) 2-79
2.7.6 Alternative RP-D 2-80
2.7.7 Alternative RP-E 2-80
2.8 Rio Tesuque Channel Modification Project Alternatives 2-81
2.8.1 Alternative RT-A—No Action 2-81
2.8.2 Common Features of the Action Alternatives 2-81
2.8.3 Summary Comparison of Action Alternatives 2-82
2.8.4 Alternative RT-B 2-82
2.8.5 Alternative RT-C 2-86
2.8.6 Alternative RT-D (Preferred Alternative) 2-87
2.8.7 Alternative RT-E 2-88
2.9 Pueblo de San Ildefonso Future Projects Alternatives 2-90
2.9.1 Alternative SI-A—No Action 2-90
2.9.2 Alternative SI-B—Proposed Wastewater and Water Infrastructure 2-90
2.10 Summary Comparison of Impacts 2-93

2.11 Alternatives Considered but Eliminated from Detailed Study 2-109
2.11.1 Horizontal Collection from the West Bank of the Rio Grande 2-109
2.11.2 Side Channel Surface Diversion on the West Bank of the Rio Grande 2-109
2.11.3 Series of Vertical Wells 2-109
2.11.4 Pipe from Abiquiu Lake (Value Planning Study) 2-110
2.11.5 Treated Water Surface Ponds or Reservoir 2-110
2.11.6 Raw Water Surface Ponds 2-110
2.11.7 Nambé Falls Reservoir as a Backup Supply 2-110
2.11.8 Interconnect with Santa Fe Basin via Bishop's Lodge for Redundancy 2-111
2.11.9 ASR Well (Deep) at Chupadero 2-111
2.11.10 Water Treatment Plant near the Southern Border of the Pueblo de San Ildefonso 2-111
2.11.11 Water Treatment Plant 0.5 Mile East of SH 30 and Approximately 1.0 Mile North of SH 502 2-112
2.11.12 Water Treatment Plant 1,000 Feet East of SH 30 next to an Existing Wastewater Pond 2-112
2.11.13 Water Treatment Plant at Eastern Border of the Pueblo de San Ildefonso 2-112
2.11.14 Parallel Pipelines for Potable and Nonpotable Water 2-113
2.11.15 Distributed Renewable Generation at RWS Facilities 2-113
2.11.16 Include Chupadero in the RWS Service Area 2-113
2.11.17 Include the Tano Road Area in the RWS Service Area 2-113
2.11.18 Exclude Bishop's Lodge from the RWS Service Area 2-114
2.11.19 Exclude Tesuque Village from the RWS Service Area 2-114
2.11.20 Include Los Alamos County, Española, and the Ohkay Owingeh Pueblo in the RWS Service Area 2-115
2.11.21 Operating New Diversion Structure on the River to Divert Rio Pojoaque Water into the Acequia de Los Indios 2-115

CHAPTER 3 Affected Environment 3-1

3.1 Introduction 3-1
3.2 Setting 3-1
3.3 Surface Water 3-6
3.3.1 Methods 3-6
3.3.2 Rio Grande Watershed 3-6
3.3.3 Pojoaque Watershed 3-12
3.3.4 Channel Morphology 3-14
3.4 Groundwater 3-17
3.4.1 Methods 3-17
3.4.2 Aquifers 3-18
3.4.3 Existing and Planned Projects 3-19
3.4.4 Regional Groundwater Conditions 3-20

3.5 Water Quality 3-21
3.5.1 Methods 3-21
3.5.2 Surface Water Quality 3-21
3.5.3 Groundwater Quality 3-27
3.6 Geology and Soils 3-30
3.6.1 Methods 3-30
3.6.2 Geology 3-30
3.6.3 Soils 3-31
3.7 Paleontological Resources 3-32
3.7.1 Paleontological Potential 3-32
3.8 Air Quality 3-35
3.8.1 Methods 3-35
3.8.2 Ambient Air Quality 3-35
3.9 Climate Change 3-36
3.9.1 Methods 3-36
3.9.2 Historic Climate Trends 3-36
3.9.3 Future Climate Projections 3-37
3.9.4 Greenhouse Gases 3-40
3.10 Vegetation 3-43
3.10.1 Methods 3-43
3.10.2 Vegetation Communities 3-43
3.10.3 Special Status Plant Species 3-45
3.10.4 New Mexico State Sensitive and Endangered Plant Species With the Potential to Occur in the Biological Resources Area of Analysis 3-45
3.10.5 Cottonwood Galleries 3-50
3.10.6 Noxious Weed Species 3-50
3.11 Wetlands, Non-wetland Waters, and Floodplains 3-51
3.11.1 Methods 3-52
3.11.2 Wetland Descriptions 3-53
3.11.3 Non-wetland Waters Descriptions 3-53
3.11.4 Floodplains 3-53
3.12 Wildlife 3-55
3.12.1 Methods 3-55
3.12.2 General Wildlife Species 3-55
3.12.3 Special Status Wildlife Species 3-57
3.13 Aquatic Resources 3-61
3.13.1 Methods 3-61
3.13.2 Overview of Aquatic Resources in the Pojoaque Basin 3-61
3.13.3 Aquatic Habitat 3-62
3.13.4 Aquatic Biota 3-66
3.13.5 Special Status Fish Species 3-69
3.14 Federally Listed Threatened and Endangered Species 3-71
3.14.1 Methods 3-72
3.14.2 Federally Listed Threatened and Endangered Species Descriptions 3-72
3.14.3 Critical Habitat 3-78

3.15 Cultural Resources 3-78
3.15.1 Methods 3-79
3.15.2 Cultural History of the Pojoaque Basin 3-83
3.15.3 Previous Research 3-84
3.15.4 Summary of Class III Survey Results 3-84
3.16 Indian Trust Assets 3-88
3.16.1 Pueblo Lands 3-89
3.16.2 Water Rights 3-89
3.17 Land Use 3-90
3.17.1 Methods 3-90
3.17.2 Land Use 3-90
3.17.3 Land Grants 3-95
3.17.4 Access 3-95
3.17.5 Recreation 3-95
3.18 Visual Resources 3-97
3.18.1 Methods 3-97
3.18.2 Viewshed Characteristics 3-97
3.19 Traffic 3-98
3.19.1 Methods 3-98
3.19.2 Roadways 3-102
3.19.3 Traffic 3-103
3.20 Noise 3-103
3.20.1 Methods 3-103
3.20.2 Existing Noise Sources 3-103
3.20.3 Existing Sensitive Receptors 3-104
3.20.4 Ambient Noise Conditions 3-104
3.21 Solid and Hazardous Materials 3-108
3.21.1 Methods 3-108
3.21.2 General Project Area 3-109
3.21.3 Sites of Concern 3-110
3.22 Socioeconomic Resources 3-110
3.22.1 Methods 3-111
3.22.2 Socioeconomic Area of Analysis Demographics 3-111
3.22.3 Community and Social Conditions 3-117
3.22.4 Water Service and Rates 3-119
3.22.5 Public Services 3-120
3.22.6 Fiscal Conditions 3-121
3.23 Environmental Justice 3-122
3.23.1 Methods 3-123
3.23.2 Low-Income Populations 3-124
3.23.3 Minority Populations 3-125
3.24 Energy and Utilities 3-128
3.24.1 Methods 3-128
3.24.2 Infrastructure and Consumption 3-129

CHAPTER 4 Environmental Consequences 4-1

4.1 Introduction 4-1
4.2 Impact Analysis Terminology 4-1
4.3 Surface Water 4-2
4.3.1 Impact Indicators 4-2
4.3.2 Analysis Methods and Assumptions 4-2
4.3.3 RWS Alternatives 4-2
4.3.4 Rio Pojoaque Irrigation Improvement Project 4-12
4.3.5 Rio Tesuque Channel Modification Project 4-15
4.3.6 Pueblo de San Ildefonso Future Projects Alternatives 4-17
4.4 Groundwater 4-17
4.4.1 Impact Indicators 4-17
4.4.2 Analysis Methods and Assumptions 4-18
4.4.3 RWS Alternatives 4-18
4.4.4 Rio Pojoaque Irrigation Improvement Project 4-24
4.4.5 Rio Tesuque Channel Modification Project 4-25
4.4.6 Pueblo de San Ildefonso Future Projects Alternatives 4-27
4.5 Water Quality 4-27
4.5.1 Impact Indicators 4-27
4.5.2 Analysis Methods and Assumptions 4-28
4.5.3 RWS Alternatives 4-28
4.5.4 Rio Pojoaque Irrigation Improvement Project 4-35
4.5.5 Rio Tesuque Channel Modification Project 4-36
4.5.6 Pueblo de San Ildefonso Future Projects Alternatives 4-38
4.6 Geology and Soils 4-39
4.6.1 Impact Indicators 4-39
4.6.2 Analysis Methods and Assumptions 4-39
4.6.3 RWS Alternatives 4-41
4.6.4 Rio Pojoaque Irrigation Improvement Project 4-46
4.6.5 Rio Tesuque Channel Modification Project 4-49
4.6.6 Pueblo de San Ildefonso Future Projects Alternatives 4-54
4.7 Paleontological Resources 4-55
4.7.1 Impact Indicators 4-55
4.7.2 Analysis Methods and Assumptions 4-55
4.7.3 RWS Alternatives 4-55
4.7.4 Rio Pojoaque Irrigation Improvement Project 4-58
4.7.5 Rio Tesuque Channel Modification Project 4-60
4.7.6 Pueblo de San Ildefonso Future Projects Alternatives 4-62
4.8 Air Quality 4-63
4.8.1 Impact Indicators 4-63
4.8.2 Analysis Methods and Assumptions 4-63
4.8.3 RWS Alternatives 4-64
4.8.4 Rio Pojoaque Irrigation Improvement Project 4-70
4.8.5 Rio Tesuque Channel Modification Project 4-73
4.8.6 Pueblo de San Ildefonso Future Projects Alternatives 4-76

4.9 Climate Change 4-77
4.9.1 Impact Indicators 4-77
4.9.2 Analysis Methods and Assumptions 4-77
4.9.3 RWS Alternatives 4-78
4.9.4 Rio Pojoaque Irrigation Improvement Project 4-84
4.9.5 Rio Tesuque Channel Modification Project 4-89
4.9.6 Pueblo de San Ildefonso Future Projects Alternatives 4-93
4.10 Vegetation 4-94
4.10.1 Impact Indicators 4-95
4.10.2 Analysis Methods and Assumptions 4-95
4.10.3 RWS Alternatives 4-97
4.10.4 Rio Pojoaque Irrigation Improvement Project 4-103
4.10.5 Rio Tesuque Channel Modification Project 4-106
4.10.6 Pueblo de San Ildefonso Future Projects Alternatives 4-109
4.11 Wetlands, Non-wetland Waters, and Floodplains 4-111
4.11.1 Impact Indicators 4-111
4.11.2 Analysis Methods and Assumptions 4-111
4.11.3 RWS Alternatives 4-112
4.11.4 Rio Pojoaque Irrigation Improvement Project 4-120
4.11.5 Rio Tesuque Channel Modification Project 4-123
4.11.6 Pueblo de San Ildefonso Future Projects Alternatives 4-128
4.12 Wildlife 4-130
4.12.1 Impact Indicators 4-130
4.12.2 Analysis Methods and Assumptions 4-130
4.12.3 RWS Alternatives 4-130
4.12.4 Rio Pojoaque Irrigation Improvement Project 4-133
4.12.5 Rio Tesuque Channel Modification Project 4-135
4.12.6 Pueblo de San Ildefonso Future Projects Alternatives 4-138
4.13 Aquatic Resources 4-139
4.13.1 Impact Indicators 4-139
4.13.2 Analysis Methods and Assumptions 4-139
4.13.3 RWS Alternatives 4-140
4.13.4 Rio Pojoaque Irrigation Improvement Project 4-151
4.13.5 Rio Tesuque Channel Modification Project 4-155
4.13.6 Pueblo de San Ildefonso Future Projects Alternatives 4-158
4.14 Federally Listed Threatened and Endangered Species 4-159
4.14.1 Impact Indicators 4-159
4.14.2 Analysis Methods and Assumptions 4-159
4.14.3 RWS Alternatives 4-160
4.14.4 Rio Pojoaque Irrigation Improvement Project 4-163
4.14.5 Rio Tesuque Channel Modification Project 4-164
4.14.6 Pueblo de San Ildefonso Future Projects Alternatives 4-166
4.15 Cultural Resources 4-167
4.15.1 Impact Indicators 4-167
4.15.2 Analysis Methods and Assumptions 4-167
4.15.3 RWS Alternatives 4-167
4.15.4 Rio Pojoaque Irrigation Improvement Project 4-173

4.15.5 Rio Tesuque Channel Modification Project 4-174
4.15.6 Pueblo de San Ildefonso Future Projects Alternatives 4-175
4.16 Indian Trust Assets 4-176
4.16.1 Impact Indicators 4-176
4.16.2 Analysis Methods and Assumptions 4-176
4.16.3 RWS Alternatives 4-176
4.16.4 Rio Pojoaque Irrigation Improvement Project 4-178
4.16.5 Rio Tesuque Channel Modification Project 4-180
4.16.6 Pueblo de San Ildefonso Future Projects Alternatives 4-182
4.17 Land Use 4-182
4.17.1 Impact Indicators 4-183
4.17.2 Analysis Methods and Assumptions 4-183
4.17.3 RWS Alternatives 4-183
4.17.4 Rio Pojoaque Irrigation Improvement Project 4-191
4.17.5 Rio Tesuque Channel Modification Project 4-193
4.17.6 Pueblo de San Ildefonso Future Projects Alternatives 4-195
4.18 Visual Resources 4-196
4.18.1 Impact Indicators 4-196
4.18.2 Analysis Methods and Assumptions 4-196
4.18.3 RWS Alternatives 4-198
4.18.4 Rio Pojoaque Irrigation Improvement Project 4-222
4.18.5 Rio Tesuque Channel Modification Project 4-224
4.18.6 Pueblo de San Ildefonso Future Projects Alternatives 4-226
4.19 Traffic 4-228
4.19.1 Impact Indicators 4-228
4.19.2 Analysis Methods and Assumptions 4-228
4.19.3 RWS Alternatives 4-229
4.19.4 Rio Pojoaque Irrigation Improvement Project 4-234
4.19.5 Rio Tesuque Channel Modification Project 4-236
4.19.6 Pueblo de San Ildefonso Future Projects Alternatives 4-238
4.20 Noise 4-239
4.20.1 Impact Indicators 4-239
4.20.2 Analysis Methods and Assumptions 4-239
4.20.3 RWS Alternatives 4-242
4.20.4 Rio Pojoaque Irrigation Improvement Project 4-244
4.20.5 Rio Tesuque Channel Modification Project 4-247
4.20.6 Pueblo de San Ildefonso Future Projects Alternatives 4-249
4.21 Solid and Hazardous Materials 4-249
4.21.1 Impact Indicators 4-249
4.21.2 Analysis Methods and Assumptions 4-249
4.21.3 RWS Alternatives 4-250
4.21.4 Rio Pojoaque Irrigation Improvement Project 4-255
4.21.5 Rio Tesuque Channel Modification Project 4-257
4.21.6 Pueblo de San Ildefonso Future Projects Alternatives 4-259
4.22 Socioeconomic Resources 4-260
4.22.1 Impact Indicators 4-260
4.22.2 Analysis Methods and Assumptions 4-260
4.22.3 RWS Alternatives 4-263

4.22.4 Rio Pojoaque Irrigation Improvement Project 4-274
4.22.5 Rio Tesuque Channel Modification Project 4-276
4.22.6 Pueblo de San Ildefonso Future Projects Alternatives 4-279
4.23 Environmental Justice 4-279
4.23.1 Impact Indicators 4-279
4.23.2 Analysis Methods and Assumptions 4-280
4.23.3 RWS Alternatives 4-280
4.23.4 Rio Pojoaque Irrigation Improvement Project 4-282
4.23.5 Rio Tesuque Channel Modification Project 4-284
4.23.6 Pueblo de San Ildefonso Future Projects Alternatives 4-286
4.24 Energy and Utilities 4-287
4.24.1 Impact Indicators 4-287
4.24.2 Analysis Methods and Assumptions 4-287
4.24.3 RWS Alternatives 4-287
4.24.4 Rio Pojoaque Irrigation Improvement Project 4-289
4.24.5 Rio Tesuque Channel Modification Project 4-291
4.24.6 Pueblo de San Ildefonso Future Projects Alternatives 4-292
4.25 Cumulative Impacts 4-293
4.25.1 Surface Water 4-293
4.25.2 Groundwater 4-297
4.25.3 Water Quality 4-298
4.25.4 Geology and Soils 4-299
4.25.5 Paleontological Resources 4-300
4.25.6 Air Quality 4-301
4.25.7 Climate Change 4-302
4.25.8 Vegetation 4-303
4.25.9 Wetlands, Non-wetland Waters, and Floodplains 4-303
4.25.10 Wildlife 4-304
4.25.11 Aquatic Resources 4-305
4.25.12 Federally Listed Threatened and Endangered Species 4-306
4.25.13 Cultural Resources 4-308
4.25.14 Indian Trust Assets 4-309
4.25.15 Land Use 4-309
4.25.16 Visual Resources 4-310
4.25.17 Traffic 4-311
4.25.18 Noise 4-312
4.25.19 Solid and Hazardous Materials 4-313
4.25.20 Socioeconomic Resources 4-314
4.25.21 Environmental Justice 4-315
4.25.22 Energy and Utilities 4-316
4.26 Short-Term Uses and Long-Term Productivity 4-316
4.27 Unavoidable Adverse Impacts 4-317
4.28 Irreversible and Irretrievable Commitments of Resources 4-319

CHAPTER 5 Public Involvement, Consultation, and Coordination 5-1

5.1 Introduction 5-1
5.2 Public Outreach and Involvement 5-1
5.3 Cooperating Agency Involvement 5-4

5.4 Pueblo and Tribal Consultation and Coordination 5-5
5.4.1 Pueblo and Tribal Coordination 5-5
5.4.2 National Historic Preservation Act 5-5
5.5 Other Consultations and Coordination 5-6
5.5.1 U.S. Fish and Wildlife Service, Endangered Species Act, Section 7 Consultation 5-6
5.5.2 U.S. Army Corps of Engineers, Clean Water Act, Section 404 Coordination 5-7
5.6 Final EIS Distribution 5-7

CHAPTER 6 List of Preparers 6-1

CHAPTER 7 References 7-1

CHAPTER 8 Glossary 8-1

CHAPTER 9 Index 9-1

List of Tables

Table ES-1. Summary Comparison of RWS Action Alternatives ES-9
Table ES-2. RWS Surface Disturbance Comparison ES-11
Table ES-3. Summary of RWS Action Alternatives Estimated Costs ES-12
Table ES-4. Summary Comparison of Rio Pojoaque Irrigation Improvement Project Action Alternatives ES-15
Table ES-5. Summary Comparison of Rio Tesuque Channel Modification Project Action Alternatives ES-16
Table 2-1. Major Water Treatment Plant Facilities 2-6
Table 2-2. Heavy Equipment for the RWS 2-12
Table 2-3. Summary Comparison of RWS Action Alternatives 2-20
Table 2-4. RWS Surface Disturbance Comparison 2-22
Table 2-5. Summary of RWS Action Alternatives Estimated Costs 2-27
Table 2-6. Estimated Disturbance on Settlement Pueblos, Alternative B 2-30
Table 2-7. Short-Term Storage Tanks, Alternative B 2-38
Table 2-8. Pumping Plant Facility Approximate Dimensions, Alternative B 2-40
Table 2-9. Estimated Electrical Loads, Alternative B 2-41
Table 2-10. Summary of Electrical Distribution Lines to Backup Supply Options 2-42
Table 2-11. Summary of Electrical Distribution Lines to Short-Term Storage Tanks, Alternative B 2-43
Table 2-12. Summary of Electrical Distribution Lines to Pumping Plants, Alternative B 2-43
Table 2-13. Estimated Disturbance on Settlement Pueblos, Alternative C 2-44
Table 2-14. Short-Term Storage Tanks, Alternative C 2-50
Table 2-15. Pumping Plant Facility Approximate Dimensions, Alternative C 2-52
Table 2-16. Estimated Electrical Loads under Alternative C 2-54
Table 2-17. Summary of Electrical Distribution Lines to Short-Term Storage Tanks under Alternative C 2-54
Table 2-18. Summary of Electrical Distribution Lines to Pumping Plants under Alternative C 2-55
Table 2-19. Estimated Disturbance on Settlement Pueblos, Alternative D 2-57
Table 2-20. Short-Term Storage Tanks, Alternative D 2-60
Table 2-21. Pumping Plant Facility Approximate Dimensions, Alternative D 2-62
Table 2-22. Estimated Electrical Loads, Alternative D 2-63
Table 2-23. Summary of Electrical Distribution Lines to Short-Term Storage Tanks, Alternative D 2-64
Table 2-24. Summary of Electrical Distribution Lines to Pumping Plants under Alternative D 2-64
Table 2-25. Estimated Disturbance on Settlement Pueblos, Alternative E 2-65
Table 2-26. Short-Term Storage Tanks, Alternative E 2-71
Table 2-27. Pumping Plant Facility Approximate Dimensions, Alternative E 2-73
Table 2-28. Estimated Electrical Loads, Alternative E 2-74
Table 2-29. Summary of Electrical Distribution Lines to Short-Term Storage Tanks, Alternative E 2-75
Table 2-30. Summary of Electrical Distribution Lines to Pumping Plants under Alternative E 2-75

Table 2-31. Summary Comparison of Rio Pojoaque Irrigation Improvement Project Action Alternatives 2-76
Table 2-32. Rio Pojoaque Irrigation Improvement Project Surface Disturbance 2-78
Table 2-33. Summary Comparison of Rio Tesuque Channel Modification Project Action Alternatives 2-84
Table 2-34. Rio Tesuque Channel Modification Project Surface Disturbance 2-84
Table 2-35. Center/South Sewer Pipes 2-91
Table 2-36. Summary Comparison of Impacts by Project 2-94
Table 2-37. Summary Comparison of Impacts for the Pueblo de San Ildefonso Future Projects Alternatives 2-106
Table 3-1. Resource Condition Indicators 3-3
Table 3-2. Reservoirs 3-7
Table 3-3. San Juan-Chama Project Contracts 3-9
Table 3-4. Maximum Allowable Withdrawals 3-21
Table 3-5. State of New Mexico Designated Uses for Waters in the Rio Grande Basin 3-22
Table 3-6. Pueblo Designated Uses for Waters in the General Project Area 3-23
Table 3-7. Impaired Waters in the Rio Grande Basin 3-25
Table 3-8. Impaired Waters in the Pojoaque Basin 3-26
Table 3-9. Rio Grande Source Water Quality 3-27
Table 3-10. NPDES Permits in the Rio Grande Basin 3-28
Table 3-11. Summary of Groundwater Samples in the Region 3-29
Table 3-12. Sensitive Soils in the Area of Potential Disturbance (Acres) 3-32
Table 3-13. Vegetation Communities in the Pojoaque Basin General Project Area 3-48
Table 3-14. Special Status Plant Species with Habitat in the Biological Resources Area of Analysis 3-48
Table 3-15. Noxious Weeds in the Biological Resources Area of Analysis 3-51
Table 3-16. FEMA Participating National Flood Insurance Program Communities in the General Project Area 3-54
Table 3-17. Special Status Species in Santa Fe County that Potentially Occur in the Biological Resources Area of Analysis 3-58
Table 3-18. Fish Species Sampled by NMDGF at the Buckman Wash (RM 254.3) 3-67
Table 3-19. Special Status Fish Species with Suitable Habitat in the Rio Grande Reach of the General Project Area 3-70
Table 3-20. Federally Listed Threatened and Endangered Species With the Potential to Occur in the Biological Resources Area of Analysis 3-73
Table 3-21. Summary of Historic Property Types in the Affected Environment 3-84
Table 3-22. Major Cultural Periods and Phases in the Northern Rio Grande 3-85
Table 3-23. Historic Buildings by Location in the General Project Area 3-88
Table 3-24. Key Observation Points 3-101
Table 3-25. Traffic Levels 3-103
Table 3-26. Common Sound Levels in Air 3-105
Table 3-27. Noise Inventory Sites in the Noise Areas of Analysis 3-107
Table 3-28. Sites of Concern in the General Project Area 3-110
Table 3-29. Area of Analysis Population Totals (1980-2014) 3-112
Table 3-30. Area of Analysis Employment Status in the Population 16 and Older (2014) 3-114
Table 3-31. Area of Analysis Employment Characteristics (2014) 3-115

Table 3-32. Comparative Water Rates Surrounding the Area of Analysis 3-120
Table 3-33. Property Tax Obligations and Assessed Values 3-121
Table 3-34. Area of Analysis Population in Poverty (2014) 3-124
Table 3-35. Area of Analysis Key Community Poverty Data (2014) 3-124
Table 3-36. Area of Analysis Populations by Race/Ethnicity (2014) 3-125
Table 3-37. Area of Analysis Key Community Race/Ethnicity Data (2014) 3-128
Table 4-1. Surface Water Changes from Reduced Pojoaque Basin Groundwater Use 4-4
Table 4-2. Projected RWS Supply and Demand After Full Project Buildout 4-5
Table 4-3. Length of Pipelines in the Active Channel 4-6
Table 4-4. Days of Adverse Conditions Affecting Surface Diversions 4-8
Table 4-5. Average Sediment Removal from the Rio Grande 4-9
Table 4-6. Scour Protection for Pipelines in the Active Channel—Alternative B 4-9
Table 4-7. Scour Protection for Pipelines in the Active Channel—Alternative C 4-10
Table 4-8. Scour Protection for Pipelines in the Active Channel—Alternative D 4-11
Table 4-9. Scour Protection for Pipelines in the Active Channel—Alternative E 4-11
Table 4-10. Future Changes in Depths to Groundwater—Alternative A 4-18
Table 4-11. Number of Existing Well Impacts—Alternative A 4-19
Table 4-12. Changes in Pojoaque Basin Groundwater Use—Alternatives B through E 4-20
Table 4-13. Future Changes in Depths to Groundwater with Full Project Buildout (Year 2050)—Alternatives B to E 4-20
Table 4-14. Project Backup Supply 4-21
Table 4-15. Comparison of Drinking Water Standards and Existing Quality 4-31
Table 4-16. Impacts on Sensitive Soils under Alternative B (Acres) 4-43
Table 4-17. Impacts on Sensitive Soils under Alternative C (Acres) 4-44
Table 4-18. Impacts on Sensitive Soils under Alternative D (Acres) 4-45
Table 4-19. Impacts on Sensitive Soils under Alternative E (Acres) 4-45
Table 4-20. Impacts on Sensitive Soils under Alternative RT-B (Acres) 4-51
Table 4-21. Impacts on Sensitive Soils under Alternative RT-C (Acres) 4-52
Table 4-22. Impacts on Sensitive Soils under Alternative SI-B (Acres) 4-54
Table 4-23. PFYC Class by RWS Disturbance Areas 4-56
Table 4-24. Estimated Equipment-Related Criteria Pollutant Emissions by Proposed Work Component (Tons) 4-68
Table 4-25. Estimated GHG Emissions by Proposed Component 4-80
Table 4-26. Special Status Species and Associated Vegetation Communities 4-96
Table 4-27. Alternative B Disturbance of Vegetation Communities Associated with Special Status Plant Species 4-100
Table 4-28. Alternative C – Disturbance of Vegetation Communities Associated with Special Status Plant Species 4-101
Table 4-29. Alternative D – Disturbance of Vegetation Communities Associated with Special Status Plant Species 4-101
Table 4-30. Alternative E – Disturbance of Vegetation Communities Associated with Special Status Plant Species 4-102
Table 4-31. Alternative SI-B Disturbance of Vegetation Communities Associated with Special Status Plant Species 4-110
Table 4-32. Transmission and Distribution Pipelines in the 100-Year Floodplain 4-113
Table 4-33. Frequency of Flooding on Rio Grande at Otowi Bridge 4-115

Table 4-34. Extent of Electrical Distribution Lines within Floodplains (Alternative B) 4-116
Table 4-35. Extent of Electrical Distribution Lines within Floodplains (Alternative C) 4-117
Table 4-36. Extent of Electrical Distribution Lines within Floodplains (Alternative D) 4-118
Table 4-37. Extent of Electrical Distribution Lines within Floodplains (Alternative E) 4-119
Table 4-38. Rio Pojoaque Irrigation Improvement Project Alternative RP-B Floodplain Changes 4-121
Table 4-39. Rio Tesuque Alternative RT-B Floodwater Surface and Flooded Area 4-125
Table 4-40. Rio Tesuque Alternative RT-C Floodwater Surface and Flooded Area 4-126
Table 4-41. Rio Tesuque Alternative RT-D Floodwater Surface and Flooded Area 4-127
Table 4-42. Alternative SI-B Disturbance in the 100-Year Floodplain 4-129
Table 4-43. Acreage of Temporary and Permanent Impacts on Aquatic Habitat by RWS Action Alternative 4-142
Table 4-44. Summary of Documented Cultural Resources Under Each Alternative 4-169
Table 4-45. Acres of Land Needed for Permanent RWS Facilities (Excluding Pipelines) by Action Alternative and Land Ownership 4-184
Table 4-46. Miles of Water Transmission and Distribution Pipelines along Roads (All RWS Action Alternatives) 4-184
Table 4-47. Alternative B: Proposed Project Features Visible from Key Observation Points 4-201
Table 4-48. Alternative C: Proposed Project Features Visible from Key Observation Points 4-209
Table 4-49. Alternative D: Proposed Project Features Visible from Key Observation Points 4-214
Table 4-50. Alternative E: Proposed Project Features Visible from Key Observation Points 4-218
Table 4-51. Alternative B: Hazardous Sites 4-253
Table 4-52. Future Projects Alternatives: Hazardous Sites 4-260
Table 4-53. Direct Job Estimates by Year 4-265
Table 4-54. Economic Impacts-Construction 4-266
Table 4-55. Economic Impacts Total Federal Taxes 4-267
Table 4-56. Economic Impacts Total State and Local Taxes 4-267
Table 4-57. Potential Affecting Factors Associated with Past, Present, and Reasonably Foreseeable Future Actions and Basin-Wide Trends 4-294
Table 5-1. List of Draft EIS Public Meeting Locations and Dates 5-4
Table 6-1. Preparers of Draft Environmental Impact Statement 6-1

List of Figures

Figure ES-1. General Project Area ES-3
Figure 1-1. Pojoaque Basin 1-5
Figure 1-2. General Project Area 1-6
Figure 2-1. Components and Elements of the Proposed RWS 2-3
Figure 2-2. Components of the Proposed RWS 2-3
Figure 2-3. Typical Welded and Bolted Steel, Short-Term Storage Tanks 2-8
Figure 2-4. Typical Concrete, Short-Term Storage Tank 2-8
Figure 2-5. Comparison of Primary Source Water Collection Elements 2-15
Figure 2-6. Comparison of Water Treatment Plants 2-16
Figure 2-7. Comparison of New Short-Term Storage Tanks and Access Roads 2-17
Figure 2-8. Comparison of New Water Transmission and Distribution Systems 2-18
Figure 2-9. Comparison of New Electrical Service 2-19
Figure 2-10. RWS Alternative B: HKM Implementable 2-31
Figure 2-11. Model of Shallow Passive Infiltration and Recovery Wells 2-34
Figure 2-12. Conceptual Rendering of Intake Structure and Pumping Plant 2-36
Figure 2-13. Example Sheet Pile Cofferdam 2-36
Figure 2-14. RWS Alternative C 2-45
Figure 2-15. Conceptual Rendering of a Parallel River Interceptor Drain 2-47
Figure 2-16. RWS Alternative D 2-56
Figure 2-17. Infiltration Gallery 2-58
Figure 2-18. RWS Alternative E (Preferred Alternative) 2-66
Figure 2-19. Conceptual Rendering of Horizontal Radial Well Collector 2-68
Figure 2-20. Comparison of Rio Pojoaque Irrigation Improvement Project Alternatives 2-77
Figure 2-21. Rio Pojoaque Irrigation Improvement Project Alternative RP-B 2-79
Figure 2-22. Rio Pojoaque Irrigation Improvement Project Alternative RP-C (Preferred Alternative) 2-80
Figure 2-23. Rio Pojoaque Irrigation Improvement Project Alternative RP-E 2-81
Figure 2-24. Comparison of Rio Tesuque Channel Modification Project Alternatives 2-83
Figure 2-25. Rio Tesuque Channel Modification Project Alternative RT-B 2-85
Figure 2-26. Rio Tesuque Channel Modification Project Alternative RT-C 2-87
Figure 2-27. Rio Tesuque Channel Modification Project Alternative RT-D (Preferred Alternative) 2-88
Figure 2-28. Rio Tesuque Channel Modification Project Alternative RT-E 2-89
Figure 2-29. Preliminary Wastewater System Design 2-91
Figure 2-30. Pueblo de San Ildefonso Future Projects Area 2-92
Figure 3-1. General Project Area 3-2
Figure 3-2. Historic Rio Grande at Otowi Bridge Flows 3-11
Figure 3-3. Average Monthly Stream Flows for Rio Grande at Otowi Bridge (1971 to 2012) 3-11
Figure 3-4. Potential Fossil Yield Classification 3-34
Figure 3-5. Change in Annual Volume at Otowi for Various Climate Scenarios 3-39
Figure 3-6. Change in 7Q10 Flows at Otowi for Various Climate Scenarios 3-41
Figure 3-7. Change in Peak Flows at Otowi for Various Climate Scenarios 3-42
Figure 3-8. Biological Resources Area of Analysis 3-44

Figure 3-9. Vegetation and Land Cover 3-46
Figure 3-10. SWReGAP Vegetation Communities 3-47
Figure 3-11. Cottonwood Gallery in the Biological Resources Area of Analysis 3-50
Figure 3-12. Hydrology and Floodplains 3-56
Figure 3-13. Southwestern Willow Flycatcher and Yellow-billed Cuckoo Habitat 3-76
Figure 3-14. Cultural Resources Area of Analysis 3-81
Figure 3-15. The Northern Rio Grande Cultural Area 3-83
Figure 3-16. Surface Administration 3-91
Figure 3-17. Recreation 3-96
Figure 3-18. Scenic Byways 3-99
Figure 3-19. Key Observation Points 3-100
Figure 3-20. Noise Inventory Sites 3-106
Figure 3-21. Environmental Justice Area of Analysis 3-127
Figure 4-1. Intake, Alternative B Side Channel Surface Diversion Intake Plan 4-144
Figure 4-2. Key Observation Points and Proposed Visible Infrastructure 4-197
Figure 4-3. Radio Antenna Pole Scenarios 4-198
Figure 4-4. Noise Inventory Sites and Proposed Infrastructure 4-240

Acronyms and Abbreviations

AADT	annual average daily traffic
ACS	American Community Survey
AD	anno Domini
af	acre-feet
afy	acre-feet per year
ASR	aquifer storage and recovery
BC	before Christ
BDD	Buckman Direct Diversion
BEHI	bank erosion hazard index
BIA	United States Department of the Interior, Bureau of Indian Affairs
BLM	United States Department of the Interior, Bureau of Land Management
BMP	best management practice
CAA	Clean Air Act of 1970
CDP	census-designated place
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalents
CWA	Clean Water Act of 1972
dB	decibel
dBA	A-weighted decibel scale
EDR	Environmental Data Resources, Inc.
EIS	environmental impact statement
EMPSi	Environmental Management and Planning Solutions, Inc.
EPA	United States Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act of 1986
ESA	Endangered Species Act of 1973
FEMA	Federal Emergency Management Agency
FIRM	Federal Emergency Management Agency Flood Insurance Rate Map
Forest Service	United States Department of Agriculture, Forest Service
GHG	greenhouse gas
GIS	geographic information system
gpm	gallons per minute
GPS	global positioning system
GRT	gross receipts tax
HDR	Henningson, Durham, and Richardson, Inc.
HKM	Hurlbut, Kersich, and McCullough Engineers
HUD	United States Department of Housing and Urban Development

IHS	United States Indian Health Service
IMPLAN	impact analysis for planning
IPaC	United States Fish and Wildlife Service's Information for Planning and Conservation
ISO	Insurance Service Organization
ITA	Indian trust asset
JGMS	JG Management Systems, Inc.
JMEC	Jemez Mountains Electric Cooperative
KOP	key observation point
kVA	kilovolt-amp
kWh	kilowatt hour
LANL	Los Alamos National Laboratory
MBFS	migratory bird focal species
MBTA	Migratory Bird Treaty Act of 1918
MCL	maximum contaminant level
mg/l	milligrams per liter
mgd	million gallons per day
mmBTU	million British Thermal Units
msl	mean sea level
MSO	Mexican spotted owl
NAAQS	National Ambient Air Quality Standards
NBS	near bank stress
NEPA	National Environmental Policy Act of 1969
NHD	National Hydrography Dataset
NHPA	National Historic Preservation Act of 1966
NIS	noise inventory site
NMAC	New Mexico Administrative Code
NMDGF	New Mexico Department of Game and Fish
NMDOT	New Mexico Department of Transportation
NMED	New Mexico Environment Department
NMGC	New Mexico Gas Company
NMMJM	New Mexico meadow jumping mouse
NMOS	New Mexico Ornithological Society
NPDES	National Pollutant Discharge Elimination System
NRCS	United States Department of Agriculture Natural Resources Conservation Service
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
OHV	off highway vehicle
OHWM	ordinary high water mark
OSHA	Occupational Safety and Health Administration
PA	Programmatic Agreement
PCB	polychlorinated biphenyl

pCi/l	picocuries per liter
PFYC	Potential Fossil Yield Classification
PM_{10}	particulate matter with an aerodynamic diameter of 10 microns or less
$PM_{2.5}$	particulate matter with an aerodynamic diameter of 2.5 microns or less
PNM	Public Service Company of New Mexico
PPC	Public Protection Classification
PVC	polyvinyl chloride
Reclamation	United States Department of the Interior, Bureau of Reclamation
RM	river mile
ROW	right-of-way
RWS	regional water system
SCADA	supervisory control and data acquisition
Service	United States Fish and Wildlife Service
Settlement Act	Aamodt Litigation Settlement Act, which is Title VI of the Claims Resolution Act of 2010 (Public Law 111–291, Title VI; 124 Stat. 3065)
Settlement Agreement	Aamodt Litigation Settlement Agreement
Settlement Pueblos	Pueblo de San Ildefonso, Pueblo of Nambé, Pueblo of Pojoaque, and Pueblo of Tesuque
SH	State Highway
SHPO	New Mexico State Historic Preservation Office(r)
SSA	sole source aquifer
SWFL	Southwestern willow flycatcher
SWPPP	stormwater pollution prevention plan
SWReGAP	Southwest Regional Gap Analysis Project
THPO	Tribal Historic Preservation Office(r)
TMDL	total maximum daily load
Tri-State	Tri-State Generation and Transmission Inc.
TSP	total suspended particulate
TSS	total suspended sediment
U.S.	United States
Uniform Act	Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970
USACE	United States Army Corps of Engineers
USC	United States Code
USGS	United States Geological Survey
WQCC	New Mexico Water Quality Control Commission
YBCU	yellow-billed cuckoo

This page intentionally left blank.

EXECUTIVE SUMMARY

ES.1 Introduction

The United States (U.S.) Department of the Interior, Bureau of Reclamation (Reclamation) has prepared this environmental impact statement (EIS). Its purpose is to analyze the environmental impacts of constructing a proposed regional water system (RWS) and the connected actions in the Pojoaque Basin in north-central New Mexico.

The RWS is described in and authorized by the Aamodt Litigation Settlement Act (hereafter, Settlement Act). The Settlement Act (Title VI of the Claims Resolution Act of 2010; Public Law 111-291, Title VI; 124 Stat. 3065) authorizes and ratifies the Aamodt Litigation Settlement Agreement (hereafter, Settlement Agreement), dated January 19, 2006, as conformed to the Settlement Act and amendments.

The settlement parties are the United States; the State of New Mexico; Santa Fe County; the City of Santa Fe; the Pueblo de San Ildefonso, the Pueblo of Nambé, the Pueblo of Pojoaque, and the Pueblo of Tesuque (Settlement Pueblos); and other individual defendants. The Settlement Agreement resolves the water rights claims of the Settlement Pueblos.

Among other provisions, the RWS and 2,220 acre-feet per year of new water supply to the basin are included in the Settlement Agreement, in exchange for the Settlement Pueblos agreeing to reduce their claims to water in the basin and to limit their priority calls against existing non-Pueblo water users that agree to become party to the Settlement Agreement. The Settlement Agreement also addresses funding for other water-related projects on the Settlement Pueblos.

As the lead federal agency, Reclamation prepared the Draft EIS, in cooperation with the U.S. Bureau of Indian Affairs (BIA), the U.S. Indian Health Service, the U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service (Service), the Pueblo de San Ildefonso, the Pueblo of Nambé, the Pueblo of Pojoaque, the Pueblo of Tesuque, the New Mexico Department of Transportation, Santa Fe County, and the City of Santa Fe.

The EIS complies with the National Environmental Policy Act of 1969 (NEPA; 42 United States Code [USC], Section 4321 et seq.), the Council on Environmental Quality's (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 Code of Federal Regulations [CFR], Parts 1500-1508), the U.S. Department of the Interior's NEPA Regulations (43 CFR, Part 46), and other relevant federal and state laws and regulations.

ES.2 Project Description

Section 611(a) of the Settlement Act authorizes Reclamation to plan, design, and construct a RWS, consisting of water diversion from the Rio Grande and water treatment facilities on the Pueblo de San Ildefonso. Moreover, it authorizes any treatment, transmission, storage, and distribution facilities and wellfields for Santa Fe County's distribution system and Pueblo Water Facilities that are necessary to distribute up to

4,000 afy of water annually to customers in the Pojoaque Basin (Settlement Act, Section 611[a][2][B]).

The project includes the following actions:

- Substantially completing construction of the RWS by June 30, 2024 (Settlement Act, Section 623[e])
- Bringing portions of the RWS into operation as they are constructed
- Operating and maintaining the RWS until construction is substantially complete
- Transferring title to all RWS facilities and land interests to the Settlement Pueblos, Santa Fe County, and the Regional Water Authority, after construction is complete, in accordance with Section 611(h) of the Settlement Act

The EIS also analyzes alternatives for the proposed connected actions of the Rio Pojoaque irrigation improvement project (on the Pueblo de San Ildefonso) and the Rio Tesuque channel modification project (on the Pueblo of Tesuque). The funding for these actions is authorized under Sections 611(f)(1) and 617(a) of the Settlement Act.

The Pueblo de San Ildefonso is also proposing to construct a wastewater system and future water-related infrastructure projects. Funding for these actions is made available under Section 617(c)(1)(A)(i) of the Settlement Act. While these actions are not directly part of the RWS, they are analyzed in the EIS as connected actions, authorized by Section 615(d)(7)(A)(ii) of the Settlement Act. This provision authorizes the expenditure of funds appropriated under Section 617(c)(1)(A)(i) of the Settlement Act, before substantial completion of the RWS "for any activity that is more cost-effective when implemented in conjunction with the construction of the [RWS], as determined by the Secretary [of the Interior]."

ES.3 Setting

The proposed RWS and proposed connected actions are in the Pojoaque Basin in north-central New Mexico, north of the city of Santa Fe. It is between the Pueblo of Nambé to the east, the Pueblo de San Ildefonso to the west, the Pueblo of Pojoaque to the north, and Bishop's Lodge to the south. The Pojoaque Basin, as defined in the Settlement Act, covers approximately 147,300 acres

To provide context as to where construction and development is proposed, a general project area is defined and is shown on **Figure ES-1**. The 30,400-acre general project area encompasses an approximately 0.25-mile buffer surrounding all proposed project features. This includes the RWS, the Rio Pojoaque irrigation improvement project, the Rio Tesuque channel modification project, and the Pueblo de San Ildefonso future projects alternatives.

Unless otherwise defined in the EIS, the general project area represents the primary area of analysis in which most direct and indirect impacts of the RWS, the Rio Pojoaque irrigation improvement project, the Rio Tesuque channel modification project, and the Pueblo de San Ildefonso future projects alternatives would be realized. Some resource

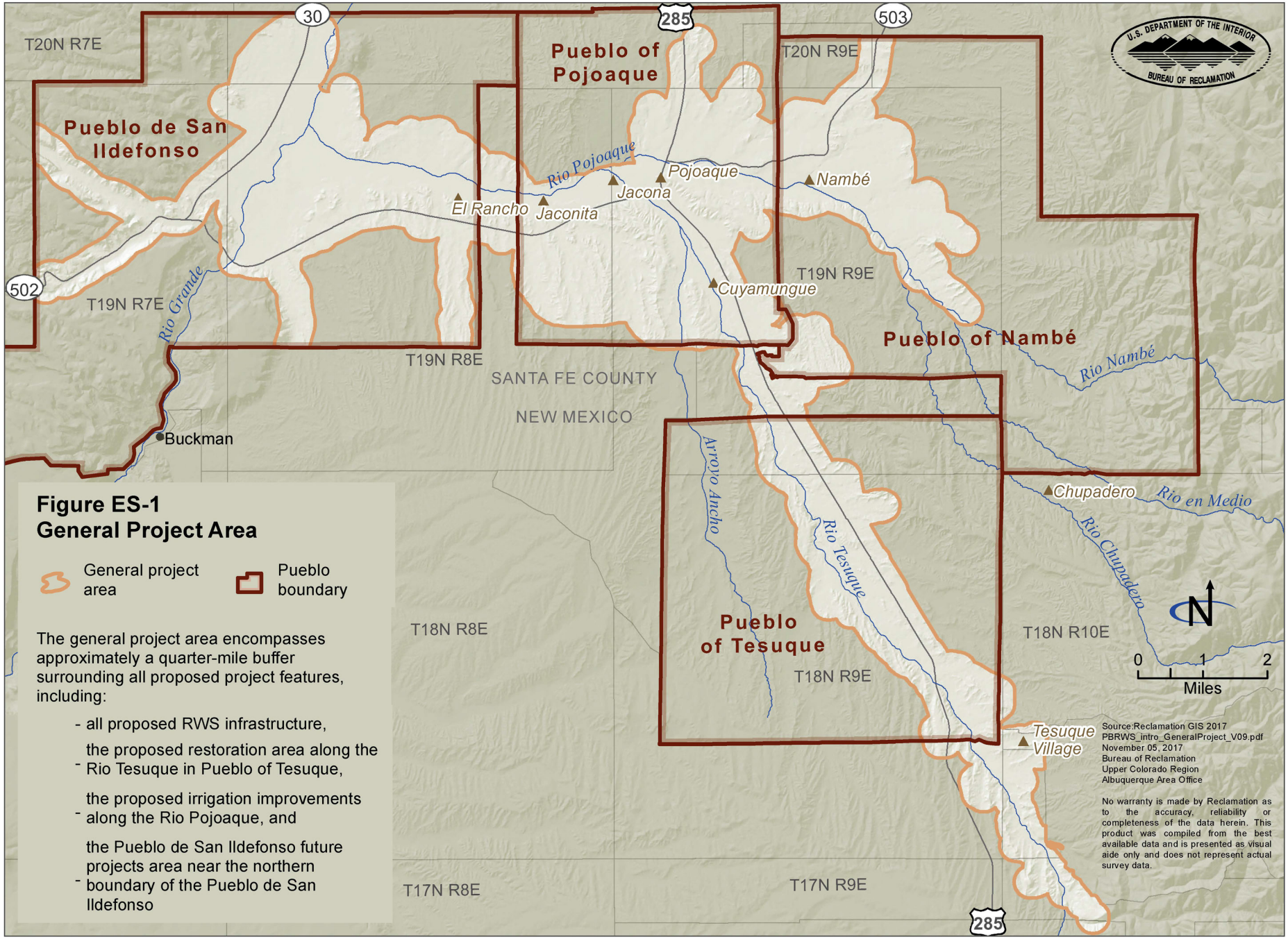


Figure ES-1
General Project Area

General project area

Pueblo boundary

The general project area encompasses approximately a quarter-mile buffer surrounding all proposed project features, including:

- all proposed RWS infrastructure,
- the proposed restoration area along the Rio Tesuque in Pueblo of Tesuque,
- the proposed irrigation improvements along the Rio Pojoaque, and
- the Pueblo de San Ildefonso future projects area near the northern boundary of the Pueblo de San Ildefonso

programs define different areas of analysis to account for the nature of impacts on those resources. For example, impacts on air quality and socioeconomics are not described within the bounds of the general project area. This is because they are measured, and better described, by broader regions. Some resources are more location specific, such as cultural resources, and have a narrower area of analysis in the general project area. Specific resource areas of analysis are tailored to describe conditions only in areas where the applicable resource is likely to be affected by the alternatives.

ES.4 Purpose of and Need for Action

The **purpose** of Reclamation's action is to reliably provide a firm, safe supply of treated drinking water for distribution in the Pojoaque Basin, in compliance with the Settlement Act.

The **need** for Reclamation's action is to reduce reliance on groundwater in the Pojoaque Basin and to allow the Settlement Pueblos to receive a portion of the water provided under the Settlement Act.

Reclamation's action would also enable the Settlement Pueblos to use funding made available in the Settlement Act for certain water-related infrastructure improvements, if requested. This funding can be requested before the RWS is substantially complete. It can be used for any water-related improvements that would be more cost effective, when implemented in conjunction with RWS construction, if approved by the Secretary of the Interior (Settlement Act, Section 615[d][7][A][ii]).

ES.5 Other Objectives of the Project and Connected Actions

The Settlement Pueblos' and Santa Fe County's specific objectives for the project are as follows:

- Use water secured under the Settlement Act to meet current and anticipated future demand in the Pojoaque Basin
- Provide adequate water volume and pressure for fire protection
- Reduce the impacts of groundwater pumping to provide for recharging the aquifer

The Pueblo de San Ildefonso's additional objectives of the connected actions are as follows:

- Collect surface water from the Rio Pojoaque to improve irrigation (Rio Pojoaque irrigation improvement project)
- Complete an assessment of environmental baseline conditions for future water-related projects (Pueblo de San Ildefonso future projects)
- Complete an assessment of environmental impacts of proposed wastewater system improvements (Pueblo de San Ildefonso future projects)

The Pueblo of Tesuque's additional objectives of the connected actions (all related to the Rio Tesuque channel modification project) are as follows:

- Protect and preserve critical wetlands and springs
- Increase stream flows
- Increase infiltration
- Restore the natural characteristics of the river, including meanders, native vegetation, and a connected floodplain
- Improve infrastructure used to store water for agriculture, wildlife, and cultural purposes

ES.6 Federal Decisions to Be Made

The EIS complies with NEPA by supporting federal decisions related to the RWS project. Both Reclamation and the BIA are making decisions based on the analysis in the EIS. Specifically, Reclamation will decide whether and how to construct and temporarily operate a water treatment and distribution system for the Pojoaque Basin, in accordance with the Settlement Agreement and the Settlement Act. Reclamation's decision would determine the design alternative for the water system and whether to proceed with project construction and temporary operations before transferring them to a newly created Regional Water Authority, Santa Fe County, and the Settlement Pueblos.

The BIA, in consultation with the Settlement Pueblos, will decide whether to issue right-of-way (ROW) easements and permits on Tribal lands for the construction, operation, and maintenance of the RWS. According to the Settlement Act (Section 611[c][1]) and Cost Sharing and System Integration Agreement (Section 2.3), Pueblos will grant easements and ROWs as necessary for the construction of the RWS at no cost. If needed, this would include the Rio Pojoaque irrigation improvement project and the Rio Tesuque channel modification project.

Additional federal decisions would be made as part of permitting processes, including those under the Clean Water Act, the Endangered Species Act, and other applicable federal laws.

ES.7 Summary of Changes Between the Draft EIS and the Final EIS

Reclamation released the Draft EIS to the public for review and comment in January 2017. This Final EIS includes changes in response to public comments on the Draft EIS. It also includes updates, based on ongoing engineering design work and collaboration with stakeholders. All acres, distances, volumes, maps, visual simulations, and analyses were revised, as necessary. A general summary of notable changes is below. **Chapter 1**, **Section 1.10**, describes the specific changes to the document.

Changes to the RWS alternatives (**Chapter 2**) include adding clarifying information, such as the size and volume of existing storage tanks, details on the communication system related to antenna poles, and sodium hypochlorite injection buildings at existing storage tanks. Some infrastructure was moved, removed, or reduced in size to avoid impacts, address stakeholder concerns, or improve performance of the system. This included removing the proposed storage tank near the Santa Fe Opera under Alternative

E. Also under Alternative E, Reclamation minimized the footprint of the staging area near the El Rancho cemetery to reduce noise and visual impacts.

Changes to the Rio Pojoaque irrigation improvement project alternatives included clarifying that the conveyance system could be a pipe, a conveyance canal, or a combination of the two, and that the collection from the Rio Pojoaque could occur farther upstream. Components of the wastewater system, as part of the Pueblo de San Ildefonso future projects, were refined.

The Pojoaque Basin Regional Water System Biological Assessment and the Service's concurrence letter for the Pojoaque Basin Regional Water System were added to this Final EIS as **Appendix J**. The affected environment (**Chapter 3**) and impacts analysis (**Chapter 4**) in the federally listed threatened and endangered species section was updated, based on the Pojoaque Basin Regional Water System Biological Assessment. Revised information on acres of wetlands and other waters of the U.S. was added to the wetlands, non-wetlands waters, and floodplains section.

A description of the Draft EIS public comment period was added to the Final EIS. **Volume 3**, Draft EIS Comment Summary and Response Report, describes the results of the public review of the Draft EIS and includes a comprehensive list of all public comments received, showing how Reclamation addressed each comment.

ES.8 Regional Water System Alternatives

The EIS assesses the potential environmental impacts of the five RWS alternatives under consideration: the No Action Alternative (Alternative A) and four Action Alternatives (Alternatives B, C, D, and E). Each of the RWS Action Alternatives address six main components:

1. Firm, reliable water supply
2. Primary source water collection
3. Water treatment
4. Short-term storage tanks
5. Water transmission and distribution system, including pipelines, pumping plants, forebay tanks, and other associated facilities
6. Electrical power service

The different ways these components can be implemented are called project elements. Screening criteria were used to evaluate each project element, based on various criteria. Project elements that satisfy the criteria were combined into complete alternatives. It is important to note that in construction projects such as the proposed RWS, it is common to make refinements to final designs during construction. The elements analyzed in detail may evolve before the RWS design is finalized. Per Section 611(b) of the Settlement Act, the final RWS design must be completed within 90 days after the Record of Decision for the EIS is signed.

The action alternatives are summarized below in **Table ES-1**, Summary Comparison of RWS Action Alternatives. The extent of projected disturbance per alternative is provided in **Table ES-2**, RWS Surface Disturbance Comparison. Within the EIS, short-term disturbances would generally occur during construction; long-term disturbances would occur beyond construction and from operation of the proposed facilities. Estimated costs for the RWS are provided in **Table ES-3**, Summary of RWS Action Alternatives Estimated Costs.

It is important to note that, in construction projects such as the proposed RWS, it is common to make refinements to final designs during construction. The alternatives described in this chapter contain sufficient information to capture all of the impacts of the proposed action and alternatives; however, the elements analyzed in detail in subsequent sections may evolve before the RWS design is finalized. According to Section 611(b) of the Settlement Act, the final RWS design must be completed within 90 days after the Record of Decision for this EIS is signed. Reclamation will conduct additional environmental analyses, as needed, to address the impacts of any design changes not analyzed in this EIS. For example, this documentation could include a determination of NEPA adequacy, a categorical exclusion, a supplemental environmental assessment, or a supplemental environmental impact statement.

Reclamation may also combine elements from different alternatives into the final RWS design, rather than implementing a single complete alternative analyzed in this EIS (CEQ 1981). For example, primary source water could be collected using surface flows in the hyporheic zone, but backup aquifer storage and recovery (ASR) wells could also be constructed; however, this would not create a new alternative or project element that has not previously been analyzed in the EIS. Additionally, the Regional Water Authority could add a backup water supply or any other facility to the RWS at any point after Reclamation transfers ownership to it.

The RWS is being designed to be flexible in where and how it provides water to meet future demand for all customers. This may include interim use of the water by Santa Fe County for customers outside the Pojoaque Basin. In accordance with Section 614(d) of the Settlement Act, the County may use unused capacity and water rights of the County Water Utility to supply water within the County but outside of the Pojoaque Basin (1) on approval by the State and the Regional Water Authority and (2) subject to the issuance of a permit by the New Mexico State Engineer.

When the Draft EIS was published in January 2017, the County had not received approvals or permits from the State to transfer its water for interim use by customers outside the basin. In July 2017, the New Mexico Office of the State Engineer issued a permit authorizing interim uses anywhere within the County Water Utility service area. This satisfied the requirement of Section 614(d)(2) of the Settlement Act. While the County may decide to use RWS water for interim uses outside the basin, no specific plans for such use have been proposed. If it were proposed in the future, it would be subject to appropriate environmental compliance requirements at that time.

ES.8.1 Preferred Alternative

After weighing the benefits and impacts of all feasible RWS alternatives, Reclamation has identified Alternative E as the preferred alternative, subject to public review.

ES.8.2 Alternative A, No Action

The No Action Alternative is the "no build" alternative. Under this alternative, the RWS would not be constructed and a firm, reliable water supply would not be provided to residents of the Pojoaque Basin. Use of domestic wells would continue to reduce groundwater and surface water supplies in the Pojoaque Basin. The Pueblos would continue to rely on their existing separate water systems, rather than integrating their systems into one regional system.

ES.8.3 Alternative B, HKM Implementable Alternative

Alternative B incorporates the RWS facilities and components analyzed in the 2008 Engineering Report prepared by HKM Engineering, Inc., as updated through surveys and public input. The HKM Engineering Report served as the preliminary RWS concept for the Settlement Act. Under this alternative, the RWS would consist of these components:

- A firm, reliable water supply would be provided by diverting surface flows from the Rio Grande, supplemented by operational planning and scheduling of San Juan-Chama Project water supplies, as well as one of the following three backup aquifer storage and recovery water supply options:
    - ASR, involving three deep injection and recovery wells for injecting raw or treated surface water into an aquifer and recovering it for use in the RWS
    - ASR, involving three shallow injection and recovery wells for injecting raw or treated surface water into an aquifer and recovering it for use in the RWS
    - ASR, involving three shallow passive infiltration reaches and recovery wells for infiltrating raw surface water into an aquifer and recovering it for use in the RWS
- A side-channel surface diversion structure and pumping plant, with a sediment removal and return system on the east bank of the Rio Grande on Pueblo de San Ildefonso lands, just north of the Otowi Bridge
- A water treatment plant and pumping plant on the Pueblo de San Ildefonso on the south side of SH 502, approximately 0.75 miles east of the Otowi Bridge
- Eleven new short-term storage tanks, in addition to 13 existing storage tanks
- A water transmission and distribution system, including approximately 194 miles of pipelines, 7 pumping plants, and pressure-reducing and flow-control valves
- Approximately 15 miles of new electrical distribution lines

Table ES-1. Summary Comparison of RWS Action Alternatives

Component	Alternative B (HKM Implementable)	Alternative C	Alternative D	Alternative E (Preferred Alternative)
Firm, reliable water supply	Rio Grande surface flows, supplemented by operational planning and scheduling of San Juan-Chama Project water supplies and one of the following three options for backup water supply: • ASR—Deep injection and recovery wells (3) • ASR—Shallow injection and recovery wells (3) • ASR—Shallow passive infiltration and recovery wells (3)	Rio Grande surface flows, supplemented by operational planning and scheduling of San Juan-Chama Project water supplies	Same as Alternative C	Rio Grande surface flows, supplemented by operational planning and scheduling of San Juan-Chama Project water supplies, plus emergency use wells
Primary source water collection	Side-channel surface diversion structure	Parallel river interceptor drain	Infiltration gallery	Horizontal radial well collectors (4)
Treatment	HKM—State Highway (SH) 502 south location	El Rancho location	Same as Alternative C	County Road 101D West location
Short-term storage	24 total tanks in Alternative B locations (11 new tanks and 13 existing)	24 total tanks in Alternative C locations (11 new tanks and 13 existing)	29 total tanks in Alternative D locations (16 new tanks and 13 existing)	22 total tanks in Alternative E locations (7 new tanks and 15 existing)

Table ES-1. Summary Comparison of RWS Action Alternatives (cont.)

Component	Alternative B (HKM Implementable)	Alternative C	Alternative D	Alternative E (Preferred Alternative)
Water transmission and distribution system	• 1-mile-long raw water pipeline, from primary source water collection facility to water treatment plant • Transmission pipeline • Distribution pipeline • Access roads • 7 pumping plants • No surge tank near County Road 101D	• 4-mile-long raw water pipeline (including trenched section over a hill), from primary source water collection facility to water treatment plant • Transmission pipeline • Distribution pipeline • Access roads • 6 pumping plants • One surge tank, between primary source water collection and water treatment plant near County Road 101D • Minor variations in pipeline alignment to reach RWS facilities	Same as Alternative C • Minor variations in pipeline alignment to reach RWS facilities	Same as Alternative C • Minor variations in pipeline alignment to reach RWS facilities
Electrical service	Electrical power from existing grid; no distributed generation	Electrical power from existing grid, supplemented by solar distributed generation; minor variations in electrical line alignment to reach RWS facilities	Electrical power from existing grid, with solar-ready facilities; minor variations in electrical line alignment to reach RWS facilities	Same as Alternative D; minor variations in electrical line alignment to reach RWS facilities

Table ES-2. RWS Surface Disturbance Comparison

	Alternative B (HKM Implementable)		Alternative C		Alternative D		Alternative E (Preferred Alternative)	
	Short-Term Disturbance	Long-Term Disturbance	Short-Term Disturbance	Long-Term Disturbance	Short-Term Disturbance	Long-Term Disturbance	Short-Term Disturbance	Long-Term Disturbance
Total Pueblo Acres[1]	1,062	48	1,000	23	1,002	22	743	25
Total Non-Pueblo Acres[1]	141	3	141	3	144	4	113	2
Total Acres[1]	**1,203**	**51**	**1,141**	**26**	**1,146**	**26**	**856**	**27**

Sources: Reclamation GIS 2017; Reclamation 2015b

[1] The total short- and long-term disturbance estimated acreages are calculated without any overlapping areas. For example, new access roads and new water transmission and distribution pipelines are counted only once.

Table ES-3. Summary of RWS Action Alternatives Estimated Costs

	Alternative B (HKM Implementable)	Alternative C	Alternative D[1]	Alternative E (Preferred Alternative)[2]
Construction cost[3]	$214,700,000	$212,700,000	$229,700,000	$168,900,000
Deep ASR capital cost[4]	$12,966,000 to $38,781,000	$0	$0	$0
Deep ASR operation and maintenance costs[4]	$7,535,000 to $171,445,000	$0	$0	$0
Non-contract costs[5]	$66,505,000	$66,505,000	$66,505,000	$66,505,000
Realty costs[6]	$8,068,000	$8,068,000	$8,068,000	$8,068,000
Costs for 50 years of operation, maintenance, and replacement[7]	$68,352,000	$64,919,000	$65,405,000	$64,762,000
Life cycle costs	**$378,126,000 to $567,851,000**	**$352,192,000**	**$369,678,000**	**$308,235,000**

Source: Reclamation 2015b
Note: Costs are in 2014 dollars.
[1] Alternative D assumes intake costs would be approximately the same as Alternative C intake, with an additional five storage tanks, at an average cost of $3 million each.
[2] Alternative E costs would be refined as the final RWS design process moves forward.
[3] Source: Reclamation 2015b
[4] Source: AMEC Foster Wheeler 2016
[5] Non-contract costs are for all investigations and studies required to develop final designs; planning and stakeholder coordination; environmental compliance costs; costs to prepare feasibility level, 30 percent, 60 percent, 90 percent, and final designs, specifications, and cost estimates; project management; contract administration; and construction management.
[6] Realty costs are for planning and document preparation to acquire ROW grants over Tribal lands and sufficient land interests in NMDOT Highway and County maintained road ROWs for construction; easements across private parcels needed to construct portions of the system that do not serve County residents; and estimated relocation costs.
[7] Operation, maintenance, and replacement costs do not include costs to maintain emergency use wells.

ES.8.4 Alternative C

Under this alternative, the RWS would consist of the following major components:

- A firm, reliable water supply that would be ensured by collecting flows from the hyporheic zone of the Rio Grande and supplemented by operational planning and scheduling of San Juan-Chama Project water supplies
- A parallel river interceptor drain in the alluvium, below the water table in the bosque and on the east side of the Rio Grande north of the Otowi Bridge
- A water treatment plant on the eastern portion of the Pueblo de San Ildefonso, on the east side of County Road 101D, near the El Rancho power substation
- Eleven new short-term storage tanks, in addition to 13 existing storage tanks

- A water transmission and distribution system, including approximately 189 miles of pipelines, 1 surge tank, 6 pumping plants, and pressure-reducing and flow-control valves
- Approximately 7 miles of new electrical distribution lines, supplemented by distributed solar generation

ES.8.5 Alternative D

Under Alternative D, the RWS would consist of the following major components:

- A firm, reliable water supply that would be ensured by collecting flows from the hyporheic zone of the Rio Grande and supplemented by operational planning and scheduling of San Juan-Chama Project water supplies
- An infiltration gallery (an estimated 180 horizontal drains to collect groundwater) on the east bank to the Rio Grande
- A water treatment plant on the eastern portion of the Pueblo de San Ildefonso, on the east side of County Road 101D, near the El Rancho power substation
- Sixteen new short-term storage tanks in addition to 13 existing tanks
- A water transmission and distribution system, including approximately 187 miles of pipelines, 1 surge tank, 6 pumping plants, and pressure-reducing and flow-control valves
- Approximately 7 miles of new electrical distribution lines, with facilities capable of being supplemented by distributed solar generation

ES.8.6 Alternative E (Preferred Alternative)

Under this alternative, the RWS would consist of the following major components:

- A firm, reliable water supply that would be ensured by collecting flows from the hyporheic zone of the Rio Grande and supplementing it with operational planning and scheduling of San Juan-Chama Project water supplies; emergency use wells would allow water to be withdrawn during emergencies lasting longer than 2 days that cannot be supplied by short-term storage tanks
- Four horizontal radial well collectors on the east bank of the Rio Grande, on the Pueblo de San Ildefonso, north of the Otowi Bridge
- A water treatment plant on the west side of County Road 101D, north of SH 502
- Seven new short-term storage tanks, in addition to 15 existing storage tanks
- A water transmission and distribution system, including approximately 151 miles of pipelines, 1 surge tank, 6 pumping plants, and pressure-reducing and flow-control valves
- Approximately 7 miles of new overhead and buried electrical distribution lines, with facilities capable of being supplemented by distributed solar generation

ES.8.7 RWS Alternatives Considered but Eliminated from Detailed Study

Federal agencies are required to rigorously explore and objectively evaluate all reasonable alternatives and to discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR, Subpart 1502.14). During this process, Reclamation, BIA, and the Settlement Pueblos considered 20 other alternatives, ranging from different diversion locations and techniques to more broad geographic service areas such as Los Alamos, Tesuque Village, and Chupadero, among others. However, these alternatives were not brought forward for detailed analysis, because they would not meet the stated purpose of and need for the project or because they would not be technically, economically, or legally feasible.

ES.9 Connected Actions

The EIS also includes analysis of three connected actions: (1) the Rio Pojoaque irrigation improvement project; (2) the Pueblo de San Ildefonso future project, which consists of a wastewater system and water distribution infrastructure; and (3) the Rio Tesuque channel modification project. Each of the connected actions have been analyzed in the EIS to the extent that the details of the projects have been developed. The three connected actions are summarized below.

ES.9.1 Rio Pojoaque Irrigation Improvement Project Alternatives

Under the connected actions, the EIS assesses the potential short- and long-term environmental impacts of the five alternatives under consideration for the Rio Pojoaque irrigation improvement project: the No Action Alternative (Alternative RP-A) and four Action Alternatives (Alternatives RP-B, RP-C, RP-D, and RP-E). The Action Alternatives are summarized below in **Table ES-4**.

ES.9.1.1 Preferred Alternative and Selected Alternative

For the Rio Pojoaque irrigation improvement project, the Pueblo de San Ildefonso identified Alternative RP-C as the preferred alternative.

ES.9.1.2 Alternative RP-A, No Action

Under Alternative RP-A, the Rio Pojoaque irrigation improvement project would not be completed. The Pueblo de San Ildefonso's objectives would not be realized through this project, and the existing Rio Pojoaque Barrier Dam would continue operating with its current design.

ES.9.1.3 Alternative RP-B

Under Alternative RP-B, the existing Pojoaque River Barrier Dam would be extended from its north edge, across the Rio Pojoaque, to its north bank. The dam spans the southern channel of the Rio Pojoaque on the Pueblo de San Ildefonso. The extended barrier dam would improve the effectiveness of the barrier dam in recharging the

Table ES-4. Summary Comparison of Rio Pojoaque Irrigation Improvement Project Action Alternatives

Alternative RP-B	Alternative RP-C (Preferred Alternative)	Alternative RP-D	Alternative RP-E
Extend existing barrier dam	Pipe water from Acequia de Los Indios or collect directly from the Rio Pojoaque at the Pueblo boundary into a pipeline, a conveyance canal, or a combination of the two, to Pueblo's existing irrigation system	Enhance existing infiltration gallery	Extend existing infiltration gallery
Short-term disturbance of 1 acre	Short-term disturbance of 11 acres	N/A	Short-term disturbance of 36 acres
Long-term disturbance of 0 acres	Long-term disturbance of 5 acres	N/A	Long-term disturbance of 1 acre

Sources: Reclamation GIS 2017; Reclamation 2015b
Note: The total short- and long-term disturbance estimated acreages are calculated without any overlapping areas.

alluvium (loose sediment deposited on the riverbank) and diverting alluvial flows to the Rio Pojoaque infiltration gallery under drought conditions. Each winter, the Pueblo de San Ildefonso removes sediment from behind the barrier dam as part of annual maintenance. In addition, sediment would be removed from the proposed extension.

ES.9.1.4 Alternative RP-C (Preferred Alternative)

Under Alternative RP-C, Rio Pojoaque water owned by the Pueblo de San Ildefonso would either be piped from the Acequia de Los Indios into a new conveyance system or collected directly from the Rio Pojoaque into a new conveyance system. This system would be composed of a pipe, a concrete-lined conveyance canal, or a combination of the two, and it would tie into the existing Pueblo de San Ildefonso irrigation system.

The water would be collected by installing a new infiltration gallery and intake system on the Rio Pojoaque or by replacing a head gate at the downstream end of the Acequia de Los Indios on Pueblo land, north of County Road 84A. The Pueblo would coordinate with the Pojoaque Valley Irrigation District and Acequia de Los Indios to determine the timing of collection. It may enter into an agreement with these parties to ensure that the acequia has capacity available to deliver the Pueblo's irrigation water, if the acequia is used.

Up to a 9,300-foot-long conveyance system would be constructed from the collection area to the existing Pueblo irrigation system. The conveyance system would not obstruct any arroyo flows.

ES.9.1.5 Alternative RP-D

Under Alternative RP-D, Reclamation would analyze the working condition of the existing infiltration gallery (just upstream of the Rio Pojoaque Barrier Dam), in combination with the surrounding stratigraphy. Based on this analysis, Reclamation would identify operational issues that could be addressed to improve infiltration to the Pueblo de San Ildefonso irrigation system. The 15-inch-diameter pipe would be replaced with larger perforated pipe, and new gravel would be added.

ES.9.1.6 Alternative RP-E

Under Alternative RP-E, Reclamation would add approximately 2,540 feet of perforated pipe to the existing Rio Pojoaque infiltration gallery to deliver more water to the Pueblo de San Ildefonso irrigation system. Eighteen-inch-diameter perforated pipe would be installed, with a bed of engineered gravel for the infiltration gallery extension.

ES.9.1.7 Rio Pojoaque Irrigation Improvement Project Alternative Considered but Eliminated from Detailed Study

Reclamation considered operating a new diversion structure on the river to divert Rio Pojoaque water from the Indios Canal; however, this was eliminated from detailed study, because the project would not be technically or economically feasible.

ES.9.2 Rio Tesuque Channel Modification Project Alternatives

The EIS also assesses the potential short- and long-term environmental effects of the five alternatives under consideration for the Rio Tesuque channel modification project: the No Action Alternative (Alternative RT-A) and four Action Alternatives (Alternatives RT-B, RT-C, RT-D, and RT-E). The Action Alternatives are summarized below in **Table ES-5**.

Table ES-5. Summary Comparison of Rio Tesuque Channel Modification Project Action Alternatives

Alternative RT-B	Alternative RT-C	Alternative RT-D (Preferred Alternative)	Alternative RT-E
Restore existing incised channel	Relocate channel	Remove sediment	Infiltration gallery
Short-term disturbance of 14 acres	Short-term disturbance of 15 acres	Short-term disturbance of 6 acres	Short-term disturbance of 7 acres
Long-term disturbance of 4 acres	Long-term disturbance of 5 acres	Long-term disturbance of 1 acre	Long-term disturbance of 3 acres

Note: All acreages are preliminary estimates and will change before final design is complete.

ES.9.2.1 Preferred Alternative and Selected Alternative

For the Rio Tesuque channel modification project, the Pueblo of Tesuque has identified Alternative RT-D as the preferred alternative.

ES.9.2.2 Alternative RT-A, No Action

Under Alternative RT-A, the Rio Tesuque channel modification project would not be completed, and the Pueblo of Tesuque's objectives would not be realized.

ES.9.2.3 Alternative RT-B

Under Alternative RT-B, the Rio Tesuque channel modification project would restore the incised channel between the Upper Ponds Diversion Dam and the U.S. Highway84/285 bridge. This restoration would aim to reconnect the channel with its floodplain, allowing high flows during spring runoff or monsoon season to spill over the channel banks and into the floodplain.

ES.9.2.4 Alternative RT-C

The Rio Tesuque channel modification project under Alternative RT-C would be similar to that under Alternative RT-B and would be constructed along the same sub-reach discussed under that alternative. The major difference under Alternative RT-C is that, rather than encouraging the channel to follow the evolution model processes, a new channel would be excavated in the floodplain, to the east of the current channel alignment.

ES.9.2.5 Alternative RT-D (Preferred Alternative)

Under Alternative RT-D, the Rio Tesuque channel modification project would remove deposited sediment from the east side of the Rio Tesuque, just upstream of the TP-806 Bridge. The goal is to increase the capacity of the river to carry water and sediment past the bridge during a high flow event.

Approximately 1,320 cubic yards of material would be excavated from the project area and hauled to a nearby stockpiling site. If the Pueblo had use for this material, or if it were suitable for backfill material for RWS construction, the haul distance would be no more than an estimated 3.5 miles. Excavation would be completed during periods of little to no flow on the Rio Tesuque.

ES.9.2.6 Alternative RT-E

Under Alternative RT-E, the Rio Tesuque channel modification project would construct an infiltration gallery upstream of the Upper Ponds Diversion Dam. Its purpose would be to collect water from the Rio Tesuque and transmit it to the Pueblo of Tesuque irrigation system. The goals of this alternative would be to allow for low-flow collection so that water can be collected over an extended period and to minimize sediment delivery to the Pueblo of Tesuque irrigation ponds.

ES.9.3 Pueblo de San Ildefonso Future Projects Alternatives

In accordance with Section 615(d)(7)(A)(ii) of the Settlement Act, the Pueblo de San Ildefonso is considering constructing certain water-related infrastructure improvements, including wastewater system improvements. These could be more cost effective when implemented in conjunction with RWS construction. This EIS assesses the potential environmental impacts of constructing certain water-related infrastructure improvements, including a wastewater treatment plant and associated wastewater conveyance systems. In addition to these improvements, the Pueblo de San Ildefonso is considering other water-related infrastructure in a 680-acre area, near the Pueblo's northern boundary, along with three potential new pipeline alignments.

ES.10 Environmental Consequences and Summary Impacts

The purpose of the environmental consequences analysis is to describe the anticipated environmental and socioeconomic impacts that would result from each alternative for the RWS, the Rio Pojoaque irrigation improvement project, the Rio Tesuque channel modification project, and the Pueblo de San Ildefonso future projects alternatives.

Chapter 4 presents the potential direct, indirect, and cumulative impacts on the human and natural environment that could occur from implementing the alternatives for each project. Potential impacts on the relevant resources are described in terms of context, duration, and intensity.

Key findings of the impact analysis are summarized below. They are based on the key resource issues identified during public scoping and subsequent meetings with the cooperating agencies and Pueblos. They are organized in the same order as they are in the EIS.

ES.10.1 Surface Water and Groundwater

The implementation of any of the RWS action alternatives would, over time, reduce groundwater pumping in the Pojoaque Basin. This groundwater use depletes surface water flows in the Pojoaque Basin and the Rio Grande, due to the hydrological connectivity between groundwater and surface water. Reduction in groundwater use over time would result in beneficial increased base flows in these surface watercourses. Across RWS action alternatives, flows on the Rio Grande below the Otowi Bridge would not be measurably affected by the project, on an average annual basis. The connected actions should also have a net beneficial impact on surface water and groundwater, if an action alternative were selected.

ES.10.2 Water Quality

Under all action alternatives, the RWS would supply safe drinking water to the users and would alleviate potential health and safety issues associated with the individual water systems. All action alternatives are anticipated to provide similar quantities of water and, therefore, have similar impacts on water quality. The RWS would also comply with all aspects of Sections 404/401 of the Clean Water Act (CWA), in order to avoid or minimize potential impacts during construction or future operations. The connected actions should maintain or improve current water quality conditions and would also comply with the CWA.

ES.10.3 Air Quality and Climate Change

Constructing the RWS and connected actions would have a short-term impact on air quality. This would come about by generating fugitive dust (PM_{10} and $PM_{2.5}$) from surface-disturbing activities and by emitting criteria pollutants through the combustion of fuel in commute vehicles, trucks, and construction equipment; however, the increase in air pollutants, compared with present levels, would be negligible.

There would also be direct short-term impacts on global greenhouse gas (GHG) emissions. This would come about through the combustion of fuel from construction

vehicles and increased traffic and the release of carbon from soils and vegetation during surface-disturbing activities.

Air pollutant and GHG emissions associated with operating the RWS and connected action facilities would be less than emissions from construction; however, this would occur over the lifetime of the projects, no matter how negligible they are. Under future climate change, the imported water from the RWS would provide greater future water reliability for residents during droughts, compared with No Action.

ES.10.4 Vegetation

Long- and short-term surface disturbance acreage due to construction and operations is anticipated to be similar across the RWS action alternatives. Also anticipated to be similar across the action alternatives are the acres and locations of disturbance of vegetation communities that include potential habitat for special status plant species. Anticipated disturbance acreage includes a variety of land cover types, including unvegetated, previously disturbed, and developed lands. However, there would be direct impacts from the removal of native vegetation and loss of vegetation that may provide habitat for special status plant species. Two of the connected actions would have similar impacts on the RWS, although on a significantly decreased scale. The Pueblo de San Ildefonso future projects alternatives could have impacts at levels modeled for the RWS. Mitigation measures would be implemented to minimize any impacts.

ES.10.5 Wetlands, Non-wetland Waters, and Floodplains

Under each RWS action alternative, direct impacts on wetlands and non-wetland waters would vary, based on the location and acreage of ground disturbance necessary to accommodate each infrastructure component. There would be <1 to 3 acres of wetlands within the project area that would be directly affected by pipelines and other facilities, depending on the alternative. Most wetlands would be avoided by boring under arroyos and rerouting pipelines and facilities. Floodplains could be affected by various project elements and alternatives. Caissons associated with horizontal radial well collectors (Alternative E) could have limited impacts on the 100-year floodplain.

Alternatives with the water treatment plant on an unnamed arroyo that crosses SH 502 would be evaluated during final engineering design. This would be to determine if there were any impacts related to this non-wetland waterway and the associated floodplain and if any mitigation measures would be required by the USACE. For the connected actions, the Rio Tesuque project could impact wetlands and non-wetland waters; the Rio Pojoaque project could impact non-wetland waters, and Pueblo de San Ildefonso future projects alternatives could impact floodplains. Mitigation measures would be implemented to minimize any impacts from these actions.

ES.10.6 Aquatic Resources

Transferring water use from groundwater to surface water and reallocating existing surface water rights do not increase the baseline quantity of water depletions in the Middle Rio Grande Basin; therefore, water diverted for the project would not represent a new net depletion of annual flows downstream of the RWS diversion/collection sites proposed under any action alternative.

Based on the analysis presented in the EIS, no measurable impacts, positive or negative, are anticipated, relative to aquatic habitat or species use, under any of the action alternatives. For these reasons, operating the RWS would not impact aquatic habitat or communities in the Rio Grande reach, from the confluence with the Red River to the RWS diversion and collection locations or farther downstream of these locations to Cochiti Dam. The connected actions should have no impacts on aquatic resources.

ES.10.7 Federally Listed Threatened and Endangered Species

In the RWS project area of analysis, potential habitat for federally listed threatened and endangered species is present only in riparian areas along the rivers for the southwestern willow flycatcher (SWFL).

During biological surveys conducted in 2015 and protocol surveys for SWFL conducted in 2016, biologists detected migrating willow flycatchers along the Rio Pojoaque; however, none were confirmed to be SWFLs. Due to marginal riparian habitat along the rivers associated with the RWS and its related projects, there would be no direct impacts; there would be limited short-term impacts from construction noise and activities that may indirectly impact SWFLs.

The connected actions should have no direct impacts on federally listed threatened and endangered species; however, foraging threatened or endangered avian species may be temporarily displaced by short-term construction noise and activities.

ES.10.8 Cultural Resources

All RWS action alternatives would include adverse impacts on one or more historic properties, despite every effort to avoid or minimize impacts. Examples of resources that may be affected by implementing the RWS are archeological sites, historic buildings, historic structures, historic districts, National Historic Trails, and battlefield sites. The Rio Pojoaque, Rio Tesuque, and Pueblo de San Ildefonso future projects alternatives would also have impacts on historic properties. Mitigation measures would be implemented to minimize all impacts.

Settlement Pueblos and interested Tribes have been consulted throughout the NEPA process. No sacred sites meeting the definition in Executive Order 13007 were identified; however, Reclamation has relocated proposed infrastructure to avoid areas of Tribal concern. Reclamation will continue to consult with interested Tribes and pueblos.

ES.10.9 Indian Trust Assets

Under all action alternatives, the proposed RWS would require the use of Settlement Pueblo land for easements, ROWs, and facility construction. There would be permanent changes to the Pueblos' use of these lands, by constructing facilities and operating the RWS; there would be temporary changes during construction.

In general, the change in the use of these lands would not result in net loss, damage, depletion, or waste of assets, property, or property rights. Most of the anticipated surface disturbance on Pueblo lands would be short term and construction related. Long-term disturbance and change in use of Pueblo land is anticipated to be similar across the alternatives.

Pipelines, treatment, storage, electrical lines, and road infrastructure supporting the RWS would ensure access to water provided under the Settlement Act. They also would ensure protection and use of Pueblo water rights into the future.

The connected actions would have similar short- and long-term impacts. They would also allow for more efficient use of Pueblo water rights into the future, for such purposes as agriculture, wildlife, and traditional cultural practices.

ES.10.10 Land Use

Impacts on land use, access, and recreation would occur mostly during construction. Placing pipelines, electrical lines, wells, and other features underground would temporarily reduce access to private and public lands and would displace certain types of recreation. Once installed, there would be negligible impacts from operating and maintaining the pipelines, electrical lines, and wells; however, the Bishop's Lodge RKM pumping plant and storage tank would be within approximately 250 feet of residences.

Placement and operation of the pumping plants and tanks would result in short- and long-term vehicle traffic and management of the property supporting the industrial use. This could conflict with future residential and, to a lesser extent, commercial and public uses in the vicinity.

These and other potential conflicts would be mitigated through land use planning strategies; examples are setbacks, landscaping, lighting, and noise baffling. For example with mitigation, the pumping plants and tanks would be in conformance and would not conflict with existing land use plans. Impacts from two of the connected actions would be similar to those of the RWS, although on a significantly decreased scale. The Pueblo de San Ildefonso future projects alternatives could have impacts at levels modeled for the RWS.

Most pipeline construction would occur in public ROWs and on public land; however, temporary encroachment of construction is possible, in the form of temporary parking for loading and unloading of employees and materials or vehicle maneuvering on private property. Any activity on private property would occur along the portion of the property next to an existing public ROW or in a temporary construction easement; therefore, it would not result in a long-term change in the underlying use of the private property or a change in private property rights.

Where easements would be required for RWS permanent facilities, land use, in general, is not anticipated to change; conformance with existing land use or zoning plans would continue.

Installing the pipelines for the RWS would be in conformance with land use planning objectives, such as the Santa Fe County Sustainable Growth Management Plan (Santa Fe County 2010). These advocate for a more sustainable water supply in the region. Accordingly, there would be no long-term conflict with private property as a result of pipeline installation. This portion of the project would conform with and would not conflict with existing land use and zoning plans.

ES.10.11 Solid and Hazardous Materials

All four RWS action alternatives would involve the chemical treatment of raw water and the generation of solid waste from water treatment. Because of these actions, most public health and safety impacts from hazardous material exposure and solid waste generation and disposal would be the same under all RWS action alternatives.

There would also be potential short-term direct impacts on the health and safety of construction workers and general public at construction sites from fuel and chemical spills or hazardous materials used during construction. These potential impacts would be similar across the action alternatives, including for the connected actions. Mitigation measures would be implemented to minimize these potential impacts.

ES.10.12 Socioeconomic Resources

Impacts from constructing the RWS and associated projects would result in the short-term disturbance of local communities, due to increased dust, noise, and traffic. Economic impacts would be the direct and indirect increases in jobs, income, and total value for the local economy. Sectors most likely to be affected would be construction companies, retail gas stations, clothing and other merchandise businesses, restaurants, real estate, and hospitals. Operating the RWS would support improved water quality and reliability, which could support long-term development potential in the area.

Costs for domestic water in the Santa Fe County non-Pueblo portion of the analysis area vary, due to such factors as the level of use and the depth of wells. As a result, connecting to the water system and paying Santa Fe County rates represents increased costs for residents; the costs would be variable. Costs for Settlement Pueblo residents would depend on the level that costs for connection to the water system would be passed along to individuals.

The level of impacts on property values and related property taxes from connecting to the RWS remains unclear. Based on previous studies, changes in property values as a result of connection to a water system or as a result of improved water quality are likely to vary. Site-specific impacts on property values would occur as a result of temporary and permanent easements required on private lands for constructing and operating the RWS. Any impacts on property values would be compensated, in accordance with the requirements of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, based on appraisal and fair market value estimates.

CHAPTER 1 PURPOSE OF AND NEED FOR ACTION

1.1 Introduction

The United States (U.S.) Department of the Interior, Bureau of Reclamation (Reclamation) has prepared this environmental impact statement (EIS). Its purpose is to analyze the environmental impacts of constructing a proposed regional water system (RWS) and connected actions in the Pojoaque Basin in north-central New Mexico.

The RWS is described in and authorized by the Aamodt Litigation Settlement Act (Settlement Act; Title VI of the Claims Resolution Act of 2010; Public Law 111–291, Title VI; 124 Stat. 3065). The Settlement Act authorizes and ratifies the Aamodt Litigation Settlement Agreement (Settlement Agreement), dated January 19, 2006, as conformed to the Settlement Act and amendments.

The settlement parties are the United States; the State of New Mexico; Santa Fe County; the City of Santa Fe; the Pueblo de San Ildefonso, the Pueblo of Nambé, the Pueblo of Pojoaque, the Pueblo of Tesuque (Settlement Pueblos); and other individual defendants.

The Settlement Agreement resolves the water rights claims of the Settlement Pueblos. Among other provisions, the RWS and 2,220 acre-feet per year (afy) are included in the Settlement Agreement, in exchange for the Settlement Pueblos agreeing to reduce their claims to water in the basin and to limit their priority calls against existing non-Pueblo water users that agree to become party to the Settlement Agreement. The Settlement Agreement also addresses funding for other water-related projects on the Settlement Pueblos.

As the lead federal agency, Reclamation prepared this EIS in cooperation with the U.S. Bureau of Indian Affairs (BIA), U.S. Indian Health Service (IHS), the U.S. Army Corps of Engineers (USACE), the U.S. Fish and Wildlife Service (Service), the Settlement Pueblos, the New Mexico Department of Transportation (NMDOT), Santa Fe County, and the City of Santa Fe.

The EIS complies with the National Environmental Policy Act of 1969 (NEPA; 42 United States Code [USC], Section 4321 et seq.), the Council on Environmental Quality's (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 Code of Federal Regulations [CFR], Parts 1500-1508), the U.S. Department of Interior's NEPA Regulations (43 CFR, Part 46), and other relevant federal and state laws and regulations.

1.2 Project Description

Section 611(a) of the Settlement Act authorizes Reclamation to plan, design, and construct a RWS, consisting of water-diversion facilities from the Rio Grande and water treatment on the Pueblo de San Ildefonso. Moreover, it authorizes any treatment, transmission, storage, and distribution facilities and wellfields for Santa Fe County's distribution system and Pueblo water facilities that are necessary to distribute up to 4,000 afy of water to customers in the Pojoaque Basin (Settlement Act, Section 611[a][2][B]).

The project includes the following actions:

- Substantially completing construction of the RWS by June 30, 2024 (Settlement Act, Section 623[e])
- Bringing portions of the RWS into operation as they are constructed
- Operating and maintaining the RWS until construction is substantially complete
- Transferring title to all RWS facilities and land interests to the Settlement Pueblos, Santa Fe County, and the Regional Water Authority, upon construction completion, in accordance with Section 611(h) of the Settlement Act
- Contracting with the Settlement Pueblos for 1,079 afy of San Juan-Chama Project water (Settlement Act, Section 613[a][2])

This EIS also analyzes alternatives for the proposed connected actions of the Rio Pojoaque irrigation improvement project on the Pueblo de San Ildefonso and the Rio Tesuque channel modification project on the Pueblo of Tesuque. The funding for these actions is authorized under Section 611(f)(1) and 617(a) of the Settlement Act.

The Pueblo de San Ildefonso is also proposing to construct a wastewater system and future water-related infrastructure projects. Funding for these actions is made available under Section 617(c)(1)(A)(i) of the Settlement Act. While these actions are not directly part of the RWS, they are being analyzed in this EIS as connected actions authorized by Section 615(d)(7)(A)(ii) of the Settlement Act. This provision authorizes the expenditure of funds appropriated under Section 617(c)(1)(A)(i) of the Settlement Act prior to substantial completion of the RWS "for any activity that is more cost-effective when implemented in conjunction with the construction of the [RWS], as determined by the Secretary [of the Interior]."

1.3 Purpose of and Need for Action

The **purpose** of Reclamation's action is to reliably provide a firm, safe supply of treated drinking water for distribution in the Pojoaque Basin, in compliance with the Settlement Act.

The **need** for Reclamation's action is to reduce reliance on groundwater in the Pojoaque Basin and to allow the Settlement Pueblos to receive a portion of the water provided under the Settlement Act.

Reclamation's action would also enable the Settlement Pueblos to use funding made available in the Settlement Act for certain water-related infrastructure improvements, if requested. This funding can be requested prior to substantial completion of the RWS and used for water-related improvements that would be more cost-effective when implemented in conjunction with RWS construction, if approved by the Secretary of the Interior (Settlement Act section 615[d][7][A][ii]).

1.4 Other Objectives of the Project and Connected Actions

The Settlement Pueblos' and Santa Fe County's specific objectives for the project are as follows:

- Use water secured under the Settlement Act to meet current and anticipated future demand in the Pojoaque Basin
- Provide adequate water volume and pressure for fire protection
- Reduce the impacts of groundwater pumping to provide for recharging the aquifer

The Pueblo de San Ildefonso's additional objectives of the connected actions are as follows:

- Collect surface water from the Rio Pojoaque to improve irrigation (Rio Pojoaque irrigation improvement project)
- Complete an assessment of environmental baseline conditions for future water-related projects (Pueblo de San Ildefonso future projects)
- Complete an assessment of environmental impacts of proposed wastewater system improvements (Pueblo de San Ildefonso future projects)

The Pueblo of Tesuque's additional objectives of the connected actions (all related to the Rio Tesuque channel modification project) are as follows:

- Protect and preserve critical wetlands and springs
- Increase stream flows
- Increase infiltration
- Restore the natural characteristics of the river, including meanders, native vegetation, and a connected floodplain
- Improve infrastructure used to store water for agriculture, wildlife, and cultural purposes

1.5 Project Background

Litigation concerning claims to the scarce water resources of the Pojoaque Basin began in 1966, in the case *State of New Mexico ex rel. State Engineer v. Aamodt* (No. 66cv6639 MV/LCS [District of New Mexico], Aamodt adjudication). The purpose of the litigation was to determine the nature and extent of the claims to water rights in the Pojoaque Basin. In August 2000, the federal court ordered confidential mediation over settlement of the Pueblo claims. In May 2006, the non-federal parties to the case signed the Settlement Agreement; these were the Settlement Pueblos, the City of Santa Fe, Santa Fe County, the State of New Mexico, and other individual defendants.

This Settlement Agreement allowed for up to 4,000 afy of water to be diverted from the Rio Grande, and it contemplated constructing the RWS; 2,500 afy of water would be

allocated to the four Settlement Pueblos, and up to 1,500 afy would be allocated to Santa Fe County.

The technical details of the RWS described in the Settlement Agreement were set out in a 2008 engineering report prepared by Hurlbut, Kersich, and McCullough Engineering, Inc. (HKM 2008). The Settlement Act, signed in 2010, accomplished the following:

- Authorized the U.S., through the Secretary of the Interior, to sign the Settlement Agreement, as conformed to the Settlement Act
- Required Reclamation to construct an RWS

Reclamation announced its intent to prepare the RWS EIS in February 2012 (77 *Federal Register* 11,155).

The conformed Settlement Agreement (dated April 2012) was signed by the Settlement Pueblos, Santa Fe County, the City of Santa Fe, the State of New Mexico, and the Secretary of the Interior on March 14, 2013. It includes revisions to conform to the Settlement Act. County residents of the Pojoaque Basin have the option of signing onto the Settlement Agreement under one of three options relating to their domestic well: connecting to the RWS now; continuing to use their well, at a reduced rate, and connecting to the RWS on transfer of their property; or not connecting to the RWS and reducing use of their well.

The Pojoaque Basin is defined in Section 602(13) of the Settlement Act and encompasses about 147,300 acres. The Settlement Act defines the basin as the geographic area limited by a surface water divide, within which rainfall and runoff flow into arroyos, drainages, and named tributaries; these eventually drain into either Rio Pojoaque, the two unnamed arroyos immediately south of Rio Pojoaque, or the two arroyos (including Arroyo Alamo) that are immediately north of the confluence of the Rio Pojoaque and the Rio Grande. The Pojoaque Basin includes the San Ildefonso Eastern Reservation, which is recognized by Section 8 of Public Law 87-231 (75 Stat. 505). **Figure 1-1**, Pojoaque Basin, shows the approximate extent of the basin.

1.6 Description of the General Project Area

The proposed RWS and associated projects would be located north of the City of Santa Fe, New Mexico, between the Pueblo of Nambé to the east, the Pueblo de San Ildefonso to the west, the Pueblo of Pojoaque to the north, and Bishop's Lodge to the south (see **Figure 1-2**, General Project Area).

The general project area is delineated by an approximately quarter-mile buffer surrounding all proposed project features: the RWS infrastructure, the Rio Pojoaque irrigation improvement project, the Rio Tesuque channel modification project, and the Pueblo de San Ildefonso future water-related infrastructure projects. The general project area is in Santa Fe County and includes portions of the four Settlement Pueblos and the non-Pueblo communities of El Rancho, Jacona, Nambé Village, Cuyamungue, and Tesuque Village. The general project area encompasses approximately 30,400 acres and represents the primary area of analysis, with most potential direct and indirect impacts of the RWS.

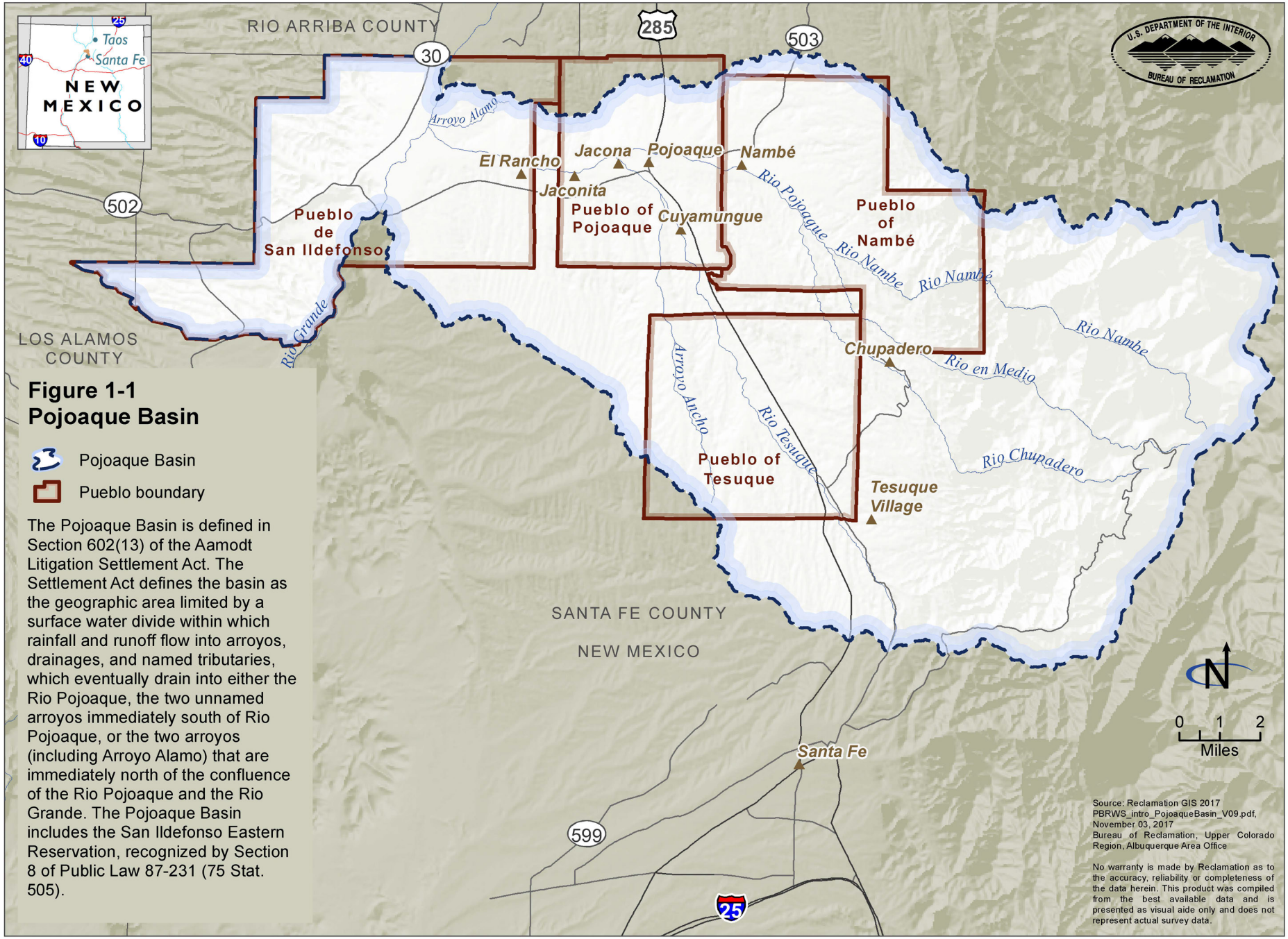


Figure 1-1
Pojoaque Basin

Pojoaque Basin

Pueblo boundary

The Pojoaque Basin is defined in Section 602(13) of the Aamodt Litigation Settlement Act. The Settlement Act defines the basin as the geographic area limited by a surface water divide within which rainfall and runoff flow into arroyos, drainages, and named tributaries, which eventually drain into either the Rio Pojoaque, the two unnamed arroyos immediately south of Rio Pojoaque, or the two arroyos (including Arroyo Alamo) that are immediately north of the confluence of the Rio Pojoaque and the Rio Grande. The Pojoaque Basin includes the San Ildefonso Eastern Reservation, recognized by Section 8 of Public Law 87-231 (75 Stat. 505).

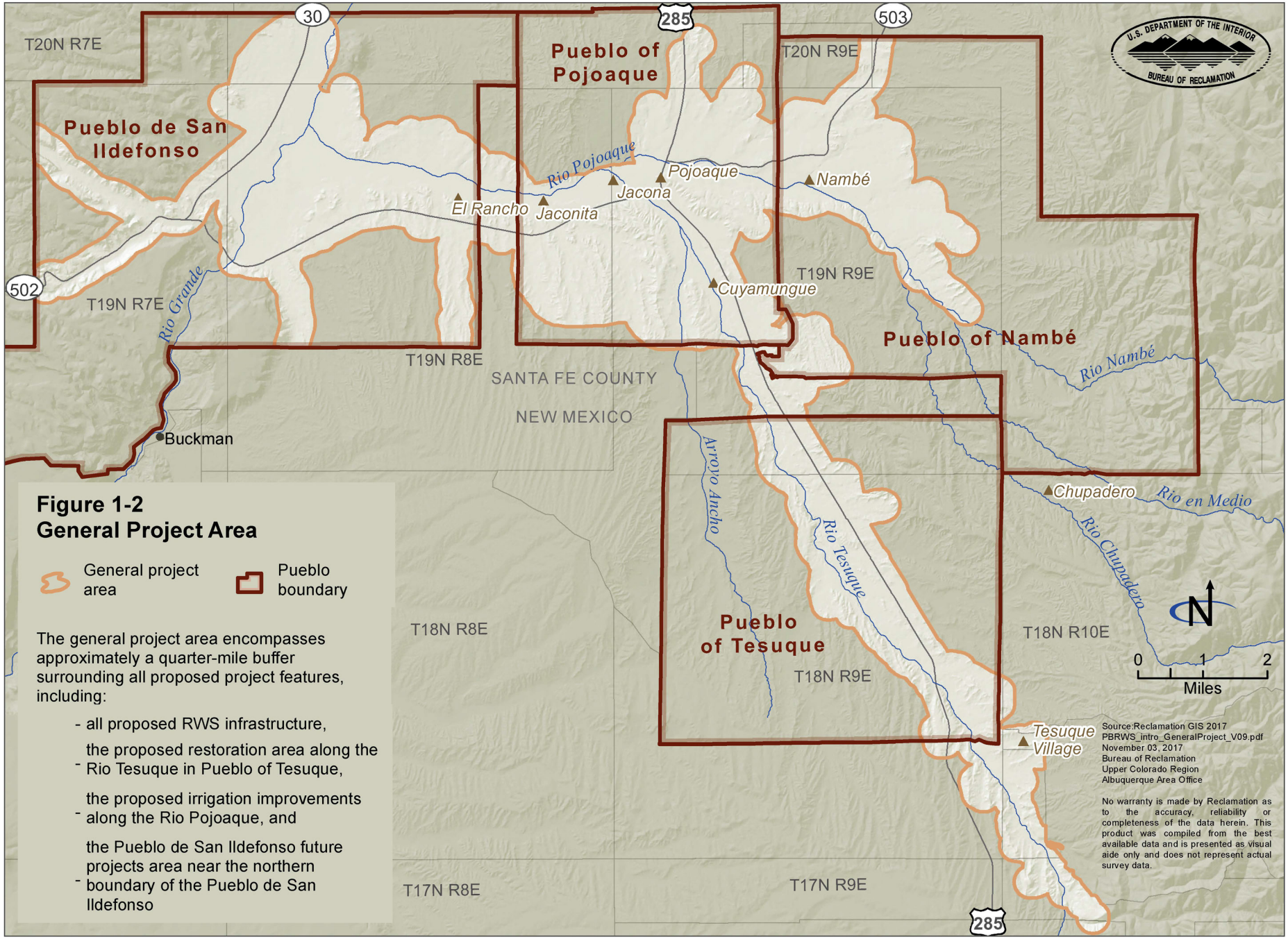


Figure 1-2
General Project Area

General project area

Pueblo boundary

The general project area encompasses approximately a quarter-mile buffer surrounding all proposed project features, including:

- all proposed RWS infrastructure,
- the proposed restoration area along the Rio Tesuque in Pueblo of Tesuque,
- the proposed irrigation improvements along the Rio Pojoaque, and
- the Pueblo de San Ildefonso future projects area near the northern boundary of the Pueblo de San Ildefonso

Source:Reclamation GIS 2017
PBRWS_intro_GeneralProject_V09.pdf
November 03, 2017
Bureau of Reclamation
Upper Colorado Region
Albuquerque Area Office

No warranty is made by Reclamation as to the accuracy, reliability or completeness of the data herein. This product was compiled from the best available data and is presented as visual aide only and does not represent actual survey data.

1.7 Federal Decisions to be Made

This EIS complies with NEPA by supporting federal decisions related to the RWS project. Both Reclamation and the BIA are making decisions based on the analysis in this EIS. Specifically, Reclamation will decide whether and how to construct and temporarily operate a water treatment and distribution system for the Pojoaque Basin, in accordance with the Settlement Agreement and the Settlement Act. Reclamation's decision would determine the design alternative for the water system and whether to proceed with project construction and temporary operations, before transferring them to a newly created Regional Water Authority, Santa Fe County, and the Settlement Pueblos.

The BIA, in consultation with the Settlement Pueblos, will decide whether to issue right-of-way (ROW) easements and permits on Tribal lands for the construction, operation, and maintenance of the RWS. According to the Settlement Act (Section 611[c][1]) and Cost Sharing and System Integration Agreement (Section 2.3), Pueblos will grant easements and ROWs as necessary for the construction of the RWS at no cost. If needed, this would include the Rio Pojoaque irrigation improvement project and the Rio Tesuque channel modification project.

Additional federal decisions would be made as part of permitting processes, including those under the Clean Water Act, the Endangered Species Act, and other applicable federal laws.

1.8 Other Related Actions

The CEQ's regulations for implementing NEPA require that parties consider the relationship of the project and its impacts on other area projects and activities and their impacts. The relationship extends to activities or projects that can be considered connected, cumulative, or similar to the proposed RWS project.

Connected actions, as defined in 40 CFR, Subpart 1508.25(a)(1), are those that are interrelated with the project and should be discussed in the same EIS. Cumulative actions, as defined in 40 CFR, Subpart 1508.25(a)(2), are those past, present, and reasonably foreseeable actions that, when viewed with the project, have cumulatively significant impacts. Finally, similar actions, as defined in 40 CFR, Subpart 1508.25(a)(3), are those that, when viewed with the project, have similarities to the project, such as common timing or geography, that provide a basis for being evaluated together. Reclamation considered the impacts and results of these actions when evaluating existing conditions and analyzing alternatives.

All water rights in the Nambé-Pojoaque-Tesuque Basin have been or will be adjudicated as part of the Aamodt general stream adjudication. The Partial Final Decree, entered in March 2016, adjudicated the Settlement Pueblos' water rights.[1] This EIS in no way determines the nature and extent of any water rights.

[1]See *Partial Final Judgment and Decree of the Water Rights of the Pueblos of Nambé, Pojoaque, San Ildefonso, and Tesuque, State of New Mexico ex rel. State Engineer v. Aamodt*, No. 66cv6639 (D.N.M.). Internet website: http://www.ose.state.nm.us/Legal/settlements/Aamodt/PDF/pfd%20and%20 appendices.pdf.

As part of the Settlement Act, Reclamation and the BIA obtained the following water rights for the RWS:

- Under contract to the Settlement Pueblos, Reclamation would provide 1,079 afy of San Juan-Chama Project water. San-Juan-Chama Project water would be delivered to the RWS from Heron Reservoir via the Rio Chama and Rio Grande (Reclamation 2015a).
- The BIA acquired 1,141 afy of Top of the World Farms water rights from Santa Fe County (BIA 2013). Groundwater from the Top of the World Farms in Taos County, New Mexico, would be delivered to the RWS via the Rio Grande.
- The BIA developed an acquisition agreement and acquired 302 afy of Pueblo of Nambé reserved water rights. This surface water would be delivered to the RWS via the Rio Nambé, the Rio Pojoaque, and the Rio Grande.

In addition, Santa Fe County would provide the following water rights:

- 611 afy of Top of the World Farms water rights to supply non-Pueblo RWS users
- Transfer of up to 889 afy of water rights from existing groundwater wells as well owners elect to hook up to the RWS, or from other sources, including additional upstream water rights, San Juan-Chama project water, or in-basin transfers from non-domestic water rights[2]

Water secured through these actions would provide a portion of the supply for the RWS project. These actions have undergone separate environmental review; however, given their relationship to the RWS project, the water use changes are assessed in this EIS, as appropriate (see **Section 2.3.1.1**, RWS Components, Water Rights).

As described in the Settlement Act, the BIA would manage an operation, maintenance, and replacement fund of $37.5 million to assist in paying the Settlement Pueblos' allocation of these costs.

Additional connected actions include the Rio Pojoaque irrigation improvement project, the Rio Tesuque channel modification project, and Pueblo de San Ildefonso's wastewater system and future water-related infrastructure projects. Neither Reclamation nor the BIA will make a decision on whether to build these projects or how to design them.

Cumulative projects and analysis of those projects are provided in **Section 4.25**, Cumulative Impacts.

[2] For the purposes of this analysis, the assumption is that most of this water would come from within the basin.

1.9 Public Involvement

Public involvement is a vital part of the EIS process. It provides the opportunity for those affected by project actions to take part in the environmental review process and facilitates full environmental disclosure. Government-to-government consultation is also ongoing with the Settlement Pueblos (see **Chapter 5**, Consultation and Coordination).

Public involvement is being conducted throughout the course of this EIS process, including providing the public with specific opportunities to comment during three phases:

1. Public scoping before NEPA analysis began. This was to determine the scope of issues and alternatives to be addressed in the EIS. It began with publication of the Notice of Intent in February 2012 and ended in May 2013. It is summarized in a scoping report published in August 2013 (Reclamation 2013a), which describes key issues identified during this process.
2. Public review of and comment on the Draft EIS. This began with publication of the notice of availability of the Draft EIS in January 2017 and ended in February 2017. Volume 3 of this EIS includes comments received, analysis of those comments, and responses to comments.
3. Public review of this Final EIS.

Public outreach during the public scoping period included a press release announcing the scoping period, newspaper advertisements, a project newsletter distributed to over 4,200 individuals and businesses on the mailing list, seven open houses throughout northern New Mexico, and a project website, www.pojoaquebasineis.com. The website provides access to background material and general project area maps.

Additional public outreach was conducted during the summer and fall of 2013, including two open houses hosted by Reclamation on August 6 and 8, 2013. These open houses were advertised in local newspapers and through the project mailing list.

After publishing the Draft EIS, Reclamation held four public meetings during a 45-day review period. The public meetings and review period were announced in a press release, newspaper advertisements, and a newsletter distributed to approximately 3,600 individuals and businesses on the mailing list. See **Chapter 5**, Consultation and Coordination, for additional information on public involvement.

1.10 Summary of Changes Between the Draft EIS and the Final EIS

This Final EIS includes changes in response to public comments on the Draft EIS. It also includes updates based on ongoing engineering design work and collaboration with stakeholders.

This section describes the changes to the document since the publication of the Draft EIS, organized by chapter; all of these changes are in the general project area. The list of these changes is not exhaustive and does not include minor, editorial word changes.

1.10.1 General Changes

- The **Abstract** and **Executive Summary** were updated to reflect the content of this Final EIS.
- All acres, distances, volumes, and maps were reviewed and revised as necessary to capture any revisions to alternatives described in **Chapter 2**.
- The Pojoaque Basin Regional Water System Biological Assessment and the Service's concurrence letter for the Pojoaque Basin Regional Water System were added to this Final EIS as **Appendix J**.
- Editorial changes were made throughout the document.

1.10.2 Changes to Chapter 1

- Information on the public Draft EIS review period was added.
- A summary of the changes between the Draft EIS and Final EIS was added.

1.10.3 Changes to Chapter 2

General Changes to Chapter 2

- Information on the size and volume of existing storage tanks was added; this was done to estimate total short-term storage capacity under each alternative for comparison.
- Mitigation measures for construction staging areas were added.
- The primary source water collection component under Alternatives C, D, and E was estimated to yield a maximum 6.23 million gallons per day (mgd). This information was added to the chapter.
- Estimated surface disturbance from sodium hypochlorite injection buildings was added; these buildings would be constructed at all existing storage tanks that would be included in the RWS, except for the IGC Tank.

Changes to Alternatives B and C

- A description of radio antenna poles was added; these poles are next to the primary source water collection, water treatment plant, pumping plants, and storage tanks and provide communication for system control as part of the SCADA system.

Changes to Alternative D

- A description of radio antenna poles was added; these poles are next to the primary source water collection, water treatment plant, pumping plants, and storage tanks and provide communication for system control as part of the SCADA system.
- The size of the Flea Market storage tank was increased, to accommodate expected demand in the area; the height of this tank was reduced by making it a larger diameter in order to reduce visual impacts.

Changes to Alternative E

- The footprint of the spoil pile staging area near the El Rancho cemetery was reduced, to avoid affecting access to that cemetery. The footprint was reduced or the locations of other staging areas were changed, including those for spoil piles and borrow pits, based on input from the Settlement Pueblos.
- A description of radio antenna poles next to the primary source water collection, water treatment plant, and pumping plants and on top of the storage tanks was added, to provide communication for system control as part of the SCADA system.
- Only existing wells are being considered for emergency use to supplement a firm reliable water supply. No new emergency use wells would be constructed. The number of potential, existing, emergency use wells was narrowed down to those wells with sufficient water quality that are already connected to short-term storage tanks proposed for inclusion in the RWS. Additional information on emergency use wells operations was added.
- No pumping plant would be constructed at the horizontal radial well collectors. Submersible pumps in each well collector would lift raw water directly to the water treatment plant. Two electrical buildings would be constructed near the well collectors.
- The proposed water treatment plant location has been moved to the north, at the request of the Pueblo de San Ildefonso, to decrease environmental impacts and reduce construction costs.
- The Pojoaque South storage tank is no longer proposed for construction. This change avoids unacceptable visual impacts on the Pueblo of Pojoaque and erosion impacts on the arroyo near Mystic Lane. As a result, the proposed Nambé South tank would be expanded to hold the water originally planned to be stored in the Pojoaque South tank. The Nambé South tank is at an elevation that would allow service to all locations previously proposed to be served by the Pojoaque South Tank.
- The Flea Market storage tank is no longer proposed for construction under the preferred alternative, based on public comment and stakeholder input.
- Due to environmental concerns, the proposed Pojoaque Industrial Park storage tank was moved next to a previously disturbed site, at the request of the Pueblo of Pojoaque.
- The proposed White Sands New storage tank was moved, at the request of the Pueblo of Pojoaque, to avoid environmental impacts and improve access. The tank in this new location is now called the Turtle storage tank under Alternative E.
- The proposed Camel Rock Casino storage tank was moved, at the request of the Pueblo of Tesuque, to avoid impacts on floodplains.

- The proposed Nambé storage tank was moved next to an existing tank in a previously disturbed parking lot. This new location avoids several arroyo crossings.
- All proposed new storage tanks would be larger, to increase the volume of water for fire protection.
- The existing Industrial Area tank on the Pueblo of Pojoaque would be part of the RWS, while the existing Nambé Tank #26 on the Pueblo of Nambé would not be part of the RWS.
- The existing Main Village tank on the Pueblo de San Ildefonso is now called the Tewa tank.
- The existing North Village tank on the Pueblo of Pojoaque is now called the White Sands tank.
- None of the raw water pipeline between the horizontal radial well collectors and the water treatment plant would be bored through the hill west of County Road 101D; instead, the entire pipeline would be trenched. As a result, a surge tank would be constructed between these two facilities.
- Access roads, water transmission and distribution pipeline routes, and electrical line alignments were updated, based on new facility locations. Pipeline routes were also updated to avoid certain areas, based on public and stakeholder input and environmental concerns.
- The name of the proposed Upper Tesuque Pueblo pumping plant was changed to the Camel Rock Casino pumping plant. Due to environmental concerns, the pumping plant was moved, at the request of the Pueblo of Tesuque.
- Due to environmental concerns, the proposed Pojoaque Industrial Park pumping plant was moved next to a previously disturbed site, at the request of the Pueblo of Pojoaque.
- To avoid impacts on adjacent private property, the proposed Tesuque pumping plant was moved, at the request of the Pueblo of Tesuque.

Changes to Rio Pojoaque Irrigation Improvement Project Alternatives

- A section describing common features of the action alternatives was added.
- Current and proposed sediment removal practices were described for the Rio Pojoaque Barrier Dam.
- The Pueblo de San Ildefonso would coordinate with the Pojoaque Valley Irrigation District and Acequia de Los Indios under Alternative RP-C.
- Reclamation clarified that the conveyance system under Alternative RP-C could be either all pipe or a combination of pipe and a concrete-lined conveyance canal. It also clarified the options for collecting or diverting water into the conveyance system and updated the alignment of the conveyance system to reduce environmental impacts and stay on Pueblo lands.

- Reclamation clarified the location of the manhole reaching the existing Rio Pojoaque infiltration gallery, based on public input.
- The conveyance system was extended further to the east.

Changes to the Rio Tesuque Channel Modification Project Alternatives

- Reclamation clarified that not all of the Pueblo of Tesuque's goals for this project could be achieved by the various alternatives; instead, the Pueblo is evaluating which project to construct, based on the analyses in this EIS.

Changes to the Pueblo de San Ildefonso Future Projects Alternatives

- Description of changes to the Northwest and Northeast service areas of the proposed wastewater system was removed; this is because these areas are no longer analyzed in this EIS.
- The description of sewer pipeline improvements and proposed wastewater treatment facility in the Center/South service area was updated, based on additional information.

Changes to Alternatives Considered but Eliminated from Detailed Study

- Reclamation revised explanation for eliminating from detailed study the operation of a new diversion structure on the river to divert Rio Pojoaque water from the Acequia de Los Indios.

1.10.4 Changes to Chapter 3

- A statement was added, noting that there are no prime and unique farmlands in the general project area.
- Noxious weed classes for bull thistle, musk thistle, and tree of heaven were updated, and the name of tamarisk was changed to salt cedar.
- The affected environment description in the Federally Listed Threatened and Endangered Species section was updated, based on the Pojoaque Basin Regional Water System Biological Assessment.
- Reclamation clarified that the action area identified in the Pojoaque Basin Regional Water System Biological Assessment is the 30,400-acre general project area, not the 5,900-acre biological area of analysis.
- Information was added on the historic Battle of Puertecito de Pojoaque battlefield site, in the vicinity of the general project area.
- Information was added on the route of the El Camino Real de Tierra Adentro and Old Spanish NHTs, in relation to the general project area.
- Revised information on acres of wetlands and other non-wetland waters of the U.S. were added to the Wetlands, Non-wetlands Waters, and Floodplains section.

1.10.5 Changes to Chapter 4

- The impact analysis was updated to reflect changes in **Chapter 2** described above.
- Additional mitigation measures were added to the air quality, vegetation, and federally listed threatened and endangered species sections.
- The analysis in the Federally Listed Threatened and Endangered Species section was updated, based on the Pojoaque Basin Regional Water System Biological Assessment.
- Information from Class III cultural surveys was added to the Cultural Resources section.
- The analysis of the El Camino Real de Tierra Adentro and Old Spanish NHTs was updated in the Cultural Resources section.
- The analysis in the Visual Resources section was updated to reflect changes in **Chapter 2** and additional visual fieldwork in the vicinity of the Santa Fe Opera.
- Information on construction noise sources was added to the Noise section.

1.10.6 Changes to Chapter 5

- A description of public Draft EIS comment period was added.

1.11 Document Organization

The document is organized as follows:

- **Volume 1**
  - *Chapter 1: Purpose of and Need for Action* introduces the project, which is being proposed to comply with the Settlement Act. The chapter also discusses the purpose of and need for the project and the objectives of this EIS.
  - *Chapter 2: Alternatives, including the Proposed Action* provides information on developing and analyzing the project alternatives. Alternatives and elements considered but eliminated from further consideration are also identified. Chapter 2 includes a description of each alternative being carried forward for analysis.
  - *Chapter 3: Affected Environment* characterizes the existing environment, particularly the resources most affected by the alternatives carried forward for analysis.
  - *Chapter 4: Environmental Consequences* identifies the impacts that would occur on the resource areas as a result of project development and operation.
  - *Chapter 5: Consultation and Coordination* presents a list of the agencies, Tribes, and other interested or affected individuals and groups that were

contacted. It also contains a summary of the public involvement process for this EIS and discusses the consultation and coordination activities that were undertaken with the Settlement Pueblos and other cooperating agencies. A list of parties receiving a copy of this EIS is included.

- *Chapter 6: List of Preparers* is a list of Reclamation and consultant staff who prepared this EIS.
- *Chapter 7: References* lists the documents and other sources used to prepare this EIS.
- *Chapter 8: Glossary* contains definitions of terms found in this EIS.
- *Chapter 9: Index* is a compilation of terms and where to find them in the EIS.

- **Volume 2**

  - *Appendices* are supplemental documents supporting the descriptions and analysis in this EIS.

- **Volume 3**

  - *Draft EIS Comment Summary and Response Report* describes the public comment and response process for the proposed RWS project. It includes a comprehensive list of all public comments received, showing how Reclamation addressed each comment.

This page intentionally left blank.

CHAPTER 2 DESCRIPTION OF ALTERNATIVES

2.1 Introduction

This chapter is a discussion of the various RWS components and elements used to create the alternatives. Also included is a summary of the alternatives development and screening process. The No Action Alternative and four action alternatives are described in detail, along with alternatives considered but eliminated from detailed analysis. Summaries of the differences and common features between the alternatives are also provided.

This chapter describes the alternatives considered for the following three connected actions:

- The Rio Pojoaque irrigation improvement project (**Section 2.7**)
- The Rio Tesuque channel modification project (**Section 2.8**)
- Future water-related infrastructure projects that may be implemented by the Pueblo de San Ildefonso (**Section 2.9**)

The maps in this chapter provide context for each alternative; detailed maps at a finer scale are in **Appendix B,** Alternatives Figures.

2.2 Alternatives Development and Screening Process

The RWS alternative development process involved collaboration with stakeholders, including cooperating agencies, as well as engineering and feasibility analyses. During a scoping period from February 2012 through May 2013, Reclamation asked for public input on the scope of the analysis and for alternatives to be considered. Reclamation analyzed the scoping comments it received and published a scoping report in August 2013.

Those comments related to alternatives were carried forward into alternatives development. Reclamation, the cooperating agencies, and other stakeholders then developed a suite of alternatives for the RWS elements and screened each element to determine which would be carried forward for combination into complete alternatives and detailed analysis.

Screening criteria were used to evaluate each element's ability to satisfy the purpose of and need for the RWS, its technological and economic practicability and feasibility, and its environmental impacts, specifically with regard to the Clean Water Act of 1972 (CWA) Sections 404(b)(1)/401 and the Endangered Species Act (ESA). Elements that failed to satisfy one of these criteria were eliminated from detailed consideration; the remaining elements were combined into complete alternatives.

Section 617(a)(5)(B) of the Settlement Act directs Reclamation to select a preferred alternative that is in substantial compliance with the RWS, as described in the 2008 report prepared by HKM Engineering, Inc. Alternative B, HKM Implementable, represents the RWS designs from the report, with updates to make the designs implementable. Other RWS action alternatives can be compared with Alternative B to evaluate whether they are in substantial compliance with the RWS, as defined in the

HKM Engineering Report. For additional detail on the alternatives screening process, see **Appendix A**, Screening Criteria Memo.

It is important to note that, in construction projects such as the proposed RWS, it is common to make refinements to final designs during construction. The alternatives described in this chapter contain sufficient information to capture all of the impacts of the proposed action and alternatives; however, the elements analyzed in detail in subsequent sections may evolve before the RWS design is finalized. According to Section 611(b) of the Settlement Act, the final RWS design must be completed within 90 days after the Record of Decision for this EIS is signed. Reclamation will conduct additional environmental analyses, as needed, to address the impacts of any design changes not analyzed in this EIS. For example, this documentation could include a determination of NEPA adequacy, a categorical exclusion, a supplemental environmental assessment, or a supplemental environmental impact statement.

Reclamation may also combine elements from different alternatives into the final RWS design, rather than implementing a single complete alternative analyzed in this EIS (CEQ 1981). For example, primary source water could be collected using surface flows in the hyporheic zone, but backup aquifer storage and recovery (ASR) wells could also be constructed; however, this would not create a new alternative or project element that has not previously been analyzed in this EIS. Additionally, the Regional Water Authority could add a backup water supply or any other facility to the RWS at any point after Reclamation transfers ownership to it.

The RWS is being designed to be flexible in where and how it provides water to meet future demand for all customers. This may include interim use of the water by Santa Fe County for customers outside the Pojoaque Basin. In accordance with Section 614(d) of the Settlement Act, the County may use unused capacity and water rights of the County Water Utility to supply water within the County but outside of the Pojoaque Basin (1) on approval by the State and the Regional Water Authority and (2) subject to the issuance of a permit by the New Mexico State Engineer.

When the Draft EIS was published in January 2017, the County had not received approvals or permits from the State to transfer its water for interim use by customers outside the basin. In July 2017, the New Mexico Office of the State Engineer issued a permit authorizing interim uses anywhere within the County Water Utility service area. This satisfied the requirement of Section 614(d)(2) of the Settlement Act. While the County may decide to use RWS water for interim uses outside the basin, no specific plans for such use have been proposed. If it were proposed in the future, it would be subject to appropriate environmental compliance requirements at that time.

2.3 Common Features of the RWS Action Alternatives

2.3.1 RWS Components

All of the action alternatives described below incorporate the same components of the proposed RWS, though the characteristics of each component may vary by alternative. The components that would be included in the RWS under all action alternatives are described in **Figure 2-1**, Components and Elements of the Proposed RWS, and are illustrated in **Figure 2-2**, Components of the Proposed RWS.

The primary source for the approximately 4,000 afy of water allocated for consumptive use in the RWS would be the Rio Grande, in the northwest portion of the general project area.

Backup options would be included in the system to provide a secondary water source, if necessary. This would ensure a firm, reliable supply of water, with adequate quality and in a high enough quantity to meet the demands of the RWS.

The collected water would need to be treated to meet national and state drinking water standards before being delivered to customers. A water treatment facility would be built in the general project area. Once the water is treated, it would need to be transported from the treatment facility through water transmission pipelines to short-term storage tanks (also known as distribution tanks) and water distribution pipelines. Distribution pipelines would deliver water from storage locations toward hook-ups for individual homes and businesses. The water distribution system would also provide treated water for fire protection.

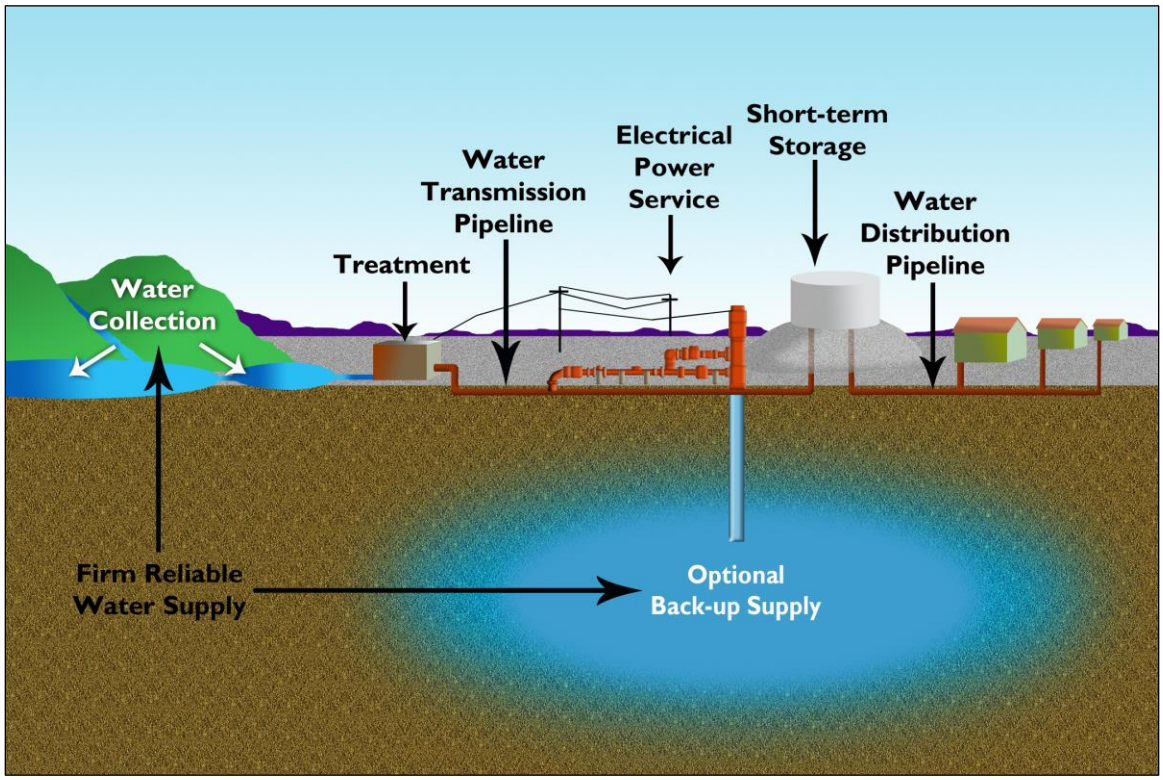
Figure 2-1. Components and Elements of the Proposed RWS

The proposed RWS consists of six components:

1. Firm, reliable water supply
2. Primary source water collection
3. Water treatment
4. Short-term storage tanks
5. Water transmission and distribution system, including pipelines, pumping plants, forebay tanks, and other associated facilities
6. Electrical power service

There are different ways these components can be implemented, which are called project elements. For example, surface water could be collected by a side channel diversion or sub-surface capture. Part of alternatives development is to identify the different elements available for each component.

Figure 2-2. Components of the Proposed RWS



Source: EMPSi

Additional details on each RWS component and its features that are common to all RWS action alternatives are provided in the sections below.

2.3.1.1 Firm, Reliable Water Supply

Under all RWS action alternatives, a firm, reliable water supply is defined as one that is able to provide up to 4,000 afy of drinking water for consumptive use in the RWS while having the capacity to satisfy estimated peak demands and providing some level of fire protection, based on Santa Fe County requirements.

The rate of collection of RWS water from the Rio Grande would increase as additional portions of the RWS are placed in service. Construction would begin on the Pueblo de San Ildefonso. Initially, average demand on this Pueblo would be an estimated 99 afy. For the first 2 to 3 years of project operations, average demand in the constructed RWS service area would be an estimated 566 afy. This includes demand in the initial service areas of Pueblo de San Ildefonso and portions of the Pueblo of Pojoaque and Pueblo of Nambé, which are included in the first phase of construction. Eventually, given full construction and anticipated future increases, demand would reach 4,000 afy.

Water Rights

The primary water rights providing sources for the RWS would be the same under all action alternatives. The U.S. would acquire the water rights necessary to supply up to 2,500 afy for the Settlement Pueblos, as follows:

- 1,079 afy of San Juan-Chama Project water contracted to the Settlement Pueblos
- 1,141 afy of water previously acquired by Santa Fe County from Top of the World Farms, commonly referred to as "Top of the World" water rights
- 302 afy of Pueblo of Nambé reserved water rights[1]

In addition to the water rights allocated to the Settlement Pueblos, Santa Fe County would provide up to 1,500 afy from water rights it owns to supply non-Pueblo RWS users. These water rights would include the following[2]:

- 611 afy of Top of the World water rights
- Up to 889 afy of water rights transferred to the County from existing groundwater well owners as they elect to hook up to the RWS, or from other

[1] See *Partial Final Judgment and Decree of the Water Rights of the Pueblos of Nambé, Pojoaque, San Ildefonso, and Tesuque, State of New Mexico ex rel. State Engineer v. Aamodt*, No. 66cv6639 (D.N.M.). Internet website: http://www.ose.state.nm.us/Legal/settlements/Aamodt/PDF/pfd%20and%20 appendices.pdf.

[2] Users who elect to connect to the RWS would transfer a portion of their groundwater rights to the County. Those groundwater rights would be part of the County's contribution to the 1,500 afy total. Because approximately 611 afy would come from the Top of the World water rights, rights from groundwater well users connecting to the RWS, along with any other water rights transferred to the County, would contribute only up to 889 afy.

sources, including additional upstream water rights, San Juan-Chama project water, or in-basin transfers from non-domestic water rights[3]

Operational Planning and Scheduling of San Juan-Chama Project Water Supplies

Reclamation, and eventually the new Regional Water Authority, would schedule releases of San Juan-Chama Project water allocated for the RWS from Heron Reservoir as needed, for example during times of anticipated low flows. This would provide an extra level of certainty of a firm, reliable water supply under all alternatives. Water rights from other sources may be used first for the RWS, so that San Juan-Chama Project water could be saved to provide this certainty. San Juan-Chama Project water may not be used regularly for RWS supply until approximately 2026, when water demand in the RWS service area is expected to be higher.

2.3.1.2 Primary Source Water Collection

Primary source water collection for all RWS action alternatives would collect surface water on the east bank of the Rio Grande, north of Otowi Bridge. All primary source water collection methods being considered in the RWS alternatives would be capable of yielding a maximum 4,000 afy and 4,326 gallons per minute (gpm; 6.23 million gallons per day [mgd]), which is the estimated yield required to meet maximum daily demand (INTERA 2016a). Actual collection rates would vary, based on demand. Initial collection rates are anticipated to be far lower than 4,326 gpm and would increase as additional customers are served by the RWS.

2.3.1.3 Water Treatment

Under all RWS action alternatives, the water for the RWS would be treated to satisfy Environmental Protection Agency (EPA) and New Mexico Environment Department (NMED) drinking water standards. While water treatment plant locations would differ, as described under **Section 2.6**, RWS Alternatives Considered in Detail, the facilities and site design at each location would remain largely the same.

The water treatment plant site would contain multiple buildings and other structures associated with the treatment process. **Table 2-1**, below, details the type of structure and approximate size for each facility anticipated to be constructed at the water treatment plant site. The exact location of facilities within the water treatment site footprint may change as RWS designs are finalized.

The water treatment plant site would have a swale along the perimeter to direct stormwater around the site and toward surrounding natural watercourses. Riprap slope protection would also be constructed along site boundaries and embankment slopes next to arroyos for protection from a 100-year flood. The site would be constructed at least 3 feet above the 100-year floodplain of any adjacent arroyos. The entire service yard for the water treatment plant would be covered in gravel to provide adequate traction and bearing surface for anticipated site traffic.

[3] For the purposes of this analysis, the assumption is that most of this water would come from within the basin.

Table 2-1. Major Water Treatment Plant Facilities

Facility	Structure Type	Size
Pre-sedimentation basin (Alternative B only)	Concrete structure	78 feet long by 33 feet wide by 17 feet deep
Water treatment plant building	Enclosed building	225 feet long by 120 feet wide, with a roof eave height of 29 feet
Filter press building	Enclosed building	Two stories; 72 feet long by 36 feet wide, with a roof eave height of 39 feet
Clear well and pumping plant building	Enclosed building	34 feet long by 30 feet wide, with a roof eave height of 12 feet (81 feet long by 34 feet wide by up to 21 feet below ground for the sump and clear well)
Air chamber building for clear well pumps	Enclosed building	28 feet long by 20 feet wide, with a roof eave height of 20 feet
Gravity thickeners	Two concrete circular tanks	65 feet in diameter (under Alternative B), 35 feet in diameter (under Alternatives C, D, and E), set in the ground

Source: Reclamation 2015b

The treatment plant site would be accessed via a pair of drives, a motorized rolling gate, and a pair of 20-foot-wide chain-link gates. The site would be fenced on all sides with 7-foot-tall chain-link fencing. The water treatment plant building (the largest facility at the site) would be soundproofed and designed to blend with the surrounding topography and architecture. Chemicals would be stored in large tanks in the water treatment plant building in enough quantities to provide for a minimum 30-day supply to minimize trucked chemical deliveries. Cleaning chemicals would be stored in containers large enough to hold them for a minimum of six cleaning cycles.

All sediment generated at the water treatment plant would be considered solid waste, as defined by the Resource Conservation and Recovery Act, and would be transported to the Caja del Rio landfill in Santa Fe for disposal, rather than being returned to the Rio Grande.

The estimated connected electrical load for the water treatment plant site would be 4,300 kilovolt-amps (kVAs). This includes the plant, office, clear well pumps, and all other treatment plant site facilities.

2.3.1.4 Short-Term Storage Tanks

Short-term storage tanks are permanent tanks that would provide up to a 2-day domestic supply of water plus fire protection flow storage. These tanks would allow adjustments in RWS flows based on demand, while providing water at an adequate quantity and pressure for fire protection. The amount of fire protection flows provided would vary by alternative, as would the number and location of fire hydrants along the water transmission and distribution pipelines. Reclamation is considering a range of storage

capacities across the alternatives. This is due to trade-offs between providing fire protection flows and overall system costs and construction impacts.

The locations of new and existing short-term storage tanks in the RWS vary by alternative; nevertheless, the design and construction of the different types of tanks would be consistent with the descriptions below for all RWS action alternatives. Design criteria, including volume, would determine whether a tank would be steel or concrete. For this EIS, all of the listed existing tanks are assumed to be available for use and are in good condition; however, tanks may need to be upgraded in the future.

Steel short-term storage tanks could be either welded or bolted steel (see **Figure 2-3**, Typical Welded and Bolted Steel, Short-Term Storage **Tanks**). Each tank would have self-supporting roofs with a 36-inch air vent. These vents would be equipped with screens to keep out birds and insects. A ladder, platform, and manhole would allow access for tank inspection. The ladder and platform would be designed in accordance with U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) criteria.

Concrete short-term storage tanks would be sand-colored, with domed roofs. Berms, backfill, or excavation would be used as needed to minimize visibility. **Figure 2-4** shows a typical concrete, short-term, storage tank.

Temporary construction disturbance for each storage tank site is estimated to cover approximately 2 acres. Storage tank site permanent footprints would range from approximately 0.5 to 1.0 acre, depending on the number of proposed features, the size of tank, and the location of the site. The sites would be designed to direct any surface storm runoff away from tanks and other structures. Runoff would be discharged to permeable surfaces around the site perimeter. Tanks would be obscured from view, using natural topography where possible, and would be screened with vegetation; however, some level of elevation above the service area is required to ensure adequate water pressure in the distribution system.

Storage tank sites would be accessed via a single-lane, 20-foot-wide access road and a 16-foot-wide, double-swing chain-link gate. Each site would be fenced with a seven-foot-tall chain-link fence, with three-strand barbed wire on all sides. Storage tank sites located far from existing access roads and offset in the hills would require access road construction or improvement. All other storage tank sites would be accessed via existing roads. Newly constructed access roads would be graded dirt or base course and would follow pipeline alignments to the storage tanks.

A disinfection building, or sodium hypochlorite injection building, would be at each new and existing storage tank site, except for the proposed Nambé South existing IGC tank sites. These sites have existing buildings that could be used for disinfection. Each sodium hypochlorite injection building would be approximately 20 feet long by 20 feet wide, with a 9-foot roof eave height. Between 55 and 440 gallons of sodium hypochlorite would be stored in each injection building. The amount of sodium hypochlorite stored in each injection building would vary, based on water demand and tank capacity. Sodium hypochlorite would be injected to provide additional disinfection if the water were to remain in the tank for an extended period.

The estimated connected electrical load for each storage tank site is 10 kVA. This would provide power for instrumentation, controls, and a sodium hypochlorite booster station.

Figure 2-3. Typical Welded and Bolted Steel, Short-Term Storage Tanks

Welded



Bolted



Photo credits: Santa Fe County, Reclamation

Figure 2-4. Typical Concrete, Short-Term Storage Tank



Photo credit: Santa Fe County

2.3.1.5 Water Transmission and Distribution System

Under all RWS action alternatives, Reclamation would construct a water transmission and distribution system that would include pipelines, pumping plants, forebay tanks, pressure-reducing and flow-control valves and supervisory control and data acquisition (SCADA) systems, flow meter vaults, flow-control vaults, and air chambers.

Transmission pipelines typically do not include distribution connections; however, at the outer edges of the system, the transmission pipelines could also be used for distribution in order to avoid installing parallel pipelines.

The water transmission system would include the following:

- Between 39 and 49 miles of pipeline (actual length varies by alternative)
- Pumping plants
- Forebay tanks
- Associated valves and SCADA systems
- Associated flow meter vaults, flow-control vaults, and air chambers

Additional facilities may be included depending on the alternative. The water transmission pipelines would cross State Highway (SH) 502, U.S. Highway84/285, SH 30, SH 503, and other roads and arroyos. For major highway crossings, the pipeline would be installed in existing underground conduits, also known as utility sleeves, where possible. Otherwise, the pipeline would be bored under the road.

The existing pipeline below the Rio Grande would transmit RWS water to users on the west side of the river. To the extent possible, pipeline crossings of other rivers (such as the Rio Pojoaque, Rio Nambé, and Rio Tesuque) and arroyos would be constructed during times when these water bodies are dry. They would be temporarily dewatered in the vicinity of the crossing if construction were not able to occur when the rivers and arroyos are dry.

The SCADA system would operate from a control center in the water treatment plant. The control center would be connected to local remote terminal units at all RWS facilities, including short-term storage tanks.

Fiber optic cable may be used to communicate with the primary source water collection facility, the water treatment plant, backup supply facilities (if needed), and pumping plants. Existing fiber optic cable systems would be used wherever possible. For short-term storage tanks, the local remote terminal units would communicate with the control center by radio. Radio would also provide backup communication for all local remote terminal units connected to the control center via fiber optic cable. Radio antenna poles would be installed on or next to the primary source water collection facility, water treatment plant, short-term storage tanks, and pumping plants. Heights would range from between 30 and 50 feet from ground level, based on engineering needs.

The water distribution system would include the following:

- Between 126 and 144 miles of pipeline (actual length varies by alternative)
- Fire hydrants

- Associated valves and appurtenant structures

Water would be provided to valve boxes, which would be approximately 10 feet from the distribution line nearest each service user.

A raw water pipeline would carry untreated water from the primary source water collection facility to the water treatment plant. Raw water pipelines may also be constructed to carry water to ASR facilities from the primary source water collection facility and then to the water treatment plant from the ASR facilities.

Water transmission pipelines would be between 4 and 24 inches in diameter (in the Bishop's Lodge area); distribution pipelines would be between 6 and 13 inches in diameter. Transmission and distribution pipelines would be buried approximately 5 feet below scour depth. The average burial depth is expected to be between 4 and 5 feet below ground. For some segments, scour depth could be 10 feet or more, resulting in deeper burial depths.

The pipelines would be installed using a combination of open-trench excavation, hydraulic jacking, open-faced pipe ramming, and possibly pipe bursting methods. Some pipelines would be constructed in the earthen shoulder next to paved roadways, and some would be constructed in the middle of paved and dirt roads. In vegetated areas, transmission pipelines would be installed in roadways to avoid disturbing vegetation. Similarly, transmission and distribution pipelines in residential areas would need to be installed in the roadway to avoid removing and replacing walls, fences, utilities, and other structures. The most vulnerable sections of the pipelines, such as bends and joints, would be buried outside of paved roads to the extent possible. This would be done to minimize the need to destroy pavement for pipeline maintenance and repair.

Pumping plant sites would measure 175 feet long by 100 feet wide. Temporary construction disturbance for each site would cover approximately 0.5 acre. Each site would include pumping plant and air chamber buildings, forebay tanks, vaults, and other tanks. Forebay tanks would be just upstream of the pumping plants. These tanks would stabilize the water level that the pumps would draw from. The Pojoaque Industrial Park pumping plant would use the Jacona HKM short-term storage tank (Alternative B) or the Pojoaque Industrial Park short-term storage tank (Alternatives C, D, and E) as its forebay tank; therefore, it would not have a forebay tank on the pumping plant site.

Under Alternative C, the Bishop's Lodge VEF pumping plant would use the VEF Property short-term storage tank as its forebay tank. Under Alternative E, the Bishop's Lodge RKM pumping plant would use the RKM Property short-term storage tank as its forebay tank.

Sites would be designed to direct any stormwater runoff away from structures and to permeable surfaces toward the site perimeter. Each site would have a swale along the perimeter to direct stormwater to surrounding natural watercourses. Drain culverts would be required under access drives to carry stormwater runoff around and away from the pumping plant sites. Sites that are next to rivers and arroyos would be designed to keep the site yard a minimum of 3 feet above the 100-year flood elevation of the adjacent rivers and arroyos.

Pumping plant site access would be via a single-lane, 20-foot-wide road and a 16-foot-wide, double-swing, chain-link gate. Each site would be fenced with a seven-foot-tall

chain-link fence, with three-strand barbed wire on all sides. Pumping plant sites located far from existing access roads and offset in the hills would require access road construction or improvement. Newly constructed access roads would be graded dirt or base course.

2.3.1.6 Electrical Service

Electrical distribution lines, transformers, feeder cables, grounding systems, or backup power sources would be needed at various RWS facilities described in the action alternatives. The RWS would be powered using the existing electrical grid and energy mix in the Pojoaque Basin. Backup generators would be used only for short periods of time when primary electrical service is disrupted. The average backup generator used for the RWS would use approximately 1.8 million British Thermal Units (mmBTU) per hour.

The total power demand of the proposed RWS is too large to be solely powered by distributed solar generation, such as rooftop solar panels. A large solar facility would be needed to run the RWS independently of the existing power grid. Solar generation may supplement power at some RWS facilities, depending on the RWS alternative. Local electric utilities would cooperate with Reclamation to construct additional electrical distribution lines as needed to power RWS components. New lines would be constructed in existing ROWs, to the extent possible. All new electrical distribution lines would be overhead, except in the bosque area, near the primary source water collection facility, where they would be buried. Burying electrical power lines is approximately ten times more costly than constructing overhead power lines; therefore, it is cost prohibitive to undertake for all new electrical lines.

Most poles for new overhead lines would be 40 to 45 feet tall and would be buried 7 to 8 feet in the ground, resulting in maximum heights for new electrical line poles of 32 to 37 feet. The height of the lines themselves would be 25 to 33 feet. Buried lines would be placed 4 feet below ground in 3- to 6-inch polyvinyl chloride (PVC) pipe.

2.3.2 Construction

As permitted by Section 612 of the Settlement Act, the RWS facilities would be built in phases, based on logical sequencing of work activities and interdependencies between features. Work would occur concurrently on different Pueblos to reduce total RWS construction time. Construction would begin with the transmission system and short-term storage tanks on the Pueblo de San Ildefonso and Pueblo of Pojoaque and would continue for approximately 4 years. Construction of the transmission system and short-term storage tanks would begin on the Pueblos of Nambé and Tesuque as early as 2020, followed by construction of the transmission system and short-term storage tanks for the Bishop's Lodge Extension. During the final 3 years of construction, additional distribution pipelines would be installed throughout the project area. Section 623(e) of the Settlement Act requires the RWS to be substantially complete by June 30, 2024.

Contractors would use standard construction and dust abatement best management practices (BMPs) to minimize air quality impacts from construction. They would adhere to all relevant OSHA standards and Reclamation safety and health standards.

The following measures would be taken during and after construction:

- Residential access may be limited during construction; however, Reclamation would work to minimize the number of hours of restricted access.

- Any detour routes around construction areas would be clearly marked.
- Any new roads onto Pueblo lands would be approved by the Pueblo and gated to prevent unauthorized access.
- Sand, gravel, and other construction materials would be excavated on-site, from existing borrow pits on the Settlement Pueblos, or from off-site locations.
- Material for engineered fill would be generated from on-site or off-site sources.
- Materials excavated for construction that were not suitable for backfilling RWS trenches would be deposited in spoil piles on and outside of the Settlement Pueblos in locations determined by the Pueblos and Santa Fe County.
- Reclamation would reseed disturbed vegetated areas with native grasses and would restore the natural characteristics of the landscape where possible.

Mitigation measures would include traffic control and dust control. For the spoil pile near the El Rancho cemetery, Reclamation would institute short-term closures during funeral services, if notified in advance.

After construction, borrow pits and spoil piles would be recontoured and revegetated, at the discretion of the landowner. The sizes and locations of some borrow pits, spoil piles, and staging areas would be different under Alternative E, compared with the other action alternatives. This would be to minimize the effects on the El Rancho cemetery and would be based on input from the Settlement Pueblos. Sizes and locations are shown in the description of each alternative. **Appendix B**, Alternatives Figures, provides more detail on site locations. Some additional borrow pits, spoil piles, or staging areas for the Santa Fe County portions of the RWS may be required on land owned or leased by the County.

Table 2-2, below, shows the types of equipment that would be needed to construct certain RWS facilities under all action alternatives.

Table 2-2. Heavy Equipment for the RWS

Air compressors	Excavators	Pumps, welders, suction hoses
Bobcats	Flatbed trucks	Scissor lifts
Bulldozers	Generators	Seed sprayers
Chainsaws	Graders	Shank ripper
Clamshells	Hoe rams	Shuttle lift
Compactors	Hydraulic rams	Telescoping-boom lift trucks
Concrete pump trucks	Jaw crushers	Tractor-trailer trucks
Conveyors	Laser trackers	Transit mixer
Cranes	Light towers	Trenchers
Drop-trailers	Loaders/backhoes	Ventilation blowers
Dump trucks	Office trailers	Water trucks
Electric screens	Pickup trucks	Wood chipper

2.3.3 Other Common Features of All RWS Action Alternatives

2.3.3.1 Real Estate Transactions

Section 611(c)(1) of the Settlement Act states that "the Pueblos shall consent to the grant of such easements and rights-of-way as may be necessary for the construction of the RWS at no cost to the Secretary [of the Interior]." It further states that "To the extent that the State or County own easements or rights-of-way that may be used for construction of the RWS, the State or County shall provide that land or interest in land as necessary for construction at no cost to the Secretary [of the Interior]. The Secretary shall acquire any other land or interest in land that is necessary for the construction of the RWS" (Section 611[c][1]).

Reclamation would secure sufficient land interests or permissions for land use to construct all RWS facilities under all action alternatives. Construction ROWs would be approximately 50 feet wide, while permanent maintenance ROWs would be approximately 20 feet wide. Easements or utility permits within NMDOT and County-maintained road ROWs would be granted in accordance with Section 611(c) of the Settlement Act and as authorized under New Mexico's Public Utility Accommodation Act (17 New Mexico Administrative Code [NMAC] 4.2). Where NMDOT or the County are authorized to install, adjust, relocate, accommodate, and maintain public utilities in the highway ROWs, no permission is required from the underlying private property owner.

In addition to the utility permit from NMDOT or the County, permission to construct would be obtained from the Pueblo and the BIA wherever a Pueblo is the owner of land underlying NMDOT or County-maintained roads. If Reclamation needs to acquire temporary or permanent interests in private lands to construct RWS facilities, the landowner would be compensated at fair market value.

Reclamation would secure sufficient permissions for land use to construct RWS facilities on Settlement Pueblo land, in accordance with the Pojoaque Basin RWS Construction Agreement. The Settlement Act (paragraph 602[17]) defines Pueblo water facilities as follows:

- A portion of the RWS that would serve only water customers on Pueblo land
- Portions of existing Pueblo water systems that would be incorporated into the RWS
- The Rio Pojoaque irrigation improvement project
- The Rio Tesuque channel modification project

The agreement to construct the Pueblo system facilities would terminate on substantial completion of RWS construction. Long-term ROW grants of easement would be issued to the Regional Water Authority, in accordance with paragraph 2.3.2 of the Cost-Sharing and System Integration Agreement. This would allow the Regional Water Authority to operate and maintain RWS facilities on Pueblo lands that serve both Pueblo and County water customers.

The Settlement Act defines the County Distribution System as the portion of the RWS that serves water customers on non-Pueblo land in the Pojoaque Basin. Any interests in land acquired to construct the County Distribution System would be transferred to Santa Fe County upon substantial completion of RWS construction. Pueblo water facilities

would be transferred to the respective Pueblo, and the remaining land interests and utility permits would be transferred to the Regional Water Authority.

2.3.3.2 Title Transfer

Section 611(h) of the Settlement Act directs Reclamation, in accordance with the Operating Agreement, to convey: (1) to each Pueblo the portion of any Pueblo Water facility that is located within the boundaries of the Pueblo; (2) the County Distribution System to the County; and (3) any portions of the RWS that remain to the Regional Water Authority. These conveyances are only authorized after the RWS is declared to be substantially complete and the Operating Agreement is executed in accordance with section 612 of the Settlement Act.

2.3.3.3 Facility Color, Lighting, and Noise

All buildings and storage tanks would be painted to blend with the surrounding landscape. All construction and operation lighting would be shrouded and directed downward so as to illuminate project areas only. These lights would operate on a timer or motion sensor so that they would turn off when not in use. Facilities would be designed and constructed so as to minimize noise pollution.

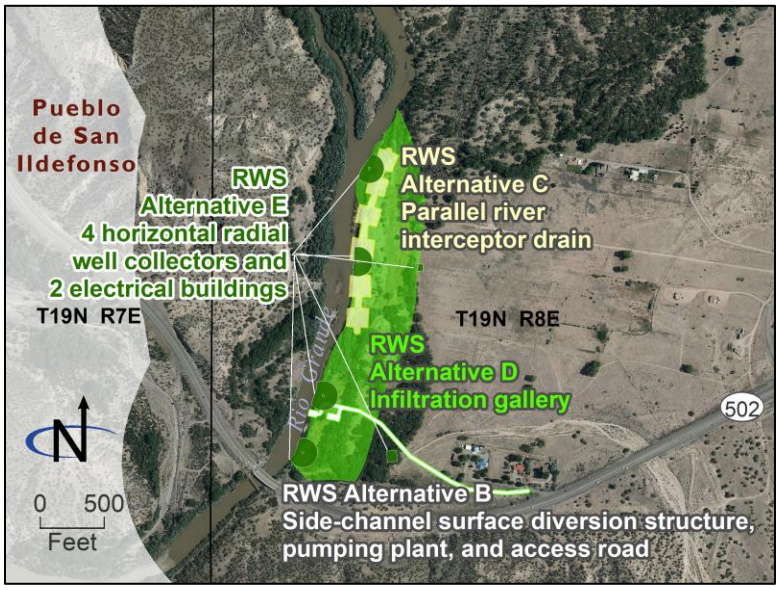
2.4 Summary Comparison of Alternatives

This section summarizes the RWS elements that would be constructed under each action alternative and highlights the major differences between the alternatives. See **Section 2.4**, Summary Comparison of Alternatives, for information on the impacts under each alternative, including the No Action, for the projects analyzed in this EIS.

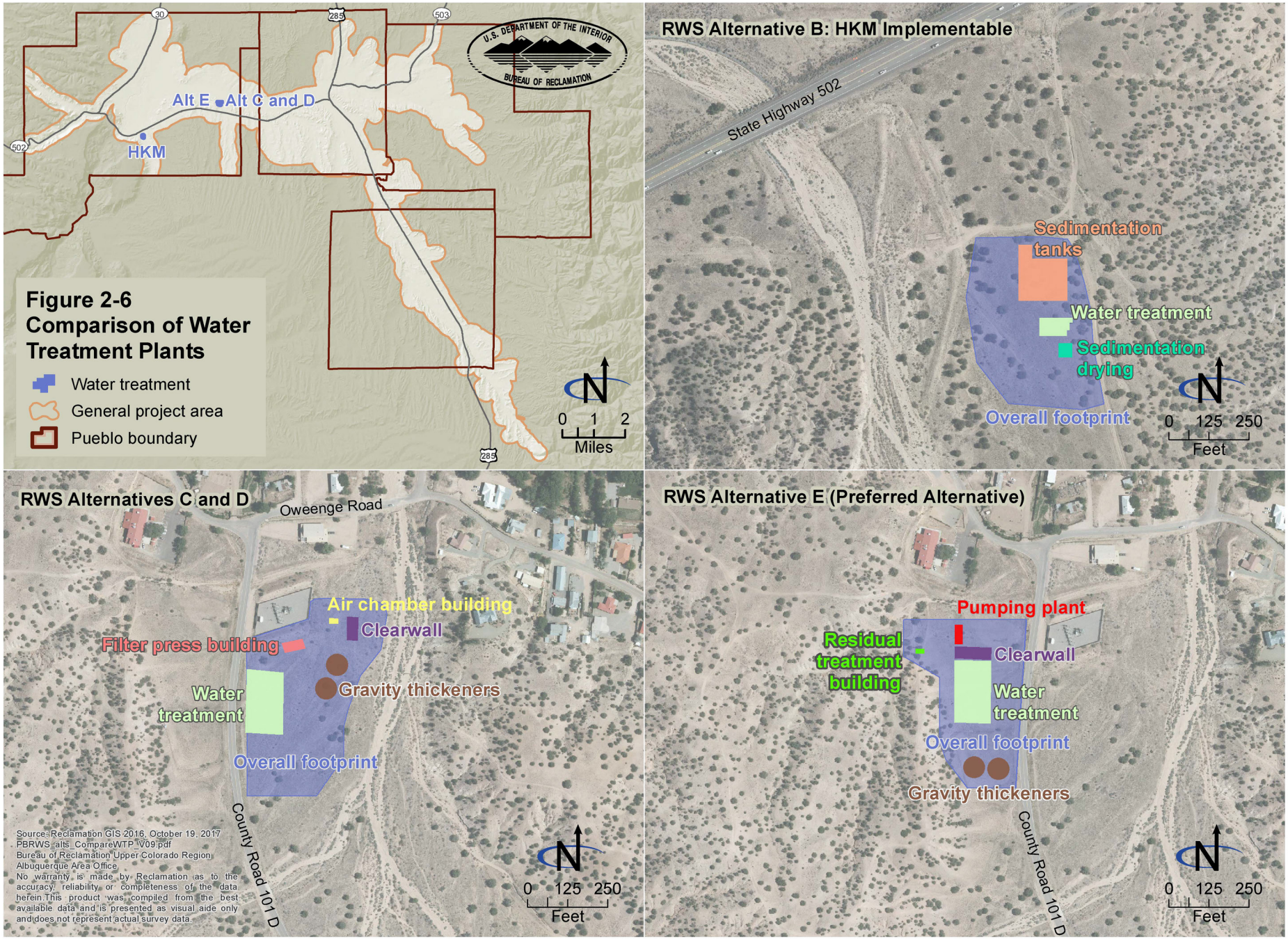
Configurations of RWS elements that would change by alternative are depicted in **Figure 2-5**, Comparison of Primary Source Water Collection Elements; **Figure 2-6**, Comparison of Water Treatment Plants; **Figure 2-7**, Comparison of New Short-Term Storage Tanks and Access Roads; **Figure 2-8**, Comparison of New Water Transmission and Distribution Systems; and **Figure 2-9**, Comparison of New Electrical Service. The figures also highlight the differences in the alignments of access roads, pipelines, and electrical power lines under each alternative. For additional detail on highlighted areas, see **Appendix B**, Alternatives Figures. The exact location of facilities within the water treatment site footprints (shown in **Figure 2-6**) may change as RWS designs are finalized.

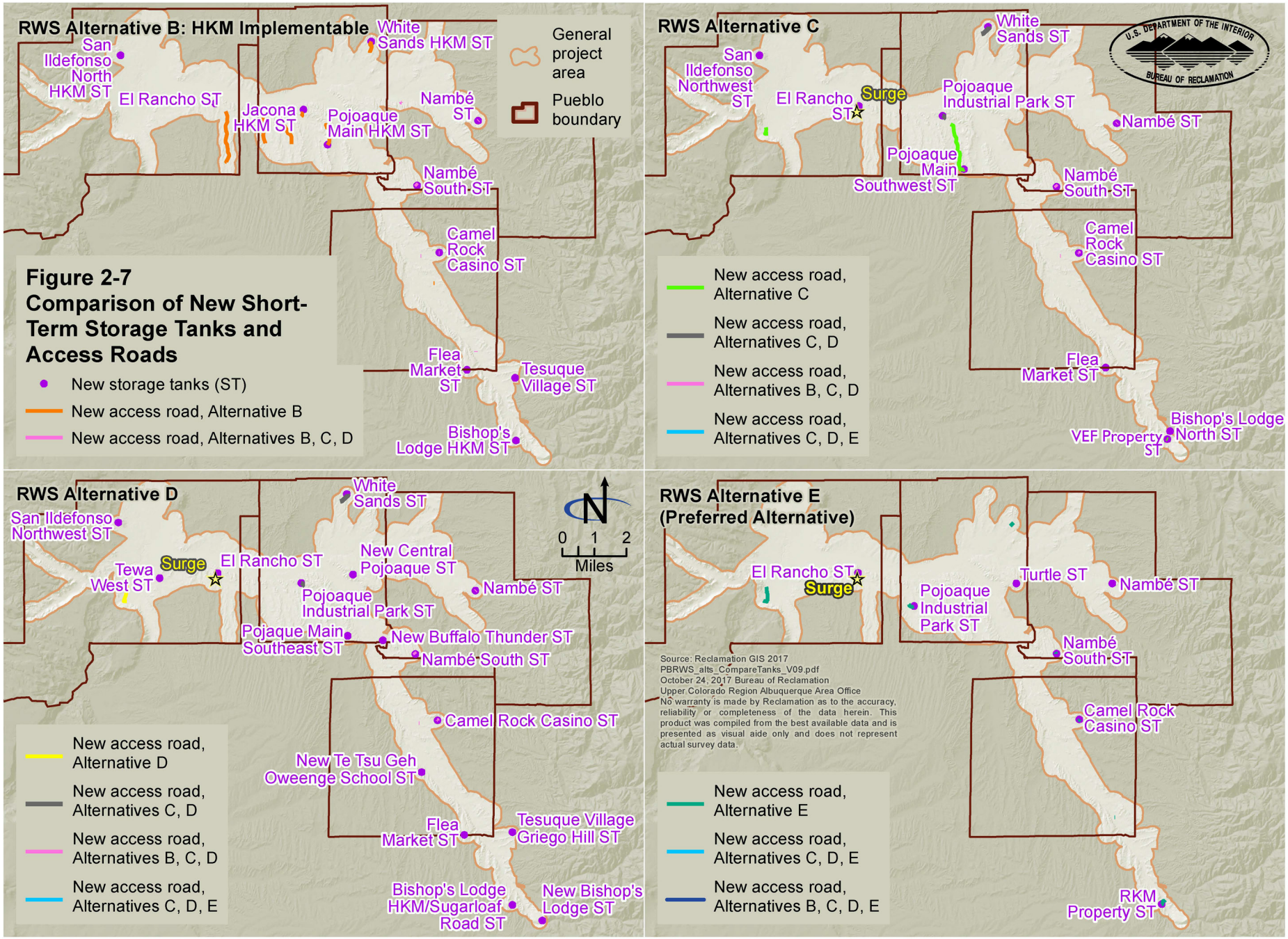
Table 2-3, Summary Comparison of RWS Action Alternatives, summarizes the elements that would make up each component of the RWS under each action alternative; **Table 2-4**, RWS Surface Disturbance Comparison, summarizes the surface disturbance associated with each RWS component under each action alternative; and **Table 2-5**, Summary of RWS Action Alternatives Estimated Costs, shows the estimated total capital, construction, labor, operations and maintenance, and life cycle costs under each RWS action alternative.

Figure 2-5. Comparison of Primary Source Water Collection Elements



Source: Reclamation GIS 2017


Figure 2-6
Comparison of Water Treatment Plants
Water treatment
General project area
Pueblo boundary
Alt E
Alt C and D
HKM
30
285
503
502
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
0 1 2
Miles
RWS Alternative B: HKM Implementable
State Highway 502
Sedimentation tanks
Water treatment
Sedimentation drying
Overall footprint
0 125 250
Feet
RWS Alternatives C and D
Oweenge Road
Air chamber building
Clearwall
Filter press building
Water treatment
Gravity thickeners
Overall footprint
County Road 101 D
Source: Reclamation GIS 2016, October 19, 2017
PBRWS_alts_CompareWTP_V09.pdf
Bureau of Reclamation Upper Colorado Region,
Albuquerque Area Office
No warranty is made by Reclamation as to the accuracy, reliability, or completeness of the data herein. This product was compiled from the best available data and is presented as visual aide only and does not represent actual survey data.
0 125 250
Feet
RWS Alternative E (Preferred Alternative)
Pumping plant
Residual treatment building
Clearwall
Water treatment
Overall footprint
Gravity thickeners
County Road 101 D
0 125 250
Feet


RWS Alternative B: HKM Implementable
San Ildefonso North HKM ST
El Rancho ST
Jacona HKM ST
White Sands HKM ST
Pojoaque Main HKM ST
Nambé ST
Nambé South ST
Camel Rock Casino ST
Flea Market ST
Tesuque Village ST
Bishop's Lodge HKM ST
General project area
Pueblo boundary
Figure 2-7
Comparison of New Short-Term Storage Tanks and Access Roads
New storage tanks (ST)
New access road, Alternative B
New access road, Alternatives B, C, D
RWS Alternative C
San Ildefonso Northwest ST
El Rancho ST
Surge
White Sands ST
Pojoaque Industrial Park ST
Nambé ST
Pojoaque Main Southwest ST
Nambé South ST
Camel Rock Casino ST
Flea Market ST
Bishop's Lodge North ST
VEF Property ST
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
New access road, Alternative C
New access road, Alternatives C, D
New access road, Alternatives B, C, D
New access road, Alternatives C, D, E
RWS Alternative D
San Ildefonso Northwest ST
Tewa West ST
Surge
El Rancho ST
White Sands ST
New Central Pojoaque ST
Pojoaque Industrial Park ST
Nambé ST
Pojaque Main Southeast ST
New Buffalo Thunder ST
Nambé South ST
Camel Rock Casino ST
New Te Tsu Geh Oweenge School ST
Flea Market ST
Tesuque Village Griego Hill ST
Bishop's Lodge HKM/Sugarloaf Road ST
New Bishop's Lodge ST
N
0 1 2
Miles
New access road, Alternative D
New access road, Alternatives C, D
New access road, Alternatives B, C, D
New access road, Alternatives C, D, E
RWS Alternative E (Preferred Alternative)
El Rancho ST
Surge
Pojoaque Industrial Park ST
Turtle ST
Nambé ST
Nambé South ST
Camel Rock Casino ST
RKM Property ST
Source: Reclamation GIS 2017
PBRWS_alts_CompareTanks_V09.pdf
October 24, 2017 Bureau of Reclamation
Upper Colorado Region Albuquerque Area Office
No warranty is made by Reclamation as to the accuracy, reliability or completeness of the data herein. This product was compiled from the best available data and is presented as visual aide only and does not represent actual survey data.
New access road, Alternative E
New access road, Alternatives C, D, E
New access road, Alternatives B, C, D, E

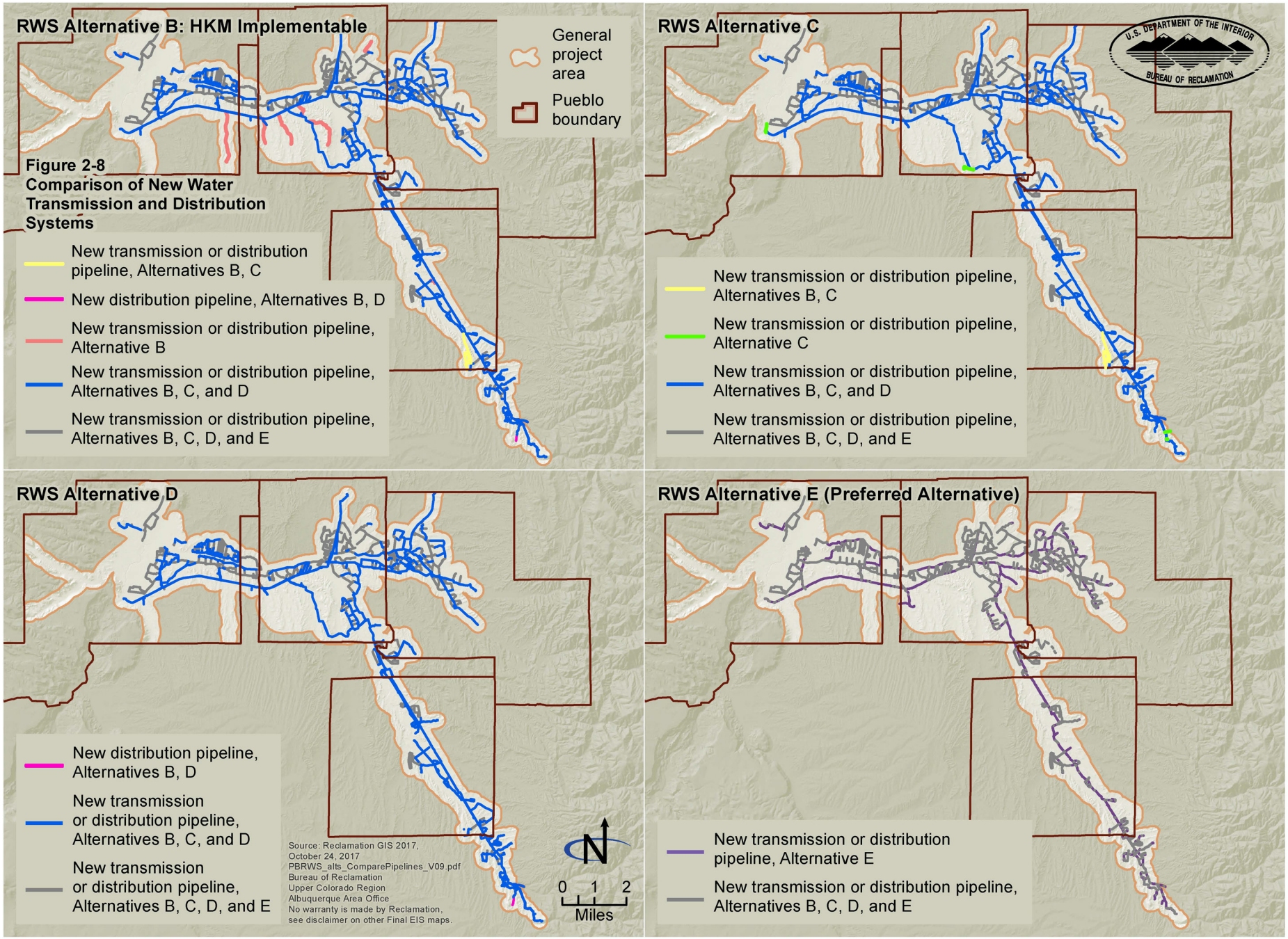


Figure 2-8
Comparison of New Water Transmission and Distribution Systems

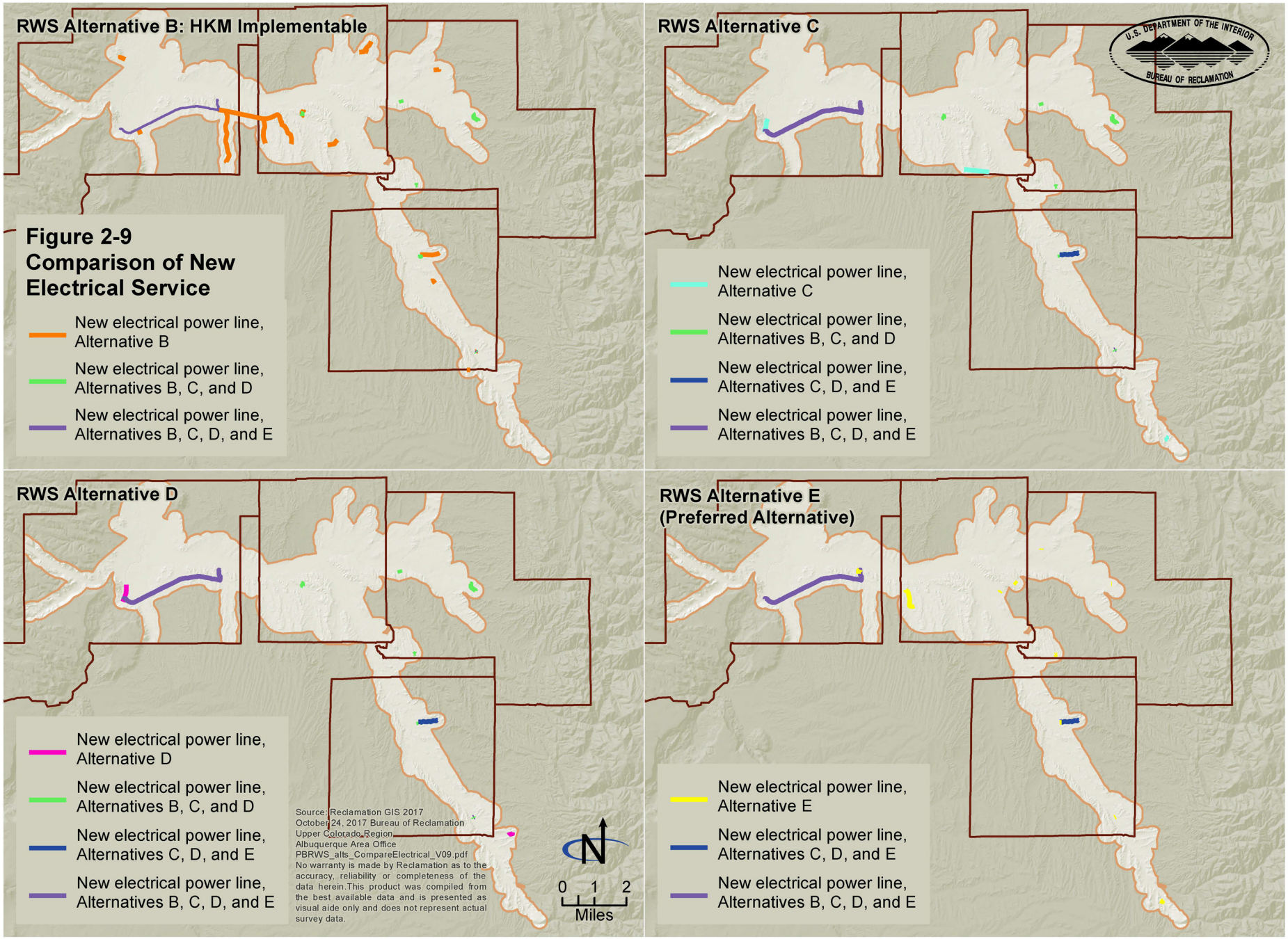

RWS Alternative B: HKM Implementable
Figure 2-9
Comparison of New Electrical Service
New electrical power line, Alternative B
New electrical power line, Alternatives B, C, and D
New electrical power line, Alternatives B, C, D, and E
RWS Alternative C
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
New electrical power line, Alternative C
New electrical power line, Alternatives B, C, and D
New electrical power line, Alternatives C, D, and E
New electrical power line, Alternatives B, C, D, and E
RWS Alternative D
New electrical power line, Alternative D
New electrical power line, Alternatives B, C, and D
New electrical power line, Alternatives C, D, and E
New electrical power line, Alternatives B, C, D, and E
Source: Reclamation GIS 2017
October 24, 2017 Bureau of Reclamation
Upper Colorado Region
Albuquerque Area Office
PBRWS_alts_CompareElectrical_V09.pdf
No warranty is made by Reclamation as to the accuracy, reliability or completeness of the data herein.This product was compiled from the best available data and is presented as visual aide only and does not represent actual survey data.
N
0 1 2
Miles
RWS Alternative E
(Preferred Alternative)
New electrical power line, Alternative E
New electrical power line, Alternatives C, D, and E
New electrical power line, Alternatives B, C, D, and E

Table 2-3. Summary Comparison of RWS Action Alternatives

Component	Alternative B (HKM Implementable)	Alternative C	Alternative D	Alternative E (Preferred Alternative)
Firm, reliable water supply	Rio Grande surface flows, supplemented by operational planning and scheduling of San Juan-Chama Project water supplies and one of the following three options for backup water supply: • ASR—Deep injection and recovery wells (3) • ASR—Shallow injection and recovery wells (3) • ASR—Shallow passive infiltration and recovery wells (3)	Rio Grande surface flows, supplemented by operational planning and scheduling of San Juan-Chama Project water supplies	Same as Alternative C	Rio Grande surface flows, supplemented by operational planning and scheduling of San Juan-Chama Project water supplies, plus emergency use wells
Primary source water collection	Side channel surface diversion structure	Parallel river interceptor drain	Infiltration gallery	Horizontal radial well collectors (4)
Water treatment	HKM—SH 502 South location	El Rancho location	Same as Alternative C	County Road 101D West location
Short-term storage tanks	24 total tanks in Alternative B locations (11 new tanks and 13 existing)	24 total tanks in Alternative C locations (11 new tanks and 13 existing)	29 total tanks in Alternative D locations (16 new tanks and 13 existing)	22 total tanks in Alternative E locations (7 new tanks and 15 existing)

Table 2-3. Summary Comparison of RWS Action Alternatives (cont.)

Component	Alternative B (HKM Implementable)	Alternative C	Alternative D	Alternative E (Preferred Alternative)
Water transmission and distribution system	• 1-mile-long raw water pipeline, from primary source water collection facility to water treatment plant • Transmission pipeline • Distribution pipeline • Access roads • 7 pumping plants • No surge tank near County Road 101D	• 4-mile-long raw water pipeline (including trenched section over a hill), from primary source water collection facility to water treatment plant • Transmission pipeline • Distribution pipeline • Access roads • 6 pumping plants • One surge tank, between primary source water collection and water treatment plant near County Road 101D • Minor variations in pipeline alignment to reach RWS facilities	Same as Alternative C • Minor variations in pipeline alignment to reach RWS facilities	Same as Alternative C • Minor variations in pipeline alignment to reach RWS facilities
Electrical service	Electrical power from existing grid; no distributed generation	Electrical power from existing grid, supplemented by solar distributed generation; minor variations in electrical line alignment to reach RWS facilities	Electrical power from existing grid, with solar-ready facilities; minor variations in electrical line alignment to reach RWS facilities	Same as Alternative D; minor variations in electrical line alignment to reach RWS facilities

Table 2-4. RWS Surface Disturbance Comparison

	Alternative B (HKM Implementable)		Alternative C		Alternative D		Alternative E (Preferred Alternative)	
	Short-Term Disturbance	**Long-Term Disturbance**	**Short-Term Disturbance**	**Long-Term Disturbance**	**Short-Term Disturbance**	**Long-Term Disturbance**	**Short-Term Disturbance**	**Long-Term Disturbance**
1. Firm, reliable water supply	Rio Grande surface flows, supplemented by operational planning and scheduling of San Juan-Chama Project water supplies and one of the following three options for backup water supply: 1a—ASR – Deep injection and recovery wells (3) 1b—ASR – Shallow injection and recovery wells (3) 1c—ASR – Passive infiltration and recovery wells (3)		Rio Grande surface flows supplemented by operational planning and scheduling of San Juan-Chama Project water supplies		Same as Alternative C		Rio Grande surface flows supplemented by operational planning and scheduling of San Juan-Chama Project water supplies, plus emergency use wells	
Acres	1a—17 1b—21 1c—20	1a[1]—1 1b—1 1c—13	0	0	0	0	0	0
2. Primary source water collection	Side channel surface diversion		Parallel river interceptor drain		Infiltration gallery		Horizontal radial well collectors	
Acres[2]	2	1	5	1	31	1	4	1

Table 2-4. RWS Surface Disturbance Comparison (cont.)

	Alternative B (HKM Implementable)		Alternative C		Alternative D		Alternative E (Preferred Alternative)	
	Short-Term Disturbance	Long-Term Disturbance	Short-Term Disturbance	Long-Term Disturbance	Short-Term Disturbance	Long-Term Disturbance	Short-Term Disturbance	Long-Term Disturbance
3. Water treatment	HKM – SH 502 South location		El Rancho location		Same as Alternative C		County Road 101D West location	
Acres	5	5	5	5	5	5	4	4
4. Short-term storage tanks	Tanks at Alternative B locations		Tanks at Alternative C locations		Tanks at Alternative D locations		Tanks at Alternative E locations	
Acres[3]	36	13	36	13	47	17	30	11
5. Transmission and distribution system	Pipeline alignments to reach Alternative B facility locations		Pipeline alignments to reach Alternative C facility locations		Pipeline alignments to reach Alternative D facility locations		Pipeline alignments to reach Alternative E facility locations	
Miles	194	194	189	189	187	187	151	151
Pipeline Acres[4]	1,051	0	1,020	0	1,005	0	782	0
Pumping Plants, surge tank (if necessary) and forebay tanks acres[5]	4	3	4	3	4	3	4	3

Table 2-4. RWS Surface Disturbance Comparison (cont.)

	Alternative B (HKM Implementable)		Alternative C		Alternative D		Alternative E (Preferred Alternative)	
	Short-Term Disturbance	Long-Term Disturbance	Short-Term Disturbance	Long-Term Disturbance	Short-Term Disturbance	Long-Term Disturbance	Short-Term Disturbance	Long-Term Disturbance
New or improved access roads miles	5	5	3	3	2	2	2	2
New or improved access roads acres[6]	23	12	14	7	7	4	6	3
New borrow pits, acres	10	0	10	0	10	0	1	0
New spoil piles, acres	18	18	18	18	18	18	7	7
New staging areas, acres	31	0	31	0	31	0	31	0
6. Electrical power	No distributed generation		Supplemented by solar distributed generation		Solar-ready facilities		Solar-ready facilities	
Power line (in miles; most new power lines will be overhead)	15	15	7	7	7	7	7	7

Table 2-4. RWS Surface Disturbance Comparison (cont.)

	Alternative B (HKM Implementable)		Alternative C		Alternative D		Alternative E (Preferred Alternative)	
	Short-Term Disturbance	Long-Term Disturbance	Short-Term Disturbance	Long-Term Disturbance	Short-Term Disturbance	Long-Term Disturbance	Short-Term Disturbance	Long-Term Disturbance
Power line (in acres; most new power lines will be overhead)[7]	54	0	26	0	24	0	24	0
Total Pueblo Acres[8]	**1,062**	**48**	**1,000**	**23**	**1,002**	**22**	**743**	**25**
Total Non-Pueblo Acres[8]	**141**	**3**	**141**	**3**	**144**	**4**	**113**	**2**
Total Acres[8]	**1,203**	**51**	**1,141**	**26**	**1,146**	**26**	**856**	**27**

Table 2-4. RWS Surface Disturbance Comparison (cont.)

Sources: Reclamation GIS 2017; Reclamation 2015b
Note: Based on ongoing analysis, Reclamation may make some general adjustments to proposed pipeline alignments; however, those alignments would still be in the same general project area. All acreages and mileages are preliminary estimates and will change before final RWS design is complete. Estimated disturbance acreages for each element, such as access roads, pipelines, and others, may overlap each other. Therefore, the total disturbance estimates for each element cannot be added together to generate the total estimated RWS disturbance for each alternative.
[1] The permanent deep ASR well footprint, not including access road, is estimated to be 100 square feet per wellhead and 200 square feet per pumping plant. Separate footprints for pumping plant buildings are not needed, because the long-term footprint for all deep ASR well facilities is 50 feet by 50 feet (2,500 square feet per zone of impact); therefore pumping plants are assumed to be within the general long-term footprint.
[2] Estimated short-term disturbance from the parallel river interceptor drain includes a 1,500–foot-long corridor with six caissons, each approximately 150 feet by 500 feet. There would be no long-term disturbance from the parallel interceptor drain or the infiltration gallery, except for the on-site pumping plant. The horizontal radial well collectors are estimated to have a circular short-term disturbance of a 100-foot radius from each well; the long-term disturbance estimate is a 10-foot-radius circle from each well.
[3] Temporary construction disturbance for each storage tank site is estimated to cover approximately 2 acres. Storage tank site permanent footprints would range from approximately 0.5 to 1.0 acre, depending on the number of proposed features, the size of the tank, and the location of the site. At all existing storage tanks, except for the IGC Tank, there would be new short-term and long-term disturbances associated with the sodium hypochlorite injection buildings.
[4] There would be no long-term disturbance from pipelines. All pipeline alignments would be revegetated with native grasses; however, deep-rooted shrubs and trees would not be allowed to grow. A 10-foot-wide long-term maintenance easement would follow all pipeline alignments, but this easement would not result in permanent surface disturbance. Where existing pipelines would be used, no new additional short- or long-term disturbance is assumed.
[5] Estimated long-term pumping plant footprints would measure 175 feet long by 100 feet wide. Short-term disturbance for each site would cover approximately 0.5 acre.
[6] Estimated short-term surface disturbance for new or improved access roads includes a 20-foot-wide buffer on either side of proposed roads (40-foot corridor). Estimated long-term disturbance includes a 10-foot-wide buffer (20-foot corridor). Where existing access roads would be used, no new additional short- or long-term disturbance is assumed.
[7] Estimated short-term surface disturbance for electrical power lines includes a 15-foot-wide buffer on either side of proposed new lines (30-foot corridor). There would be no long-term disturbance from overhead or buried electrical power lines.
[8] The total short- and long-term disturbance estimated acreages are calculated without any overlapping areas. For example, new access roads and new water transmission and distribution pipelines are counted only once.

Table 2-5. Summary of RWS Action Alternatives Estimated Costs

Cost	Alternative B (HKM Implementable)	Alternative C	Alternative D[1]	Alternative E (Preferred Alternative)[2]
Construction cost[3]	$214,700,000	$212,700,000	$229,700,000	$168,900,000
Deep ASR capital cost[4]	$12,966,000 to $38,781,000	$0	$0	$0
Deep ASR operation and maintenance costs[4]	$7,535,000 to $171,445,000	$0	$0	$0
Non-contract costs[5]	$66,505,000	$66,505,000	$66,505,000	$66,505,000
Realty costs[6]	$8,068,000	$8,068,000	$8,068,000	$8,068,000
Costs for 50 years of operation, maintenance, and replacement[7]	$68,352,000	$64,919,000	$65,405,000	$64,762,000
Life cycle costs	**$378,126,000 to $567,851,000**	**$352,192,000**	**$369,678,000**	**$308,235,000**

Source: Reclamation 2015b
Note: Costs are in 2014 dollars.
[1] Alternative D assumes intake costs would be approximately the same as Alternative C intake, with an additional five storage tanks, at an average cost of $3 million each.
[2] Alternative E costs would be refined as the final RWS design process moves forward.
[3] Source: Reclamation 2015b
[4] Source: AMEC Foster Wheeler 2016
[5] Non-contract costs are for all investigations and studies required to develop final designs; planning and stakeholder coordination; environmental compliance costs; costs to prepare feasibility level, 30 percent, 60 percent, 90 percent, and final designs, specifications, and cost estimates; project management; contract administration; and construction management.
[6] Realty costs are for planning and document preparation to acquire ROW grants over Tribal lands and sufficient land interests in NMDOT Highway and County maintained road ROWs for construction; easements across private parcels needed to construct portions of the system that do not serve County residents; and estimated relocation costs.
[7] Operation, maintenance, and replacement costs do not include costs to maintain emergency use wells.

2.5 Preferred Alternatives and Selected Alternatives

After comparing and weighing the benefits and impacts of all feasible alternatives, Reclamation has identified Alternative E as the preferred RWS alternative. For the Rio Pojoaque irrigation improvement project, the Pueblo de San Ildefonso has identified Alternative C as the preferred alternative. For the Rio Tesuque channel modification project, the Pueblo of Tesuque has identified Alternative D as the preferred alternative. No preferred alternative has been identified for the Pueblo de San Ildefonso future projects at this time.

2.6 RWS Alternatives Considered in Detail

This EIS analyzes five alternatives for the RWS, including the No Action Alternative. These represent the range of reasonable actions that could be taken to satisfy the purpose

of and need for Reclamation's action, with respect to the RWS. Detailed maps of the RWS facilities analyzed under each alternative are found in **Appendix B**, Alternatives Figures. For a detailed discussion of elements being considered in the alternatives see the Pojoaque Basin Regional Water System Feasibility Design Report (Feasibility Design Report; Reclamation 2015b).

The following sections provide a broad overview of each alternative, in alphabetical order.

2.6.1 Alternative A, No Action

The No Action Alternative is the "no build" alternative. Under it, the RWS would not be constructed, and the Settlement Agreement would be nullified. Reclamation would not complete any real estate actions, and the contract for purchase of San Juan-Chama Project water for the RWS would be nullified. The No Action Alternative assesses expected future conditions, without implementing the proposed action.

Water and water rights planned for use in the proposed RWS would likely continue to be allocated for current and future uses not related to the RWS and would not be diverted from the Rio Grande for the RWS. The basin would remain closed to development of new water rights. However, failure to implement the Settlement Agreement would result in the resumption of the Aamodt litigation, and uncertainty would continue to surround the water rights in the Pojoaque Basin. Section 623(f) of the Settlement Act states that the Settlement Agreement shall no longer be effective if the court is properly notified that the proposed RWS is not substantially completed or will not be substantially completed by June 30, 2024.

Groundwater would continue to be the primary source of drinking water for domestic, commercial, industrial, and community use in the Pojoaque Basin. Because no new appropriations are permitted in the basin, additional water would not be available to satisfy future demand or allow for further development. Future litigation would likely result in adjudication of all surface water and groundwater rights in the Pojoaque Basin. Adjudication of water rights may curtail water uses for some junior users in the event of a Pueblo requesting priority administration and the state enforcing Pueblo priorities, in accordance with the draft proposed Nambé-Pojoaque-Tesuque Water Master District: Active Water Resource Management Rule (19.25.XX NMAC). The New Mexico Office of the State Engineer will be issuing these new regulations governing water rights in the Pojoaque Basin, anticipated in fall of 2017.

Under the No Action Alternative, the benefits of the proposed RWS would not be realized. Use of domestic wells would continue to reduce groundwater and surface water supplies in the Pojoaque Basin. The Settlement Pueblos would continue to rely on their existing separate water systems, rather than integrating their systems into one regional system.

The No Action Alternative would not satisfy the purpose of and need for the action because it would not reliably provide a firm, safe supply of treated drinking water for domestic, commercial, industrial, and community use in the Pojoaque Basin and would not meet Reclamation's objectives to comply with the Settlement Act.

This alternative would also fail to reduce the reliance on groundwater. It is analyzed in detail to describe reasonably foreseeable future conditions without constructing the RWS;

as such, it serves as a baseline to evaluate the other alternatives, in accordance with CEQ guidance.

2.6.2 Alternative B: HKM Implementable Alternative

2.6.2.1 Overview

Alternative B incorporates the RWS facilities and components analyzed in the 2008 report prepared by HKM Engineering, Inc. (HKM 2008). Because the design features of this alternative were based on a report prepared in 2008 that had not been field verified, it was updated through surveys and public input from scoping to make it implementable. The HKM Engineering Report served as the preliminary RWS concept for the Settlement Act.

Under this alternative, the RWS would consist of the following major components, all of which are described in detail in the sections below:

- A firm, reliable water supply would be provided by diverting surface flows from the Rio Grande, supplemented by operational planning and scheduling of San Juan-Chama Project water supplies, as well as one of the following three backup water supply options:
  - ASR, involving three deep injection and recovery wells for injecting raw or treated surface water into an aquifer and recovering it for use in the RWS
  - ASR, involving three shallow injection and recovery wells for injecting raw or treated surface water into an aquifer and recovering it for use in the RWS
  - ASR, involving three shallow passive infiltration reaches and recovery wells for infiltrating raw surface water into an aquifer and recovering it for use in the RWS
- A side channel surface diversion structure and pumping plant, with a sediment removal and return system, on the east bank of the Rio Grande on Pueblo de San Ildefonso lands, just north of the Otowi Bridge
- A water treatment plant and pumping plant on the Pueblo de San Ildefonso on the south side of SH 502, approximately 0.75 miles east of the Otowi Bridge
- Eleven new short-term storage tanks in Alternative B locations, in addition to 13 existing storage tanks
- A water transmission and distribution system, including approximately 194 miles of pipelines, ranging in size from 4 to 24 inches in diameter, 7 pumping plants, and pressure-reducing and flow-control valves to keep pressures within a prescribed range, while providing some additional fire protection flows
- Electrical service to power components of the RWS, including approximately 15 miles of new electrical distribution lines

Construction of the RWS facilities, including pipelines, would disturb approximately 1,062 acres of surface within Pueblo boundaries and 141 acres of surface outside of Pueblo boundaries. Permanent RWS facilities, not including pipelines, would cover

approximately 48 acres of surface within Pueblo boundaries and 3 acres outside Pueblo boundaries.

Two new borrow pits could be created in the southern portion of the Pueblo of Pojoaque. Three new spoil piles could be created in the eastern portion of the Pueblo of Nambé, the southern portion of the Pueblo of Pojoaque, and the southern portion of the Pueblo of Tesuque (near the old Flea Market site at the southern boundary of the Pueblo).

Construction staging areas, including contractor offices and stockpiles, could be created throughout the general project area. Each borrow pit, spoil pile, and staging area would range between 2 and 10 acres.

Table 2-6, below, shows estimated short- and long-term disturbance acreages on each Settlement Pueblo; **Figure 2-10**, RWS Alternative B: HKM Implementable, shows the location of RWS facilities and elements under this alternative.

Table 2-6. Estimated Disturbance on Settlement Pueblos, Alternative B

Pueblo	Short-Term (Acres)	Long-Term (Acres)[1]
Pueblo of Nambé	232	3
Pueblo of Pojoaque	372	28
Pueblo de San Ildefonso	282	14
Pueblo of Tesuque	176	3
Total	**1,062**	**48**

Sources: Reclamation GIS 2017; Reclamation 2015b
Note: New access roads are assumed to overlap with water transmission or distribution pipeline routes.
[1] There would be no long-term disturbance from pipelines. All pipeline alignments would be revegetated with native grasses; however, deep-rooted shrubs and trees would not be allowed to grow. A 10-foot-wide long-term maintenance easement would follow all pipeline alignments, but this easement would not result in permanent surface disturbance.

2.6.2.2 Firm, Reliable Water Supply—Rio Grande Surface Flows Supplemented by Backup Water Supply and Operational Planning and Scheduling of San Juan-Chama Project Water Supplies

Under Alternative B, water for the RWS would be supplied by surface flows in the Rio Grande. The water rights supplying the RWS would be the same as those described in **Section 2.3.1.1**, Firm, Reliable Water Supply. Reclamation would schedule release of upstream water supplies to supplement Rio Grande surface flows, as described in **Section 2.3.1.1**. However, surface flows are vulnerable to drought and water quality issues (e.g., sediment loading or ash from fires). This could reduce water quantity or quality such that it could not be collected to meet the needs of the RWS. In order to ensure a firm, reliable supply of water with adequate quality and in a high enough quantity to meet the demands of the RWS, a backup water supply would be constructed.

Reclamation is considering the following three options for a backup water supply under this alternative:

- Three direct-injection ASR wells in HKM-implementable locations
- Three direct-injection ASR wells in feasibility-level locations
- Three passive infiltration ASR wells in feasibility-level locations

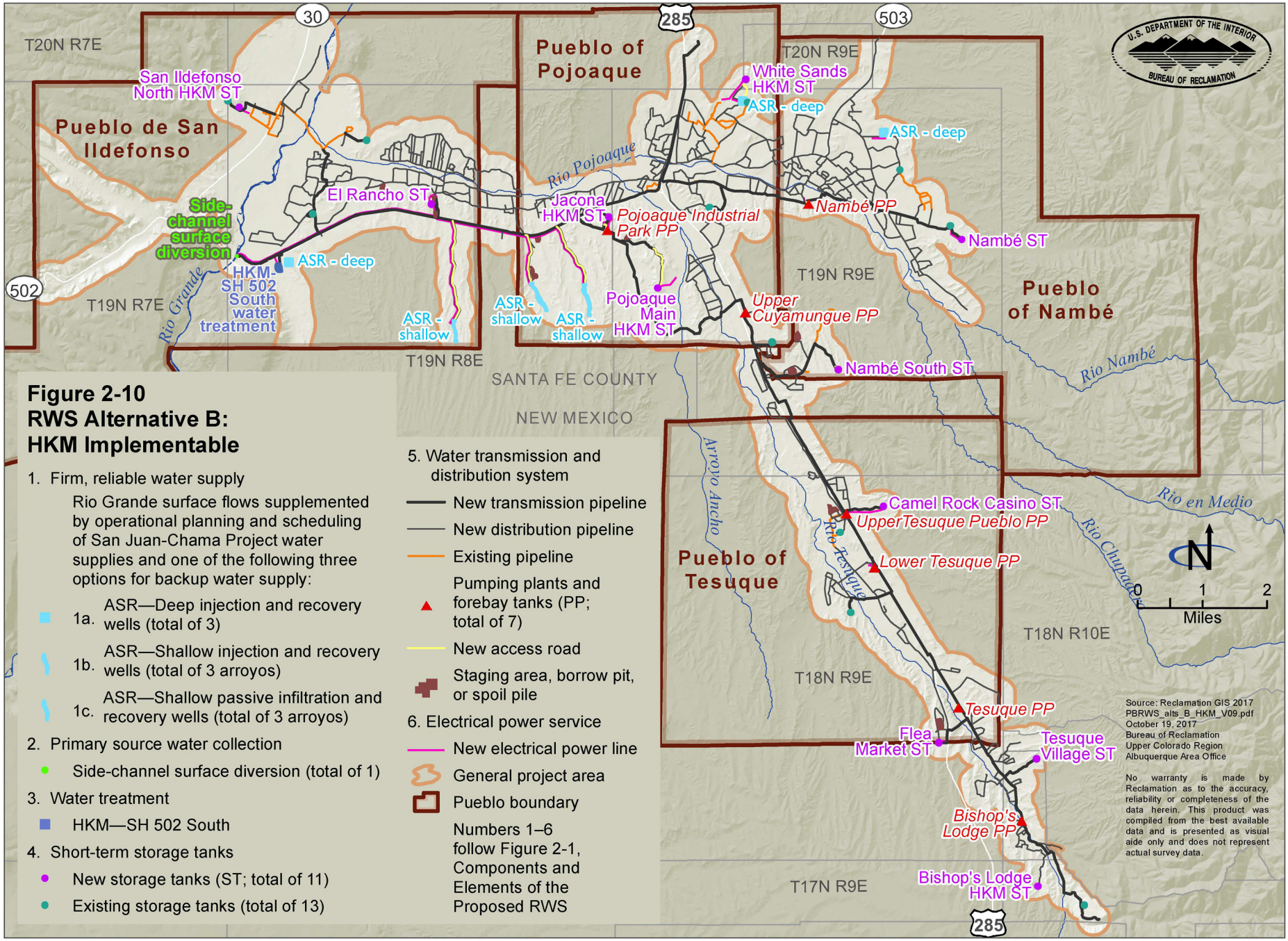


Figure 2-10
RWS Alternative B: HKM Implementable

1. Firm, reliable water supply
   Rio Grande surface flows supplemented by operational planning and scheduling of San Juan-Chama Project water supplies and one of the following three options for backup water supply:
   - 1a. ASR—Deep injection and recovery wells (total of 3)
   - 1b. ASR—Shallow injection and recovery wells (total of 3 arroyos)
   - 1c. ASR—Shallow passive infiltration and recovery wells (total of 3 arroyos)
2. Primary source water collection
   - Side-channel surface diversion (total of 1)
3. Water treatment
   - HKM—SH 502 South
4. Short-term storage tanks
   - New storage tanks (ST; total of 11)
   - Existing storage tanks (total of 13)
5. Water transmission and distribution system
   - New transmission pipeline
   - New distribution pipeline
   - Existing pipeline
   - Pumping plants and forebay tanks (PP; total of 7)
   - New access road
   - Staging area, borrow pit, or spoil pile
6. Electrical power service
   - New electrical power line
   - General project area
   - Pueblo boundary

Numbers 1–6 follow Figure 2-1, Components and Elements of the Proposed RWS

Each of these options for a backup water supply is described in more detail in the subsequent paragraphs. For additional detail on ASR wells, see **Appendix C**, Aquifer Storage and Recovery Reports.

Backup Option 1: ASR—Deep Injection and Recovery Wells

Three direct-injection ASR wells would be constructed near the water treatment plant on the Pueblo de San Ildefonso and in the northern portions of the Pueblo of Pojoaque and Pueblo of Nambé (see **Figure 2-10**). They would have the ability to both inject raw or treated water into aquifers and to withdraw water from those aquifers. The wells would be metered for production and injection. Each would be drilled to a minimum of 1,200 feet and would inject water into a suitable aquifer. The injected water would be required to meet EPA Class V Underground Injection Control Drinking Water Standards. For analysis, the assumption is that the recovered water would need to be returned to the water treatment plant before being used by RWS customers.

The surface facilities would consist of an injection well and pumping plant, a recovery well and pumping plant, and two monitoring wells at each ASR well site (a total of three injection wells, three recovery wells, and six monitoring wells). Recovery wells would be approximately 500 feet downgrade, toward the Rio Grande, from the injection wells. Monitoring wells could be approximately 500 feet in any direction from the injection well.

The two pumping plants at each ASR well site would be enclosed in buildings, each approximately 200 square feet and 10 feet tall. The electrical load for each ASR well site is estimated to be 900 kVA, which would power the two pumping plants at each site. Additional information on electrical service to this element can be found under **Section 2.6.2.7**, Electrical Service.

The short-term construction disturbance area for the surface facilities associated with each ASR site, not including access roads, is estimated to be 5.7 acres (17 acres total). The permanent footprint, not including access roads, is estimated to be 100 square feet per wellhead and 200 square feet per pumping plant. Estimated permanent disturbance for all three ASR well sites would total approximately 1 acre. Existing roads would be used to access each ASR site.

Backup Option 2: ASR—Shallow Injection and Recovery Wells

This element is similar in concept to the ASR deep injection and recovery wells, long-term storage element in Backup Option 1. The main difference is that the three ASR sites would be constructed in two arroyos in the southwestern portion of the Pueblo of Pojoaque and in one arroyo in the southeastern portion of the Pueblo de San Ildefonso. Each would be approximately 150 feet deep.

Raw or treated water would be injected into the aquifer during low-demand periods and would be extracted from the ASR wells when water demand is high. If raw water were used, it would be pumped from the collection point on the Rio Grande and would bypass the water treatment plant. The injected water would be required to meet EPA Class V Underground Injection Control drinking water standards.

Preliminary data indicate that approximately 500 acre-feet (af) of storage capacity is potentially available at each proposed site. This means that an estimated 500 af of water would be between the injection point and the recovery point at all times. Reclamation would pump water out of the aquifer via wells drilled to a depth of approximately 150 feet. Water would be recovered regularly from the aquifer, such as monthly or weekly, to keep the flow from moving past the recovery wells.

For analysis, the assumption is that the recovered water would need to be returned to the water treatment plant before it is used by RWS customers. As with Backup Option 1, the surface facilities would consist of an injection well and pumping plant, a recovery well and pumping plant, and two monitoring wells at each ASR well site (a total of three injection wells, three recovery wells, and six monitoring wells). Recovery wells would be approximately 500 feet downgrade, toward the Rio Pojoaque, from the injection wells. Monitoring wells could be approximately 500 feet in any direction from the injection well.

The two pumping plants at each ASR well site would be enclosed in buildings, each approximately 200 square feet and 10 feet tall. The electrical load for each ASR well site is estimated to be 200 kVA, which would power the two pumping plants at each site. Additional information on electrical service to this element can be found under **Section 2.6.2.7**, Electrical Service.

The estimated surface disturbance associated with these ASR sites, not including access roads, would be 21 acres during construction and 1 acre permanently disturbed. Access roads to the ASR sites would be graded dirt or base course and would follow the same alignment as the pipelines. The total estimated length of new access roads constructed to reach this element is approximately 19,020 feet. Short-term disturbance from access road construction would cover approximately 18 acres, and long-term disturbance would cover 9 acres.

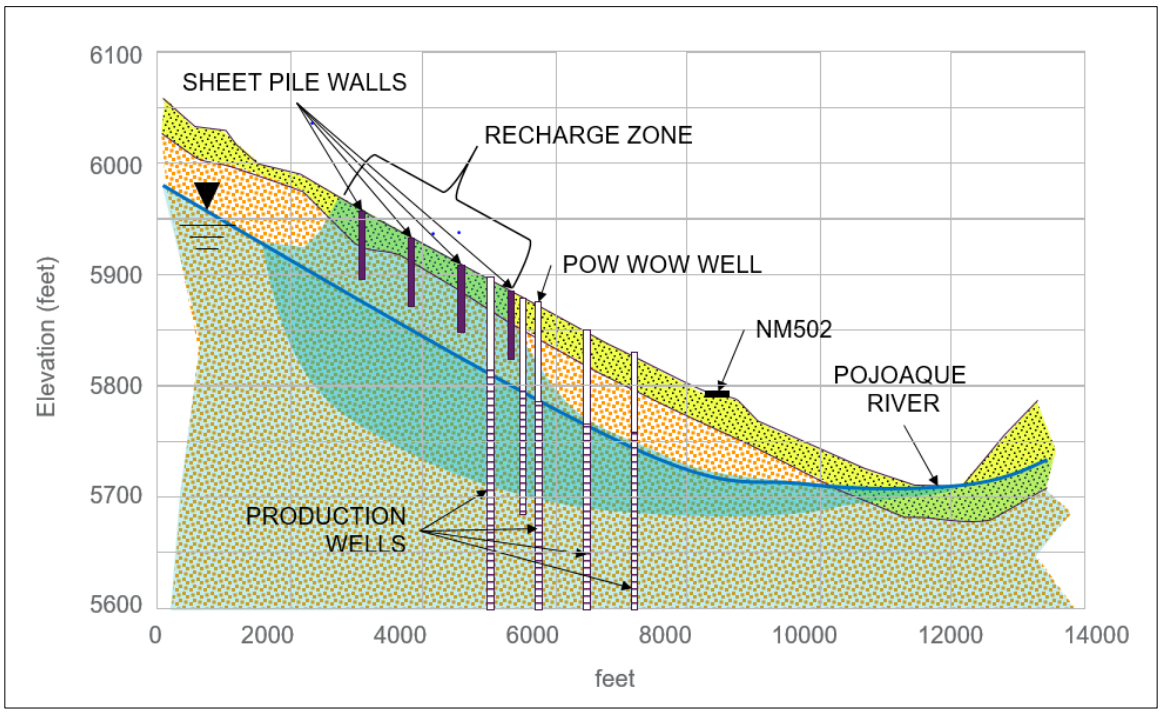
Backup Option 3: ASR—Shallow Passive Infiltration and Recovery Wells

This element is similar in concept and location to the ASR—shallow injection and recovery wells, long-term storage element described in Backup Option 2. The main difference is that raw water would passively filter into the aquifer during low-demand periods and would be extracted from the recovery wells when water demand is high.

The raw water would filter into a shallow aquifer by flowing along underground infiltration galleries in three approximately 1,500-foot-long infiltration reaches (one in each arroyo). Sheet piles would be installed in the ground beneath each arroyo to facilitate infiltration to the shallow aquifer and to reduce scour (see **Figure 2-11**, Model of Shallow Passive Infiltration and Recovery Wells). Sheet piles would not change the topography of the arroyos.

The surface facilities would consist of one recovery well and pumping plants and two monitoring wells at each ASR well site (a total of three recovery wells and six monitoring wells). Recovery wells would be located in the arroyos, approximately 500 feet downgrade, toward the Rio Pojoaque, from the infiltration zone. Monitoring wells would be located within the arroyos as well.

Figure 2-11. Model of Shallow Passive Infiltration and Recovery Wells



Source: AMEC Foster Wheeler 2016

The pumping plant at each ASR well site would be enclosed in a building, approximately 200 square feet and 10 feet tall. The electrical load for each ASR well site is estimated to be 100 kVA, which would power the pumping plant at each site. Additional information on electrical service to this element can be found under **Section 2.6.2.7**, Electrical Service.

The estimated surface disturbance associated with these ASR sites, not including access roads, would be 20 acres during construction and 13 acres permanently disturbed. Access roads to the ASR sites would be graded dirt or base course and would follow the same alignment as the pipelines. The total estimated length of new access roads constructed to reach this element is approximately 19,020 feet. Short-term disturbance from access road construction would cover approximately 18 acres, and long-term disturbance would cover 9 acres.

2.6.2.3 Primary Source Water Collection—Side Channel Surface Diversion Structure

The side channel surface diversion structure would be on the east bank of the Rio Grande, approximately 600 feet upstream of the Otowi Bridge gaging station, on Pueblo de San Ildefonso lands. The intake would draw water directly from the river channel through a series of fine screens near the channel bank. The screens would be protected from debris and other hazards and would be cleaned to maintain the required flow capacity. The intake structure would be designed and constructed to allow for fish screens to be installed in the three intake bays, if they become necessary. The intake configuration would be designed to accommodate low flows in the Rio Grande if necessary. Diversions would be limited if the river elevation at the structure were to drop below 5,492.1 feet

mean sea level (msl). If the river elevation were to drop below 5,490 feet msl, the project would not be able to divert any flows.

A pumping plant would be required to lift the raw water from the primary source water collection facility to the water treatment plant. The pumping plant would include wet well and vertical turbine pumps, along with pipes, valves, meters, and other instruments needed to deliver the water to the treatment plant. The pumping plant would have two operational pump motors and one installed spare motor.

Three cylindrical air chamber tanks (approximately 6 feet, 6 inches in diameter and 14 feet, 3 inches high) would provide surge protection for the pumps at the pumping plant building. The building itself would be 68 feet long, 38 feet wide, and 25 feet high. Earth-tone painted exterior walls, doors, and roof panels would match native surroundings. An associated pad, parking area, security fence, and graded dirt or base course access road would also be constructed.

The pumping plant could require periodic maintenance to pumping units and steel piping. Maintenance could involve mobile cranes. Floors and walls of the pumping plant building would need to be cleaned monthly or yearly, using water from an on-site filtration system or piped from the water treatment plant.

The pumping plant would be directly behind the intake structure, on the hillside near the SH 502 bridge. This location would keep the electrical equipment, such as motors, control panels, and screen backwash system, above the 100-year floodplain. The Federal Emergency Management Agency (FEMA) has estimated this to be at an elevation of 5,512 feet.

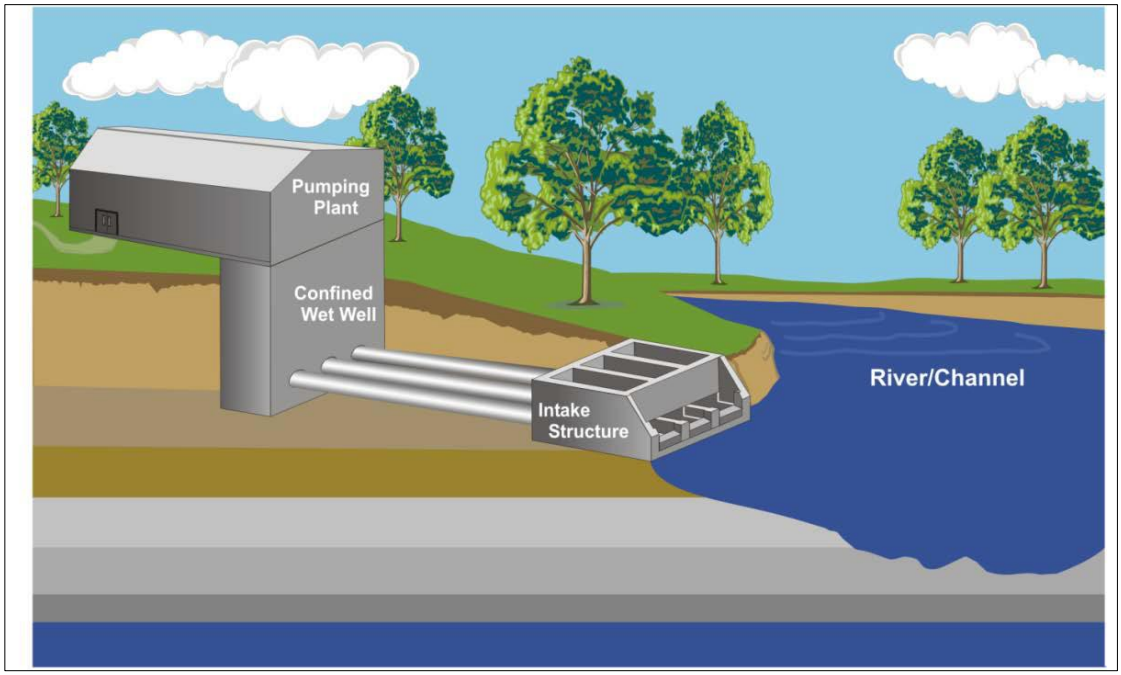
The estimated electrical load for the side channel surface diversion structure and pumping plant is 630 kVA. Additional information on electrical service to this element can be found under **Section 2.6.2.7**, Electrical Service. The intake structure and pumping plant (not including the access road) would involve approximately 2 acres of land disturbance during construction. Each of the intake and pumping plant components, such as the screens and pumps, would include redundancy to allow one of the items to be taken out of service, while still maintaining the ability to divert sufficient flows for the RWS.

Figure 2-12, Conceptual Rendering of Intake Structure and Pumping Plant, illustrates what the intake structure and pumping plant could look like. This rendering is not to scale and shows a conceptual drawing of the side channel surface diversion structure facilities.

Riprap would be used to protect the intake structure, the embankment foundation of the pumping plant building, and part of the access road near this location from potential channel scour. Approximately 10 steel, 25-foot-long H-piles (dimensionally square structural beams) extending below the expected scour depth would protect shallow foundations used to support the side channel surface diversion structure facility. Reclamation would consider implementing invasive mussel mitigation measures, as needed.

The intake structure and pumping plant would be connected to SH 502 via an access road that uses an existing entrance. The road would follow the existing road until it hits the tree line, where a new road alignment would be constructed to reach the site. The new access road would be approximately 2,000 feet long and 12 feet wide and would be composed of graded dirt or base course.

Figure 2-12. Conceptual Rendering of Intake Structure and Pumping Plant



Source: Reclamation 2015b

The side channel surface diversion would be constructed when flows in the Rio Grande are at their lowest. Reclamation would comply with all applicable requirements of the CWA during construction, including acquiring the necessary permits under Sections 404/401 of the CWA. During construction, Reclamation would install a temporary water removal and control system to provide dry construction sites for the intake structure and related facilities below water level. Water pumped from the construction site would be routed through on-site settling basins to allow sediment to settle out before the water is discharged to the river. The intake structure construction site would be boxed in with a cofferdam, made of sheet piles. Wing walls (lateral extensions), approximately 100 feet long, would be required on each side of the cofferdam to adequately dewater the area (see **Figure 2-13**, Example Sheet Pile Cofferdam).

Figure 2-13. Example Sheet Pile Cofferdam



Photo Credit: Reclamation

Sumps and submersible pumps would control seepage from the river into the construction site inside the cofferdam. Seepage water entering the work area would be pumped back into the river during construction.

2.6.2.4 Water Treatment—HKM – SH 502 South Location

Under Alternative B, the water treatment plant would be on Pueblo de San Ildefonso lands on the south side of SH 502, approximately 0.75 mile east of the Otowi Bridge. This is approximately 0.50 mile directly east (uphill) of the Rio Grande. The location does not have any structures, but pressurized gas lines traversing the site would need to be avoided during construction. Under this alternative, no earthwork would be done to conceal the water treatment plant from the nearby highway.

The footprint of the water treatment plant would be approximately 5 acres. Its electrical load, processes, and facilities would be the same as those described under **Section 2.3.1.3**, Water Treatment. The site would be accessed via an existing road. An estimated average of 50 cubic yards, or 98,000 pounds, per day of dried solids would be transported from the water treatment plant to the landfill under this alternative. An average of approximately 2,612 gpd of sanitary waste and membrane cleaning wastes would be generated at the water treatment plant after initial construction. At full future demand, an average of 5,729 gpd would be generated. This waste would be pumped to a holding tank on site and periodically pumped out and transported away. Additionally, an average of approximately 27,000 gpd of brine would be generated at the water treatment plant after initial construction. At full future demand, an average of 149,000 gpd would be generated. Brine from the water treatment process would be discharged into the Rio Grande. Reclamation would obtain any necessary permits under the CWA for this discharge.

2.6.2.5 Short-Term Storage Tanks—24 Total Tanks in Alternative B Locations

Under this RWS alternative, Reclamation would construct 11 new short-term storage tanks in Alternative B locations (see **Figure 2-10**). The storage tanks would be located as follows:

- Two on the Pueblo de San Ildefonso
- Three on the Pueblo of Pojoaque
- Two on the Pueblo of Nambé
- Two on the Pueblo of Tesuque
- Two on non-Pueblo land south of the Pueblo of Tesuque, near Tesuque Village and Bishop's Lodge

Table 2-7, below, shows the size and tank material for each new or existing short-term storage tank under Alternative B, as well as whether the tank would need a new or improved access road. Tank volumes were designed to provide some additional fire protection flows and 24 hours of the maximum daily demand required for the service zones that each tank, or group of tanks in the same location, serves. The total estimated short-term storage capacity under this alternative is 7,194,000 gallons.

Table 2-7. Short-Term Storage Tanks, Alternative B

Tank Name	Tank Diameter (Feet)	Tank Height (Feet)	Tank Volume (Gallons)	Tank Material	New or Improved Access Road Needed?
New Tanks					
San Ildefonso North HKM	20	75	136,000	Steel	No
El Rancho	48	30	366,000	Steel	Yes
White Sands HKM	70	25	696,000	Concrete	Yes
Jacona HKM	70	25	725,000	Concrete	No
Pojoaque Main HKM	35	30	232,000	Steel	Yes
Nambé	87	20	757,000	Concrete	Yes
Nambé South	45	38	417,000	Steel	Yes
Camel Rock Casino	48	30	366,000	Steel	Yes
Flea Market	39	58	494,000	Concrete	No
Tesuque Village	70	25	634,000	Concrete	No
Bishop's Lodge HKM	65	25	546,000	Concrete	No
Total short-term storage capacity from new tanks			**5,369,000**		
Existing Tanks					
Bishop's Lodge Tank #15 (non-Pueblo)	56	13	216,000	Steel	No
Black Mesa Tank (Pueblo de San Ildefonso)	20	24	55,000	Steel	No
Buffalo Thunder Tank #22 (Pueblo of Pojoaque)	51	19	300,000	Steel	No
Buffalo Thunder Tank #23 (Pueblo of Pojoaque)	20	22	40,000	Steel	No
Lower Pojoaque Tank #30 (Pueblo of Pojoaque)	39	23	200,000	Steel	No
Lower Pojoaque Tank #31 (Pueblo of Pojoaque)	38	24	200,000	Steel	No
Tewa tank (Pueblo de San Ildefonso; called Main Village Tank in the Draft EIS alternatives)	34	15	100,000	Steel	No
Nambé Tank #25	25	24	88,000	Steel	No
Nambé Tank #27	24	26	88,000	Steel	No
New Pajarito Tank (Pueblo de San Ildefonso)	31	28	150,000	Steel	No
White Sands Storage Tank (Pueblo of Pojoaque; called North Village Tank in the Draft EIS alternatives)	24	38	126,000	Steel	No

Table 2-7. Short-Term Storage Tanks, Alternative B (cont.)

Tank Name	Tank Diameter (Feet)	Tank Height (Feet)	Tank Volume (Gallons)	Tank Material	New or Improved Access Road Needed?
IGC Tank (Pueblo of Tesuque)	40	10	170,000	Steel	No
Te Tsu Geh Oweenge School Tank #18 (Pueblo of Tesuque)	30	18	92,000	Steel	No
Total short-term storage capacity from existing tanks			**1,825,000**		

Sources: Reclamation 2015b; R. Hall, Reclamation, personal communication with K. Patterson, EMPSi, July 18, 2017

Tank sites would be designed and constructed as described under **Section 2.3.1.4**, Short-Term Storage Tanks, with the same estimated electrical load (10 kVA) for each tank. Additional information on electrical service to this element can be found under **Section 2.6.2.7**, Electrical Service.

Storage tank sites located far from existing access roads and offset in the hills would require either new access roads or improved roads, as shown in **Table 2-7**. All other storage tank sites would be accessed via existing roads. Newly constructed access roads would be graded dirt base course and would follow pipeline alignments to storage tanks.

2.6.2.6 Water Transmission and Distribution System

The overall design of the water transmission and distribution system is described in **Section 2.3.1.5**, Water Transmission and Distribution System. Portions of pipeline alignments would be unique to this alternative; they would correspond with variances in locations of other RWS elements, such as the water treatment plant, the optional backup supply, and the short-term storage tanks. Radio antenna poles for the SCADA system would be installed next to the RWS facilities, as described in **Section 2.3.1.5**.

Figure 2-10 shows pumping plants and water transmission and distribution pipeline routes for Alternative B. A 1-mile-long raw water pipeline would carry untreated water from the side channel surface diversion structure to the water treatment plant.

Approximately 148 miles of transmission and distribution pipeline, between 4 and 10 inches in diameter, and 36 miles of transmission and distribution pipeline, between 11 and 24 inches in diameter, would be installed for the RWS under this alternative (Reclamation GIS 2017; Reclamation 2015b). Pipeline between 4 and 10 inches in diameter could be installed using a trencher, while larger pipeline would have to be installed using a backhoe. The diameter has not been estimated for approximately 8 miles of transmission and distribution pipeline.

Under Alternative B, the water transmission system would include seven pumping plants and six forebay tanks. This does not include the two pumping plants at the side channel

surface diversion and the water treatment plant or the pumping plants at the ASR well sites.

Table 2-8, below, describes the approximate size of the pumping plant building, air chamber building, and forebay tank at each pumping plant site under this alternative. Approximately 1,150 feet of new access roads would be constructed to reach pumping plants under this alternative. Combined short-term and long-term disturbance from these roads would cover an estimated 1 acre.

The estimated connected electrical load, as well as information on electrical service, for each pumping plant site under this alternative are under **Section 2.6.2.7**, Electrical Service. This electrical load would provide power for instrumentation, controls, and a sodium hypochlorite booster station.

Table 2-8. Pumping Plant Facility Approximate Dimensions, Alternative B

Pumping Plant Site	Pumping Plant Building Size	Air Chamber Building Size	Forebay Tank Size
Pojoaque Industrial Park	50 feet long by 30 feet wide by 14 feet high	28 feet long by 20 feet wide by 20 feet high	N/A
Upper Cuyamungue	30 feet long by 30 feet wide by 12 feet high	19 feet long by 19 feet wide by 18 feet high	22 feet in diameter by 18 feet high
Upper Tesuque Pueblo	30 feet long by 30 feet wide by 14 feet high	19 feet long by 19 feet wide by 20 feet high	22 feet in diameter by 17 feet high
Lower Tesuque	30 feet long by 30 feet wide by 16 feet high	13 feet long by 13 feet wide by 15 feet high	15 feet in diameter by 15 feet high
Tesuque	30 feet long by 30 feet wide by 12 feet high	13 feet long by 13 feet wide by 17 feet high	15 feet in diameter by 21 feet high
Bishop's Lodge	30 feet long by 30 feet wide by 12 feet high	13 feet long by 13 feet wide by 14 feet high	10 feet in diameter by 17 feet high
Nambé	30 feet long by 30 feet wide by 12 feet high	13 feet long by 13 feet wide by 12 feet high	15 feet in diameter by 22 feet high

Source: Reclamation 2015b

2.6.2.7 Electrical Service

Some or all of the following would be needed at the backup water source, side channel surface diversion structure, water treatment plant, storage tanks, and pumping plants:

- Distribution lines
- Transformers
- Feeder cables
- Grounding systems
- Backup power sources

General information on electricity sources and electrical line construction are provided in **Section 2.3.1.6**, Electrical Service. Distributed solar generation would not be incorporated as a supplemental electricity source under this alternative.

In total, approximately 15 miles of new electrical distribution lines would be constructed to reach RWS facilities under this alternative (see **Figure 2-10**). Existing and proposed new electrical distribution lines are shown together in **Appendix B**, Alternatives Figures.

Table 2-9, below, shows the estimated power demand for each RWS facility under this alternative.

Table 2-9. Estimated Electrical Loads, Alternative B

Element	Total Electrical Load in kVAs
Options for backup source to ensure firm, reliable supply[1]:	
Direct-injection ASR wells in HKM implementable locations	2,700[2]
Direct-injection ASR wells in feasibility-level locations	600[3]
Passive infiltration ASR wells in feasibility-level locations	300[4]
Side channel surface diversion structure	630
Water treatment plant	4,300
Short-term storage tanks	110[5]
Pumping plants	
Pojoaque Industrial Park	1,000
Upper Cuyamungue	290
Upper Tesuque Pueblo	230
Lower Tesuque	200
Tesuque	100
Bishop's Lodge	75
Nambé	130
Total[1]	**9,765**

Source: Reclamation 2015b
[1] Total includes the option for the backup source that has the highest estimated electrical load.
[2] 900 kVAs per well (three wells total); includes injection and recovery
[3] 200 kVAs per well (three wells total); includes injection and recovery
[4] 100 kVAs per well (three wells total); includes recovery
[5] 10 kVAs per tank

New three-phase electrical service (at a voltage common at most U.S. industrial facilities) and a step-down transformer would be provided at each ASR injection (if applicable) and recovery well pumping plant. Either the Jemez Mountains Electric Cooperative (JMEC) or the Public Service Company of New Mexico (PNM) would install this equipment. The step-down transformer would be installed on an approximately 100-square-foot concrete pad. A portable diesel-powered generator would provide backup power. **Table 2-10**, below, shows the estimated length of new electrical distribution lines that would be constructed to reach facilities associated with each backup supply option.

Table 2-10. Summary of Electrical Distribution Lines to Backup Supply Options

Well Site	Length (Feet)
ASR – Deep Injection and Recovery Wells	
Pueblo de San Ildefonso	1,140
Pueblo of Pojoaque	640
Pueblo of Nambé	1,050
ASR – Shallow Injection and Recovery Wells	
Pueblo of Pojoaque eastern arroyo	15,840
Pueblo of Pojoaque western arroyo	11,820
Pueblo de San Ildefonso arroyo	10,260
ASR – Passive Infiltration and Recovery Wells	
Pueblo of Pojoaque eastern arroyo	15,840
Pueblo of Pojoaque western arroyo	11,820
Pueblo de San Ildefonso arroyo	10,260

Sources: Reclamation GIS 2017; Reclamation 2015b

To power the side channel surface diversion structure, the JMEC would provide a step-down transformer to convert higher voltage electricity from electrical distribution lines to lower voltage electricity that could be used to power the facility. The step-down transformer would be installed on an approximately 100-square-foot concrete pad. The electrical distribution line would be both overhead and underground and would stretch for approximately 19,300 feet. A permanent diesel engine generator set at the side channel surface diversion site would provide temporary power during a loss of service. The generator would be the size of a small truck and could be painted to match the aesthetics of the building.

To power the water treatment plant, the JMEC would supply a step-down transformer to provide electrical service. Two separate feeder cables, buried at least 24 inches, would deliver power to the buildings. Approximately 16,760 feet of overhead and underground electrical distribution line would bring electricity to the water treatment plant site from El Rancho power substation east of County Road 101D, just north of SH 502.

A permanently installed diesel generator at the water treatment plant site would provide emergency power during a loss of service for up to 36 hours. A grounding system would protect personnel and property from hazardous voltages at the water treatment plant caused by lightning strikes, electrical ground faults, static discharge, or other sources of electrical energy.

Power would be supplied to short-term storage tanks at each site via a pole-mounted transformer. Overhead lines to tank sites would vary in length from 220 to 3,350 feet. Power would be supplied by either the JMEC or the PNM.

Table 2-11, below, shows the estimated length of new electrical distribution lines that would be constructed to reach each short-term storage tank location.

Table 2-11. Summary of Electrical Distribution Lines to Short-Term Storage Tanks, Alternative B

Tank	Length (Feet)
San Ildefonso North HKM	1,180
El Rancho	790
White Sands HKM	2,840
Jacona HKM	1,300
Pojoaque Main HKM	1,960
Nambé	1,710
Nambé South	220
Camel Rock Casino	3,350
Flea Market	580
Tesuque Village	920
Bishop's Lodge HKM	0

Sources: Reclamation GIS 2017; Reclamation 2015b

To use the electricity from the grid for the pumping plants, a transformer is required to change the voltage provided from the utility to match the needs of the pump motor. Sites for the Pojoaque Industrial Park Pumping Plant and the Pojoaque South Pumping Plant would include a foundation for a pad-mounted power transformer. Other pumping plant sites would be supplied via a pole-mounted transformer. The step-down transformer would be provided by either the JMEC or the PNM and would be installed on an approximately 100-square-foot concrete pad.

New electrical service would be provided at each pumping plant.

Table 2-12, below, shows the estimated length of new electrical distribution lines that would be constructed to reach each pumping plant site. A permanently installed diesel-powered generator would provide emergency power for the Pojoaque Industrial Park Pumping Plant in case normal power were lost. An additional portable generator would be trailer mounted so that it could be moved between the other pumping plants as needed.

Table 2-12. Summary of Electrical Distribution Lines to Pumping Plants, Alternative B

Pumping Plant	Length (Feet)
Pojoaque Industrial Park	650
Upper Cuyamungue	0
Upper Tesuque Pueblo	340
Lower Tesuque	800
Tesuque	290
Bishop's Lodge	80
Nambé	560

Sources: Reclamation GIS 2017; Reclamation 2015b

2.6.3 Alternative C

2.6.3.1 Overview

Under this alternative, the RWS would consist of the following major components, all of which are described in detail in the sections below:

- A firm, reliable water supply that would be ensured by collecting flows from the hyporheic zone of the Rio Grande and supplemented by operational planning and scheduling of San Juan-Chama Project water supplies
- A parallel river interceptor drain in the alluvium, below the water table in the bosque and on the east side of Rio Grande north of Otowi Bridge
- A water treatment plant on the eastern portion of the Pueblo de San Ildefonso, on the east side of County Road 101D, near the El Rancho power substation
- Eleven new short-term storage tanks in Alternative C locations, in addition to 13 existing storage tanks
- A water transmission and distribution system of approximately 189 miles of pipelines, ranging in size from 4 to 24 inches in diameter, one surge tank, six pumping plants, and pressure-reducing and flow-control valves to keep pressures within a prescribed range, while providing some additional fire protection flows
- Electrical service to power components of the RWS, including approximately 7 miles of new electrical distribution lines, supplemented by distributed solar generation

Constructing the RWS facilities, including pipelines, would disturb approximately 1,000 acres of surface in Pueblo boundaries and 141 acres of surface outside of Pueblo boundaries. Permanent RWS facilities, not including pipelines, would cover approximately 23 acres of surface within Pueblo boundaries and 3 acres outside Pueblo boundaries. Borrow pits, spoil piles, and construction staging areas would be the same as those described under Alternative B.

Table 2-13, below, shows estimated short- and long-term disturbance acreages on each Settlement Pueblo; **Figure 2-14**, RWS Alternative C, shows the location of RWS facilities and elements under Alternative C.

Table 2-13. Estimated Disturbance on Settlement Pueblos, Alternative C

Pueblo	Short-Term (Acres)	Long-Term (Acres)[1]
Pueblo of Nambé	227	3
Pueblo of Pojoaque	334	10
Pueblo de San Ildefonso	266	8
Pueblo of Tesuque	173	2
Total	**1,000**	**23**

Sources: Reclamation GIS 2017; Reclamation 2015b
Note: New access roads are assumed to overlap with water transmission or distribution pipeline routes.
[1] There would be no long-term disturbance from pipelines. All pipeline alignments would be revegetated with native grasses; however, deep-rooted shrubs and trees would not be allowed to grow. A 10-foot-wide long-term maintenance easement would follow all pipeline alignments, but this easement would not permanently disturb the surface.

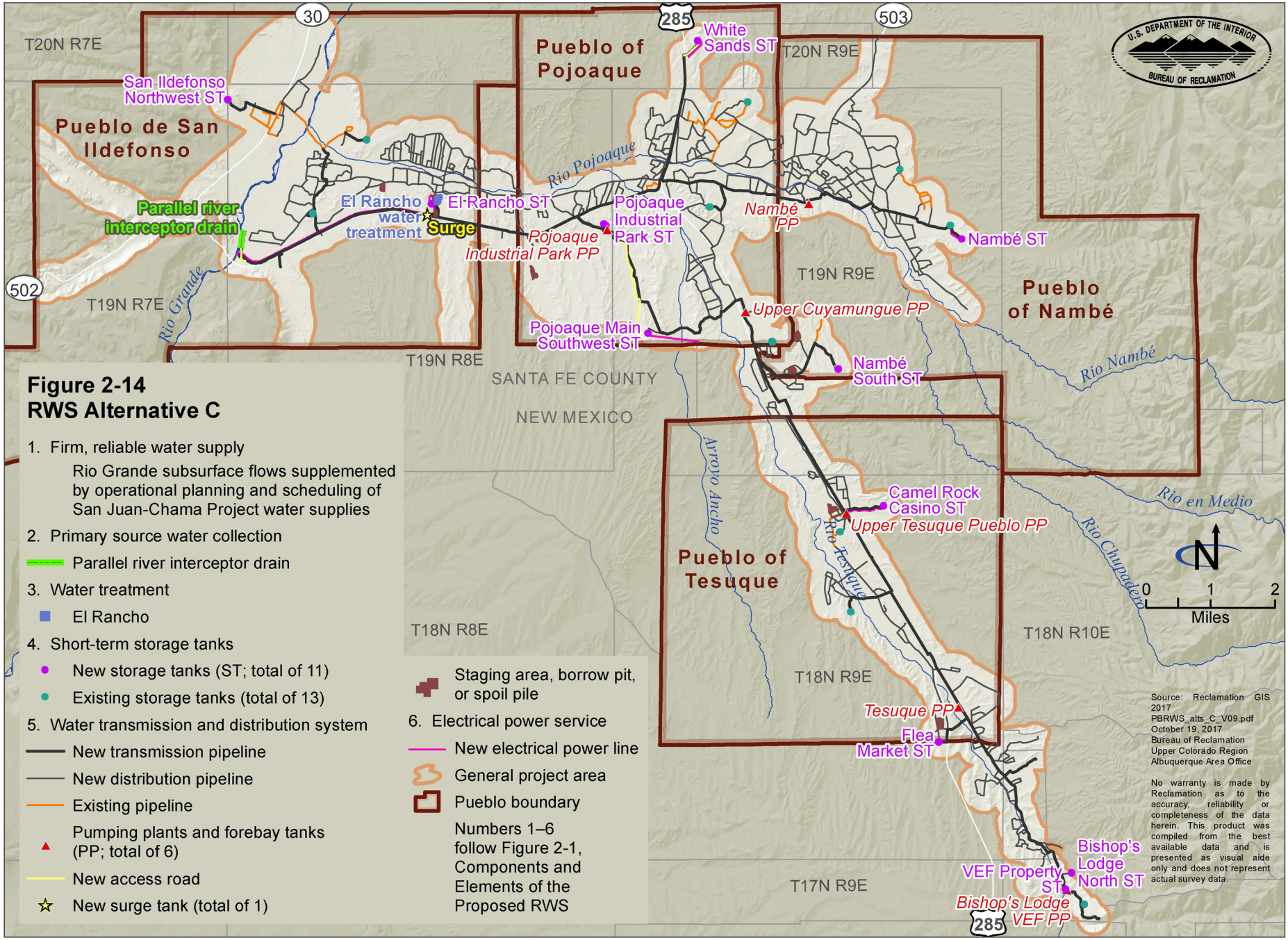


Figure 2-14
RWS Alternative C

1. Firm, reliable water supply
   Rio Grande subsurface flows supplemented by operational planning and scheduling of San Juan-Chama Project water supplies
2. Primary source water collection
   - Parallel river interceptor drain
3. Water treatment
   - El Rancho
4. Short-term storage tanks
   - New storage tanks (ST; total of 11)
   - Existing storage tanks (total of 13)
5. Water transmission and distribution system
   - New transmission pipeline
   - New distribution pipeline
   - Existing pipeline
   - Pumping plants and forebay tanks (PP; total of 6)
   - New access road
   - New surge tank (total of 1)
   - Staging area, borrow pit, or spoil pile
6. Electrical power service
   - New electrical power line
   - General project area
   - Pueblo boundary

Numbers 1–6 follow Figure 2-1, Components and Elements of the Proposed RWS

Source: Reclamation GIS 2017
PBRWS_alts_C_V09.pdf
October 19, 2017
Bureau of Reclamation
Upper Colorado Region
Albuquerque Area Office

No warranty is made by Reclamation as to the accuracy, reliability or completeness of the data herein. This product was compiled from the best available data and is presented as visual aide only and does not represent actual survey data.

2.6.3.2 Firm, Reliable Water Supply—Rio Grande Surface Flows Supplemented by Operational Planning and Scheduling of San Juan-Chama Project Water Supplies

Under Alternative C, water for the RWS would be supplied by subsurface collection of Rio Grande surface flows. This collection process is not vulnerable to the same water quality issues as surface collection of flows, such as sediment loading or ash from fires. This is because sediment and ash in the Rio Grande are filtered out by the alluvial materials in the riverbed before subsurface collection.

Additionally, collection of flows from the hyporheic zone is much more reliable than surface collection in drought conditions. Reclamation would also schedule releases of upstream water supplies to supplement Rio Grande surface flows, as described in **Section 2.3.1.1**, Firm, Reliable Water Supply.

2.6.3.3 Primary Source Water Collection—Parallel River Interceptor Drain

Under Alternative C, Reclamation would construct a parallel river interceptor drain next to the Rio Grande. The drain would be constructed in the alluvium in seven segments of screened collection pipes. It would be below the water table in the bosque, on the east side of the Rio Grande, north of Otowi Bridge (see **Figure 2-14**, RWS Alternative C, for the proposed location).

Collected water would percolate via gravity through the screened pipes in the hyporheic zone into six concrete main chambers, or caissons, which would act as underground holding tanks. From the caissons, the water would be transported to the pumping plant building via buried pipelines, using submersible pumps (described in additional detail below).

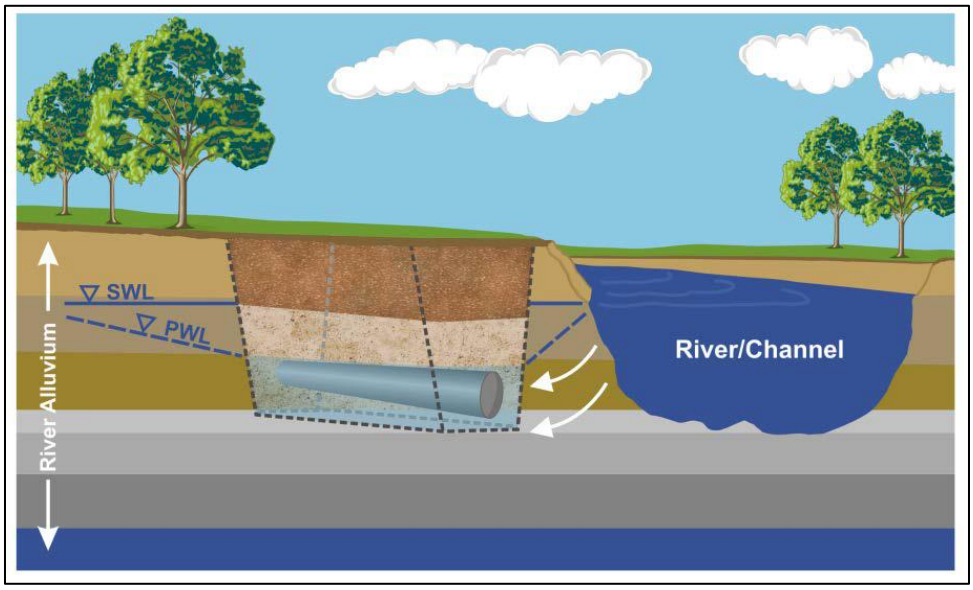
The pumping plant building would combine the water from each caisson and transport it to the water treatment plant. The drain would be constructed of an approximately 1,500- to 2,000-foot-long, 10-inch-diameter or larger perforated drainage pipe, with a well-graded gravel filter envelope. This would ensure clean water and long-term reliability.

The drain would be buried approximately 23 feet below ground surface. It could be extended before construction, if Reclamation were to determine that a longer drain is necessary for optimal operation. If this were the case, Reclamation would consult with the Pueblo de San Ildefonso and may perform additional NEPA analysis.

Transmitting water through the alluvium and the screens eliminates enough of the sediment, microorganisms, and some dissolved solids from the collected water such that additional pre-sedimentation facilities would not be necessary at the water treatment plant. **Figure 2-15**, below, illustrates what the parallel interceptor drain system could look like.

Collected water would flow along the length of the drain to one of the six caissons. Motors, pump controls, and associated equipment would be installed in watertight equipment vaults. Each of the six caissons would contain three pumps, which would provide capacity to meet maximum daily demands of the RWS and redundancy to address potential out-of-service periods. A spare pump would be stored at the water treatment plant for emergency repairs. As described under Alternative B, a pumping plant would be required to lift the raw water to the treatment plant.

Figure 2-15. Conceptual Rendering of a Parallel River Interceptor Drain



Source: Reclamation 2015b
Note: Rendering not to scale. SWL: static water level; PWL: pumping water level. Drain would run parallel to the river channel.

The estimated electrical load of all pumps is approximately 630 kVA. Additional information on electrical service to this element can be found under **Section 2.6.3.7**, Electrical Service. Each vault would have an inside diameter of at least 8 feet and would be accessed via a 48-inch-diameter, watertight, manhole access port. All vaults would be vented. They would be in line with or off to one side of the parallel river interceptor drain.

The drain segments could be installed via conventional trenching and dewatering, underground horizontal hydraulic jacking, or a bio-polymer slurry trench. Hydraulic pipe jacking would install the segments by boring the front face of the excavation and using hydraulic jacking force to push pipes horizontally through the ground.

Open-faced pipe ramming involves ramming pipe through soil using hydraulic or pneumatic force applied with a hammer device. No drilling mud would be required for any of these installation processes.

The trench for a bio-polymer slurry trench would be vertical and approximately 2 to 5 feet wide. During excavation, it would be filled with a slurry suspension of bio-polymers (biodegradable materials) in water. After the pipe is laid, the trench would be backfilled with permeable material, which would displace the slurry.

The interceptor drain would be approximately 1,500 to 2,000 feet long. It would include approximately 60 feet of blank piping to connect the screen to various fittings and to block out sections where filtration is not feasible.

An estimated 50-foot-wide construction easement would be required for trenching and installation. Each caisson installation location would require a disturbance area of approximately 22,500 square feet. After the drain is installed, the trench would be backfilled with engineered fill. During construction, the short-term disturbance for the parallel river interceptor drain, not including access road, is estimated to be 5 acres;

permanent disturbance is estimated to be 1 acre. An estimated 1,660 feet of new 12-foot-wide graded dirt or base course access road would be constructed for this element. Estimated short-term disturbance from this new road is 2 acres; estimated long-term disturbance is 1 acre.

The general sequence of construction using the bio-polymer slurry trench method would be as follows:

- Clear the work area necessary for the trench
- Excavate the trench and fill it with bio-polymer slurry
- Partially backfill the trench with a sand filter pack
- Assemble the intake pipe and attach the precast concrete caisson base and valve
- Lay the intake pipe drain and precast concrete caisson base
- Install pumps in caissons
- Backfill around the intake pipe drain with sand filter pack
- Backfill the trench with engineered fill
- Install a low permeability clay cap over the backfilled trench

Because the parallel river interceptor drain would collect water at a depth of approximately 23 feet in the river alluvium, this element would not be affected by scour or invasive mussels; therefore, no scour protection, such as riprap or H-piles, or invasive mussel mitigation measures would be necessary.

Unlike the side channel surface diversion, during periods of low river flow, the parallel river interceptor drain could continue to draw from the water that flows through the riverbed (or alluvium). If flows in the Rio Grande were to cease for an extended period, the ability of the wells to collect water could be limited; however, withdrawals would be subject to water rights regulations.

Historically, the Rio Grande has never dried up at the Otowi gage, and no climate change projection scenario for it through 2089 goes below 100 cubic feet per second (cfs; 44,883 gpm; Reclamation 2013b). The maximum expected diversion rate for the RWS is 9.6 cfs (4,326 gpm).

Major floods that shift the river channel could expose the top section of the caisson or bury it under rocks, sediment, and debris (if the caisson were installed flush with the ground). Because the intake screens would be subsurface, the wells would be able to continue to operate during times of extreme runoff or high turbidity.

Flooding is not expected to impact the parallel river interceptor drain; however, vaults could be covered by sediments and debris during floods, requiring maintenance. Channel migration from major floods in the vicinity of the parallel river interceptor drain site is unlikely; this is because of the site's proximity to Otowi Bridge. The parallel interceptor drain would be designed so that flooding and channel migration would not disrupt the RWS water supply.

2.6.3.4 Water Treatment—El Rancho Location

Under Alternative C, Reclamation would construct a water treatment plant on the east side of County Road 101D near El Rancho power substation, in the eastern portion of the Pueblo de San Ildefonso, approximately 3 miles east of the Otowi Bridge. The berm to the north of the existing substation would also be extended to reduce the visibility of the water treatment plant. As with Alternative B, the footprint of the water treatment plant would be approximately 5 acres. The water treatment plant electrical load would be the same as described under **Section 2.3.1.3**, Water Treatment. The site would be accessed via an existing road.

Because water would be filtered through the alluvium as it is collected from the Rio Grande via horizontal radial well collectors under Alternative C, no pre-sedimentation basin would be needed at the water treatment plant. An estimated average of 3 cubic yards per day, or 6,400 pounds per day, of dried solids would be transported from the water treatment plant to the landfill under this alternative.

As under Alternative B, an average of approximately 2,612 gpd of sanitary waste and membrane cleaning wastes would be generated at the water treatment plant after construction. At full future demand, an average of 5,729 gpd would be generated. This waste would be pumped to a holding tank on site and periodically pumped out and transported away.

Additionally, an average of approximately 27,000 gpd of brine would be generated at the water treatment plant after construction. At full future demand, an average of 149,000 gpd would be generated. Brine from the water treatment process would be discharged into the Rio Grande. Reclamation would obtain any necessary permits under the CWA for this discharge.

Because this location is in an arroyo, fill material would be required to level the site and protect it from flooding. Approximately 40,000 cubic yards of material would be excavated from the water treatment plant site, and approximately 35,000 cubic yards of fill material would be added under this alternative. All other water treatment plant processes and facilities would be the same as those described under **Section 2.3.1.3**.

2.6.3.5 Short-Term Storage Tanks—24 Total Tanks in Alternative C Locations

Under this RWS alternative, Reclamation would construct 11 new short-term storage tanks in Alternative C locations (see **Figure 2-14**). These locations were determined by updating appraisal-level, HKM implementable locations to take into consideration stakeholder preferences and design optimization. The storage tanks would be distributed as follows:

- Two on the Pueblo de San Ildefonso
- Three on the Pueblo of Pojoaque
- Two on the Pueblo of Nambé
- Two on the Pueblo of Tesuque
- Two on non-Pueblo land south of the Pueblo of Tesuque near Tesuque Village and Bishop's Lodge

Table 2-14, below, shows the size and tank material for each new or existing short-term storage tank under this alternative, as well as whether the tank would need a new or improved access road. Tank volumes were designed to provide some additional capacity for fire protection flows and 24 hours of the maximum daily demand required for the service zones that each tank, or group of tanks in the same location, serves. The total estimated short-term storage capacity under this alternative is 8,513,000 gallons.

Table 2-14. Short-Term Storage Tanks, Alternative C

Tank Name	Tank Diameter (Feet)	Tank Height (Feet)	Tank Volume (Gallons)	Tank Material	New or Improved Access Road Needed?
New Tanks					
San Ildefonso Northwest	50	20	250,000	Steel	No
El Rancho	48	30	366,000	Steel	Yes
White Sands	70	35	914,000	Concrete	Yes
Pojoaque Industrial Park	70	40	1,023,000	Concrete	Yes
Pojoaque Main Southwest	51	71	1,055,000	Concrete	Yes
Nambé	87	20	757,000	Concrete	Yes
Nambé South	45	38	417,000	Steel	Yes
Camel Rock Casino	48	30	366,000	Steel	Yes
Flea Market	39	58	494,000	Concrete	No
Bishop's Lodge North	65	25	546,000	Concrete	No
VEF Property	56	28	500,000	Steel	Yes
Total short-term storage capacity from new tanks			**6,688,000**		
Existing Tanks					
Bishop's Lodge Tank #15 (non-Pueblo)	56	13	216,000	Steel	No
Black Mesa Tank (Pueblo de San Ildefonso)	20	24	55,000	Steel	No
Buffalo Thunder Tank #22 (Pueblo of Pojoaque)	51	19	300,000	Steel	No
Buffalo Thunder Tank #23 (Pueblo of Pojoaque)	20	22	40,000	Steel	No
Lower Pojoaque Tank #30 (Pueblo of Pojoaque)	39	23	200,000	Steel	No
Lower Pojoaque Tank #31 (Pueblo of Pojoaque)	38	24	200,000	Steel	No
Tewa tank (Pueblo de San Ildefonso; called Main Village Tank in the Draft EIS alternatives)	34	15	100,000	Steel	No
Nambé Tank #25	25	24	88,000	Steel	No
Nambé Tank #27	24	26	88,000	Steel	No

Table 2-14. Short-Term Storage Tanks, Alternative C (cont.)

Tank Name	Tank Diameter (Feet)	Tank Height (Feet)	Tank Volume (Gallons)	Tank Material	New or Improved Access Road Needed?
New Pajarito Tank (Pueblo de San Ildefonso)	31	28	150,000	Steel	No
White Sands Storage Tank (Pueblo of Pojoaque; called North Village Tank in the Draft EIS alternatives)	24	38	126,000	Steel	No
IGC Tank (Pueblo of Tesuque)	40	10	170,000	Steel	No
Te Tsu Geh Oweenge School Tank #18 (Pueblo of Tesuque)	30	18	92,000	Steel	No
Total short-term storage capacity from existing tanks			**1,825,000**		

Sources: Reclamation 2015b; R. Hall, Reclamation, personal communication with K. Patterson, EMPSi, July 18, 2017

Tank sites would be designed and constructed as described under **Section 2.3.1.4**, Short-Term Storage Tanks, with the same estimated electrical load (10 kVA) for each tank. Additional information on electrical service to this element can be found under **Section 2.6.3.7**, Electrical Service. Storage tank sites located far from existing access roads and offset in the hills would require either new access roads or improved roads, as shown in **Table 2-14**. All other storage tank sites would be accessed via existing roads. Newly constructed access roads would be graded dirt or base course and would follow pipeline alignments to storage tanks.

2.6.3.6 Water Transmission and Distribution System

The overall design of the water transmission and distribution system is described in **Section 2.3.1.5**, Water Transmission and Distribution System. Portions of pipeline alignments would be unique to this alternative, to correspond with variances in locations of other RWS elements, such as the water treatment plant and the short-term storage tanks. **Figure 2-14** shows pumping plants and water transmission and distribution pipeline routes for Alternative C. As with Alternative B, radio antenna poles for the SCADA system would be installed next to RWS facilities, as described in **Section 2.3.1.5**.

Approximately 161 miles of transmission and distribution pipeline, between 4 and 10 inches in diameter, and 30 miles of transmission and distribution pipeline, between 11 and 24 inches in diameter, would be installed for the RWS under this alternative (Reclamation GIS 2017; Reclamation 2015b). Pipeline between 4 and 10 inches in diameter could be installed using a trencher, while larger pipeline would have to be installed using a backhoe.

Under Alternative C, the water transmission system would include six pumping plants and four forebay tanks (not including the two pumping plants at the parallel river interceptor drain and the water treatment plant). **Table 2-15**, below, describes the approximate size of the pumping plant building, air chamber building, and forebay tank at each pumping plant site under Alternative C.

Table 2-15. Pumping Plant Facility Approximate Dimensions, Alternative C

Pumping Plant Site	Pumping Plant Building Size	Air Chamber Building Size	Forebay Tank Size
Pojoaque Industrial Park	50 feet long by 30 feet wide by 14 feet high	28 feet long by 20 feet wide by 20 feet high	Not applicable
Upper Cuyamungue	30 feet long by 30 feet wide by 12 feet high	19 feet long by 19 feet wide by 18 feet high	22 feet in diameter by 18 feet high
Upper Tesuque Pueblo	30 feet long by 30 feet wide by 14 feet high	19 feet long by 19 feet wide by 20 feet high	22 feet in diameter by 17 feet high
Tesuque	30 feet long by 30 feet wide by 12 feet high	13 feet long by 13 feet wide by 17 feet high	15 feet in diameter by 21 feet high
Bishop's Lodge VEF	30 feet long by 30 feet wide by 12 feet high	13 feet long by 13 feet wide by 14 feet high	Not applicable
Nambé	30 feet long by 30 feet wide by 12 feet high	13 feet long by 13 feet wide by 12 feet high	15 feet in diameter by 22 feet high

Source: Reclamation 2015b

Approximately 1,130 feet of new access roads would be constructed to reach pumping plants under this alternative. Short-term and long-term disturbance from these roads would cover an estimated 1 acre.

Under Alternative C, a 4-mile raw water pipeline would carry untreated water from the parallel river interceptor drain to the water treatment plant. A steel surge tank would be included in the transmission and distribution system to mitigate negative water pressures at a high point in the pipeline alignment, between the horizontal radial well collectors and the treatment plant. See **Figure 2-14** for the location of the surge tank. The tank would be 40 feet in diameter and 15 feet tall. Temporary construction disturbance for the surge tank is estimated to be approximately 1 acre; the permanent footprint of the surge tank is estimated to be approximately 100 feet by 175 feet.

The estimated connected electrical load, as well as information on electrical service, for each pumping plant site under this alternative is described under **Section 2.6.3.7**, Electrical Service. This electrical load would provide power for instrumentation, controls, and a sodium hypochlorite booster station.

2.6.3.7 Electrical Service

Some or all of the following components would be needed at the parallel river interceptor drain sumps and at the surge tank, water treatment plant, storage tanks, and pumping plants:

- Distribution lines
- Transformers
- Feeder cables
- Grounding systems
- Backup power sources

General information on electricity sources and electrical line construction are provided in **Section 2.3.1.6**, Electrical Service. Under this alternative, the RWS would be powered by the existing electrical grid and energy mix in the Pojoaque Basin, supplemented by distributed solar generation.

Approximately 7 miles of new electrical distribution lines would be constructed to reach RWS facilities under this alternative. Existing and proposed new electrical distribution lines are shown in **Appendix B**, Alternatives Figures.

Large solar panels would be installed on some RWS facilities to generate supplemental electricity. Panels would be installed only on facilities with enough sun exposure to effectively generate power: the water treatment plant, all short-term storage tanks, and all pumping plants, except the Bishop's Lodge pumping plant. Solar power generated on these facilities would power nonessential functions, such as interior lighting.

Electricity generated by the solar panels could also be fed back into the existing grid and sold to local utilities. However, electricity from the grid would be the power source for all essential RWS functions. Installing solar panels would not increase the footprint of any RWS facilities, and maintaining them is not expected to require significant amounts of water.

Table 2-16, below, shows the estimated power demand for each RWS facility under this alternative.

To power the parallel river interceptor drain, the JMEC would provide new electrical service for each caisson site. A pad-mounted step-down transformer would be provided at each site, and power for the well's electrical loads would be via a buried feeder cable. The step-down transformer would be installed on an approximately 100-square-foot concrete pad. Backup power would be provided by diesel engine generators. Electrical power lines would be approximately 21,470 feet long and would be mostly overhead. New lines through the bosque near the Rio Grande would be buried.

Electrical service to the surge tank would come from an existing electrical line nearby, so no new transformer would be needed. A portable diesel-powered generator would provide backup power.

Electrical service to the water treatment plant would be similar to that described under Alternative B, except that the overhead electrical distribution line to the water treatment plant would be approximately 150 feet long under Alternative C.

Table 2-16. Estimated Electrical Loads under Alternative C

Element	Electrical Load (kVA)
Parallel river interceptor drain	630
Surge tank	10
Water treatment plant	4,300
Short-term storage tanks	110[1]
Pumping plants	
Pojoaque Industrial Park	1,000
Upper Cuyamungue	290
Upper Tesuque Pueblo	230
Tesuque	100
Bishop's Lodge	75
Nambé	130
Total	**6,875**

Source: Reclamation 2015b
[1] 10 kVA per tank

Power would be supplied to short-term storage tanks via a pole-mounted transformer at each tank site. Overhead lines to tank sites would vary in length, from 0 to 4,200 feet. Power would be supplied by either the JMEC or the PNM. **Table 2-17**, below, shows the estimated length of new electrical distribution lines that would be constructed to reach each short-term storage tank location.

Table 2-17. Summary of Electrical Distribution Lines to Short-Term Storage Tanks under Alternative C

Tank	Length (Feet)
San Ildefonso Northwest	2,100
El Rancho	740
White Sands	1,740
Pojoaque Industrial Park	650
Pojoaque Main Southwest	4,200
Nambé	1,710
Nambé South	220
Camel Rock Casino	3,250
Flea Market	580
Bishop's Lodge North	0
VEF Property	520

Sources: Reclamation GIS 2017; Reclamation 2015b

Transformers at pumping plants would be installed as described under Alternative B. **Table 2-18**, below, shows the configuration by which electricity would reach each pumping plant site. A permanent diesel-powered generator or solar panels, or both, would provide emergency power for the Pojoaque Industrial Park Pumping Plant in case normal power is lost. An additional portable generator would be trailer mounted so that it could

Table 2-18. Summary of Electrical Distribution Lines to Pumping Plants under Alternative C

Pumping Plant	Length (Feet)
Pojoaque Industrial Park	650
Upper Cuyamungue	100
Upper Tesuque Pueblo	250
Tesuque	160
Bishop's Lodge VEF	520
Nambé	560

Sources: Reclamation GIS 2017; Reclamation 2015b

be moved between the pumping plants as needed. Solar panels may also be installed at other pumping plant sites to provide backup power.

2.6.4 Alternative D

2.6.4.1 Overview

Under Alternative D, the RWS would consist of the following major components, all of which are described in detail in the sections below:

- A firm, reliable water supply that would be ensured by collecting flows from the hyporheic zone of the Rio Grande and supplemented by operational planning and scheduling of San Juan-Chama Project water supplies
- An infiltration gallery (an estimated 180 horizontal drains to collect groundwater) on the east bank to the Rio Grande
- A water treatment plant in the same location as Alternative C
- Sixteen new short-term storage tanks in Alternative D locations, in addition to 13 existing tanks
- A water transmission and distribution system, including approximately 187 miles of pipelines, ranging in size from 4 to 24 inches in diameter, one surge tank, six pumping plants, and pressure-reducing and flow-control valves to keep pressures within a prescribed range, while providing some additional fire protection flows
- Electrical service to power components of the RWS, including approximately 7 miles of new electrical distribution lines, with facilities capable of being supplemented by distributed solar generation

Construction of the RWS facilities, including pipelines, would disturb approximately 1,002 acres of surface within Pueblo boundaries and 144 acres of surface outside of Pueblo boundaries. Permanent RWS facilities, not including pipelines, would cover approximately 22 acres of surface within Pueblo boundaries and 4 acres outside Pueblo boundaries. Borrow pits, spoil piles, and construction staging areas would be the same as those described under Alternative B. **Table 2-19**, below, shows estimated short- and long-term disturbance acreages on each Settlement Pueblo; **Figure 2-16**, RWS Alternative D, shows the location of RWS facilities and elements under this alternative.

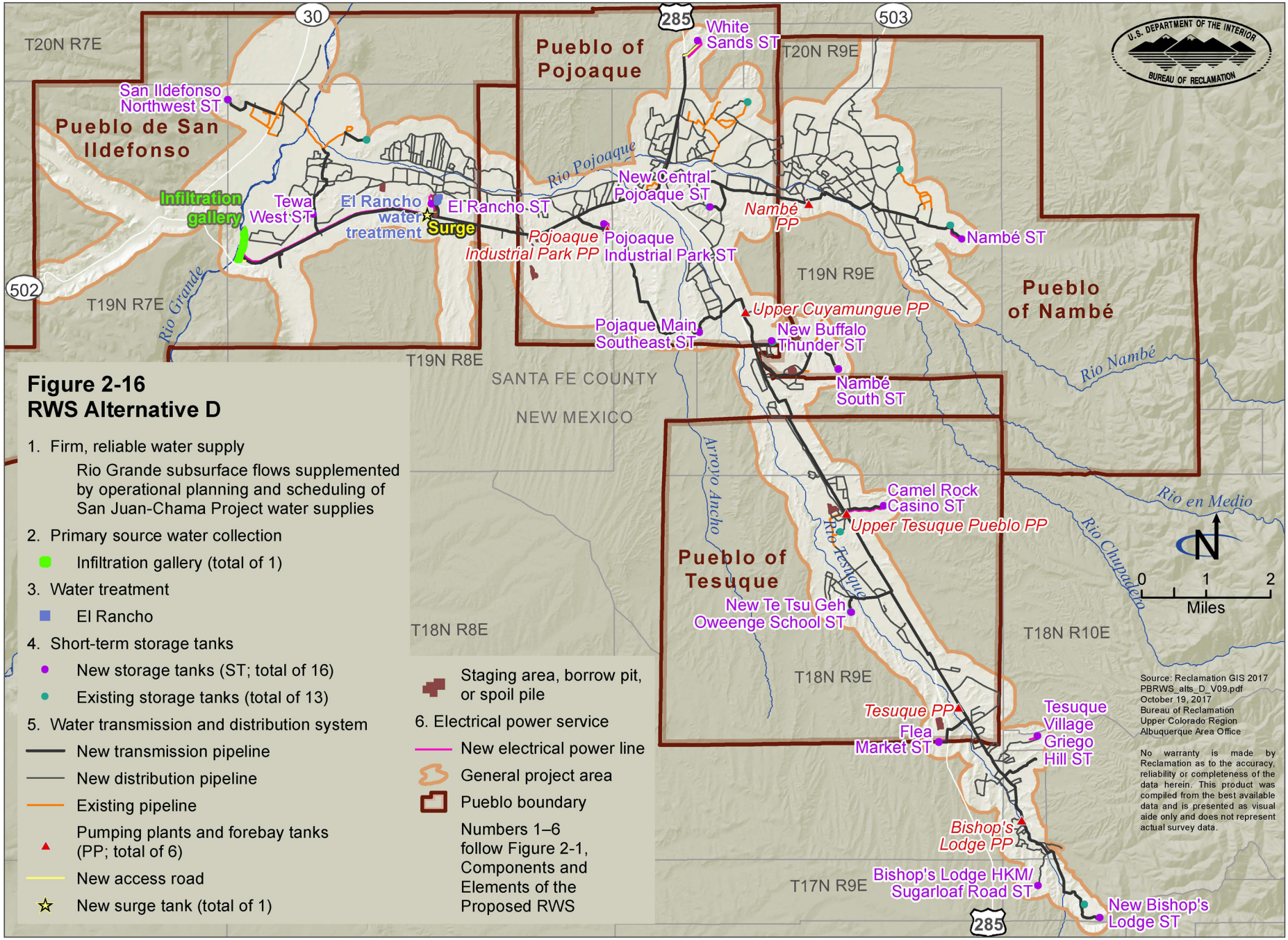


Figure 2-16
RWS Alternative D

1. Firm, reliable water supply
   Rio Grande subsurface flows supplemented by operational planning and scheduling of San Juan-Chama Project water supplies
2. Primary source water collection
   - Infiltration gallery (total of 1)
3. Water treatment
   - El Rancho
4. Short-term storage tanks
   - New storage tanks (ST; total of 16)
   - Existing storage tanks (total of 13)
5. Water transmission and distribution system
   - New transmission pipeline
   - New distribution pipeline
   - Existing pipeline
   - Pumping plants and forebay tanks (PP; total of 6)
   - New access road
   - New surge tank (total of 1)
   - Staging area, borrow pit, or spoil pile
6. Electrical power service
   - New electrical power line
   - General project area
   - Pueblo boundary

Numbers 1–6 follow Figure 2-1, Components and Elements of the Proposed RWS

Source: Reclamation GIS 2017
PBRWS_alts_D_V09.pdf
October 19, 2017
Bureau of Reclamation
Upper Colorado Region
Albuquerque Area Office

No warranty is made by Reclamation as to the accuracy, reliability or completeness of the data herein. This product was compiled from the best available data and is presented as visual aide only and does not represent actual survey data.

Table 2-19. Estimated Disturbance on Settlement Pueblos, Alternative D

Pueblo	Short-Term (Acres)	Long-Term (Acres)[1]
Pueblo of Nambé	227	3
Pueblo of Pojoaque	323	7
Pueblo de San Ildefonso	290	9
Pueblo of Tesuque	162	3
Total	**1,002**	**22**

Sources: Reclamation GIS 2017; Reclamation 2015b
Note: New access roads are assumed to overlap with water transmission or distribution pipeline routes.
[1] There would be no long-term disturbance from pipelines. All pipeline alignments would be revegetated with native grasses; however, deep-rooted shrubs and trees would not be allowed to grow. A 10-foot-wide long-term maintenance easement would follow all pipeline alignments, but this easement would not permanently disturb the surface.

2.6.4.2 Firm, Reliable Water Supply—Rio Grande Surface Flows Supplemented by Operational Planning and Scheduling of San Juan-Chama Project Water Supplies

Under Alternative D, a firm, reliable water supply would be ensured in the same manner as described under Alternative C.

2.6.4.3 Primary Source Water Collection—Infiltration Gallery

Under Alternative D, Reclamation would construct an estimated 180horizontal drains made of screened pipe, drain blocks, or other components installed in the alluvium below the water table to collect flows from the hyporheic zone of the Rio Grande on its east bank. Pipes would be approximately 40 feet long and 8 inches in diameter, spaced approximately 4 feet apart.

The drains would be installed in an estimated 1,500-foot-long by 100-foot-wide site (see **Figure 2-16** for the site location). The site could be extended before construction, if Reclamation were to determine that longer drains were necessary for optimal operation. If this were the case, Reclamation would consult with the Pueblo de San Ildefonso and may perform additional NEPA analysis.

The configuration of the collection system would be optimized to capture Rio Grande flows from the hyporheic zone, based on the permeability of the alluvium. Flows captured by the collection system would be transmitted to a clear well before being pumped to the water treatment plant.

This technology is similar to the parallel river interceptor drain, except for the configuration of the screened pipes and the method with which the infiltration gallery is constructed. For the infiltration gallery, horizontal screened pipes would be placed about 20 feet below ground surface by excavating on the east bank of the river (see **Figure 2-17**, below). Temporary construction disturbance is estimated to cover approximately 31 acres. Grass would be allowed to grow over the screened pipes, but it would be regularly mowed or cleared to prevent shrubs and deep-rooted trees from growing back.

Figure 2-17. Infiltration Gallery



Photo credit: Anson Excavating & Pipe, Inc.

Approximately 1 acre would be permanently disturbed where the pumping plant would be constructed. An estimated 3,310 feet of new 12-foot-wide graded dirt or base course access road would be constructed for this element. Estimated short-term disturbance from this new road is 4 acres; estimated long-term disturbance is 2 acres.

Transmitting water through the alluvium and the screens eliminates enough of the sediment, microorganisms, and some dissolved solids from the collected water that additional pre-sedimentation facilities would not be necessary at the water treatment plant.

As described under Alternative B, a pumping plant would be required to lift the raw water to the water treatment plant. Either submersible pumps or surface turbine pumps would pump the collected water from the clear well through buried pipelines to the pumping plant and then to the water treatment plant. The estimated electrical load of all pumps is 630 kVA. Additional information on electrical service to this element can be found under **Section 2.6.4.7**, Electrical Service.

Because the infiltration gallery would intake water at a depth of approximately 20 feet in the river alluvium, this element would not be affected by scour or invasive mussels; therefore, no scour protection (e.g., riprap or H-piles) or invasive mussel mitigation measures would be necessary.

During low river flow periods, the infiltration gallery could continue to draw from the water that flows through the riverbed or alluvium. If flows in the Rio Grande were to cease for an extended period, the ability of the drains to collect water could be limited; however, withdrawals would be subject to water rights regulations and interpretations. Historically, the Rio Grande has never dried up at Otowi gage, and no climate change projection scenario through 2089 goes below 100 cfs there (Reclamation 2013b).

Flooding is not expected to impact the infiltration gallery. Because the intake screens would be subsurface, the infiltration gallery would be able to continue to operate during times of extreme runoff or high turbidity. Channel migration from major floods in the vicinity of the infiltration gallery site is unlikely; this is because of the site's the proximity to Otowi Bridge. The infiltration gallery would be designed so that flooding and channel migration would not disrupt the RWS water supply.

2.6.4.4 Water Treatment—El Rancho Location

Under Alternative D, Reclamation would construct the same water treatment plant in the same location as under Alternative C.

2.6.4.5 Short-Term Storage Tanks—29 Total Tanks in Alternative D Locations

Under this RWS alternative, Reclamation would construct 16 new short-term storage tanks (to provide higher fire protection flows) at Alternative D locations (see **Figure 2-16** for short-term storage tank locations).

The storage tanks would be located as follows:

- Three on the Pueblo de San Ildefonso
- Five on the Pueblo of Pojoaque
- Two on the Pueblo of Nambé
- Three on the Pueblo of Tesuque
- Three on non-Pueblo land south of the Pueblo of Tesuque, near Tesuque Village and Bishop's Lodge

The volume of the proposed Flea Market tank was increased, to meet service requirements. At the same time, the height was decreased and the diameter was increased, to reduce visual impacts, in response to public comments.

Table 2-20, below, shows the size and material for each new or existing short-term storage tank under this alternative, as well as whether the tank would need a new or improved access road. Tank volumes were designed to provide additional fire protection flows of 2,000 gpm for 2 hours and 24 hours of the maximum daily demand required for the service zones that each tank, or group of tanks in the same location, serves. The total estimated new short-term storage capacity under this alternative is 10,222,000 gallons.

Tank sites would be designed and constructed as described under **Section 2.3.1.4**, Short-Term Storage Tanks, with the same estimated electrical load (10 kVA) for each tank. Additional information on electrical service to this element can be found under **Section 2.6.4.7**, Electrical Service. Storage tank sites located far from existing access roads and offset in the hills would require new access roads or improved existing roads, as shown in **Table 2-20**. All other storage tank sites would be accessed via existing roads. Newly constructed access roads would be graded dirt or base course and would follow pipeline alignments to storage tanks.

2.6.4.6 Water Transmission and Distribution System

The design of the water transmission and distribution system under Alternative D would be similar to that under Alternative C. Pipeline alignments would differ in minor ways to correspond with variances in locations of other RWS elements, such as the short-term storage tanks (see **Figure 2-16**). As with Alternative B, radio antenna poles for the SCADA system would be installed next to RWS facilities, as described in **Section 2.3.1.5**.

Table 2-20. Short-Term Storage Tanks, Alternative D

Tank Name	Tank Diameter (Feet)	Tank Height (Feet)	Tank Volume (Gallons)	Tank Material	New or Improved Access Road Needed?
New Tanks					
San Ildefonso Northwest	50	20	250,000	Steel	No
Tewa West	48	30	366,000	Steel	No
El Rancho	48	30	366,000	Steel	Yes
White Sands	70	35	914,000	Concrete	Yes
Pojoaque Industrial Park	70	40	1,023,000	Concrete	Yes
Pojoaque Main Southeast	51	71	1,055,000	Concrete	Yes
New Central Pojoaque	35	30	195,000	Steel	No
New Buffalo Thunder	20	75	170,000	Steel	No
Nambé	87	20	757,000	Concrete	Yes
Nambé South	45	38	417,000	Steel	Yes
Camel Rock Casino	48	30	366,000	Steel	Yes
New Te Tsu Geh Oweenge School	62	25	493,000	Concrete	Yes
Flea Market	55	31	542,000	Concrete	No
Tesuque Village Griego Hill	70	25	634,000	Concrete	No
Bishop's Lodge HKM/Sugarloaf Road	65	25	546,000	Concrete	No
New Bishop's Lodge	55	20	303,000	Steel	No
Total short-term storage capacity from new tanks			**8,397,000**		
Existing Tanks					
Bishop's Lodge Tank #15 (non-Pueblo)	56	13	216,000	Steel	No
Black Mesa Tank (Pueblo de San Ildefonso)	20	24	55,000	Steel	No
Buffalo Thunder Tank #22 (Pueblo of Pojoaque)	51	19	300,000	Steel	No
Buffalo Thunder Tank #23 (Pueblo of Pojoaque)	20	22	40,000	Steel	No
Lower Pojoaque Tank #30 (Pueblo of Pojoaque)	39	23	200,000	Steel	No
Lower Pojoaque Tank #31 (Pueblo of Pojoaque)	38	24	200,000	Steel	No
Tewa tank (Pueblo de San Ildefonso; called Main Village Tank in the Draft EIS alternatives)	34	15	100,000	Steel	No

Table 2-20. Short-Term Storage Tanks, Alternative D (cont.)

Tank Name	Tank Diameter (Feet)	Tank Height (Feet)	Tank Volume (Gallons)	Tank Material	New or Improved Access Road Needed?
Nambé Tank #25	25	24	88,000	Steel	No
Nambé Tank #27	24	26	88,000	Steel	No
New Pajarito Tank (Pueblo de San Ildefonso)	31	28	150,000	Steel	No
White Sands Storage Tank (Pueblo of Pojoaque; called North Village Tank in the Draft EIS alternatives)	24	38	126,000	Steel	No
IGC Tank (Pueblo of Tesuque)	40	10	170,000	Steel	No
Te Tsu Geh Oweenge School Tank #18 (Pueblo of Tesuque)	30	18	92,000	Steel	No
Total short-term storage capacity from existing tanks			**1,825,000**		

Sources: Reclamation 2015b; R. Hall, Reclamation, personal communication with K. Patterson, EMPSi, July 18, 2017

Approximately 960 feet of new access roads would be constructed to reach pumping plants under this alternative. Short-term and long-term disturbance from these roads would cover an estimated 1 acre.

Approximately 159 miles of transmission and distribution pipeline, between 4 and 10 inches in diameter, and 29 miles of transmission and distribution pipeline, between 12 and 24 inches in diameter, would be installed for the RWS, under this alternative (Reclamation GIS 2017; Reclamation 2015b). Pipeline between 4 and 10 inches in diameter could be installed using a trencher, while larger pipeline would have to be installed using a backhoe.

Under Alternative D, the water transmission system would include six pumping plants and five forebay tanks (not including the two pumping plants at the infiltration gallery and the water treatment plant). **Table 2-21**, Pumping Plant Facility Approximate Dimensions, Alternative D, describes the approximate size of the pumping plant building, air chamber building, and forebay tank at each pumping plant site, under Alternative D.

Table 2-21. Pumping Plant Facility Approximate Dimensions, Alternative D

Pumping Plant Site	Pumping Plant Building Size	Air Chamber Building Size	Forebay Tank Size
Pojoaque Industrial Park	50 feet long by 30 feet wide by 14 feet high	28 feet long by 20 feet wide by 20 feet high	Not applicable
Upper Cuyamungue	30 feet long by 30 feet wide by 12 feet high	19 feet long by 19 feet wide by 18 feet high	22 feet in diameter by 18 feet high
Upper Tesuque Pueblo	30 feet long by 30 feet wide by 14 feet high	19 feet long by 19 feet wide by 20 feet high	22 feet in diameter by 17 feet high
Tesuque	30 feet long by 30 feet wide by 12 feet high	13 feet long by 13 feet wide by 17 feet high	15 feet in diameter by 21 feet high
Bishop's Lodge	30 feet long by 30 feet wide by 12 feet high	13 feet long by 13 feet wide by 14 feet high	10 feet in diameter by 17 feet high
Nambé	30 feet long by 30 feet wide by 12 feet high	13 feet long by 13 feet wide by 12 feet high	15 feet in diameter by 22 feet high

Source: Reclamation 2015b

2.6.4.7 Electrical Service

Some or all of the following components would be needed at the infiltration gallery and at the surge tank, water treatment plant, storage tanks, and pumping plants:

- Distribution lines
- Transformers
- Feeder cables
- Grounding systems
- Backup power sources

General information on electricity sources and electrical line construction are provided in **Section 2.3.1.6**, Electrical Service. Under this alternative, the RWS would be powered using the existing electrical grid and energy mix in the Pojoaque Basin, but it would be designed to be supplemented by distributed solar generation.

Approximately 7 miles of new electrical distribution lines would be constructed to reach RWS facilities under this alternative. Existing and proposed new electrical distribution lines are shown in **Appendix B**, Alternatives Figures.

Large RWS facilities, such as the water treatment plant, would be constructed to facilitate future modification and installation of large solar panels, if the Regional Water Authority so desires. For example, the roof of the water treatment plant building would be designed

and constructed so that it could hold the weight of large solar panels, should they be installed in the future.

Table 2-22, below, shows the estimated power demand for each RWS facility under this alternative.

Table 2-22. Estimated Electrical Loads, Alternative D

Element	Electrical Load (kVA)
Infiltration gallery	630
Surge tank	10
Water treatment plant	4,300
Short-term storage tanks	160[1]
Pumping plants	
Pojoaque Industrial Park	1,000
Upper Cuyamungue	290
Upper Tesuque Pueblo	230
Tesuque	100
Bishop's Lodge	75
Nambé	130
Total	**6,925**

Source: Reclamation 2015b
[1] 10 kVA per tank

Power would be supplied to the infiltration gallery via a pole-mounted transformer at the site. Electrical power lines would be approximately 22,330 feet long and would be mostly overhead. New lines through the bosque near the Rio Grande would be buried.

Electrical service to the surge tank and water treatment plant would be the same as that described under Alternative C.

Power would be supplied to short-term storage tanks via a pole-mounted transformer at each tank site. Overhead lines to tank sites would vary in length from 0 to 4,200 feet. Power would be supplied by either the JMEC or the PNM.

Table 2-23, Summary of Electrical Distribution Lines to Short-Term Storage Tanks, Alternative D, shows the estimated length of new electrical distribution lines that would be constructed to reach each short-term storage tank location.

Transformers at pumping plants would be installed as described under Alternative B.

Table 2-24, below, shows the configuration by which electricity would reach each pumping plant site. A permanent diesel-powered generator would provide emergency power for the Pojoaque Industrial Park Pumping Plant, in case normal power is lost. An additional portable generator would be trailer mounted so that it could be moved between the pumping plants, as needed.

Table 2-23. Summary of Electrical Distribution Lines to Short-Term Storage Tanks, Alternative D

Tank	Length (Feet)
San Ildefonso Northwest	2,100
Tewa West	0
El Rancho	740
White Sands	1,740
Pojoaque Industrial Park	650
Pojoaque Main Southeast	4,200
New Central Pojoaque	0
New Buffalo Thunder	0
Nambé	1,710
Nambé South	220
Camel Rock	3,250
New Te Tsu Geh Oweenge School	0
Flea Market	580
Tesuque Village Griego Hill	0
Bishop's Lodge HKM/Sugarloaf Road	0
New Bishop's Lodge	0

Sources: Reclamation GIS 2017; Reclamation 2015b

Table 2-24. Summary of Electrical Distribution Lines to Pumping Plants under Alternative D

Pumping Plant	Length (Feet)
Pojoaque Industrial Park	650
Upper Cuyamungue	100
Upper Tesuque Pueblo	250
Tesuque	160
Bishop's Lodge	100
Nambé	560

Sources: Reclamation GIS 2017; Reclamation 2015b

2.6.5 Alternative E (Preferred Alternative)

2.6.5.1 Overview

Under this alternative, the RWS would consist of the following major components, all of which are described in detail in the sections below:

- A firm, reliable water supply that would be ensured by collecting flows from the hyporheic zone of the Rio Grande and supplementing it with operational planning and scheduling of San Juan-Chama Project water supplies. Emergency use wells would allow water to be withdrawn during emergencies lasting longer than 2 days that cannot be supplied by short-term storage tanks

- Four horizontal radial well collectors on the east bank of the Rio Grande, on the Pueblo de San Ildefonso, north of the Otowi Bridge
- A water treatment plant on the west side of County Road 101D, north of SH 502
- Seven new short-term storage tanks, in addition to 15 existing storage tanks
- A water transmission and distribution system, including approximately 151 miles of pipelines, ranging in size from 4 to 24 inches in diameter, one surge tank, 6 pumping plants, and pressure-reducing and flow-control valves to keep pressures within a prescribed range, while providing some additional fire protection flows
- Electrical service to power components of the RWS, including approximately 7 miles of new overhead and buried electrical distribution lines, with facilities capable of being supplemented by distributed solar generation

Construction of the RWS facilities, including pipelines, would disturb approximately 743 acres of surface within Pueblo boundaries and 113 acres of surface outside of Pueblo boundaries. Permanent RWS facilities, not including pipelines, would cover approximately 25 acres of surface within Pueblo boundaries and 2 acres outside Pueblo boundaries.

Under Alternative E, no new borrow pits or spoil piles would be created on the Pueblo of Pojoaque. As under the other action alternatives, two new spoil piles could be created in the eastern portion of the Pueblo of Nambé and the southern portion of the Pueblo of Tesuque (near the old Flea Market site at the southern boundary of the Pueblo).

Construction staging areas, including contractor offices and stockpiles, could be created throughout the general project area. Each borrow pit, spoil pile, and staging area would range between 2 and 10 acres.

Table 2-25, below, shows estimated short- and long-term disturbance acreages on each Settlement Pueblo; **Figure 2-18**, RWS Alternative E (Preferred Alternative), shows the location of RWS facilities and elements under this alternative.

Table 2-25. Estimated Disturbance on Settlement Pueblos, Alternative E

Pueblo	Short-Term (Acres)	Long-Term (Acres)[1]
Pueblo of Nambé	184	10
Pueblo of Pojoaque	248	5
Pueblo de San Ildefonso	199	8
Pueblo of Tesuque	112	2
Total	**743**	**25**

Sources: Reclamation GIS 2017; Reclamation 2015b
Note: New access roads are assumed to overlap with water transmission or distribution pipeline routes.
[1] There would be no long-term disturbance from pipelines. All pipeline alignments would be revegetated with native grasses; however, deep-rooted shrubs and trees would not be allowed to grow. A 10-foot-wide long-term maintenance easement would follow all pipeline alignments, but this easement would not permanently disturb the surface.

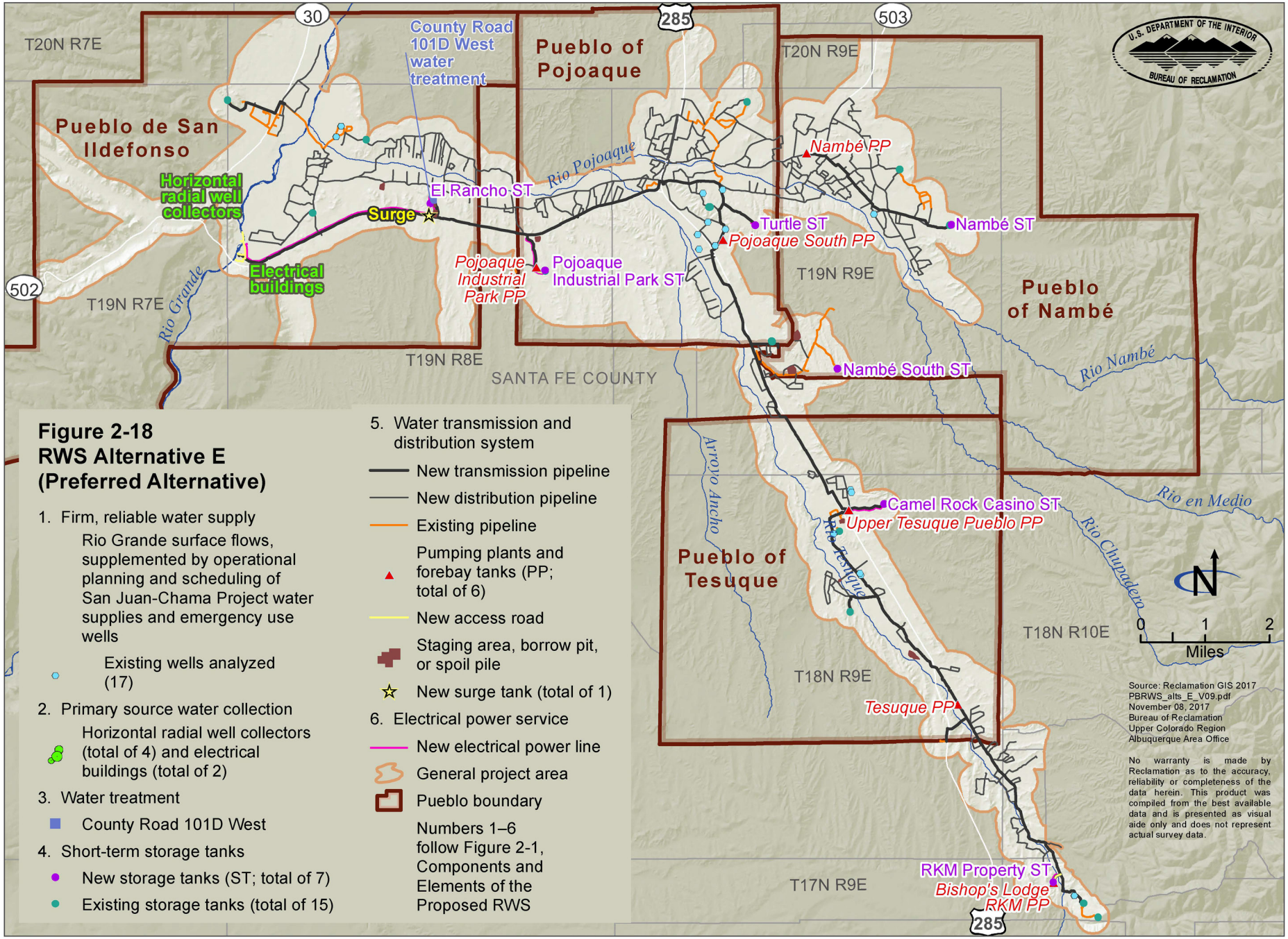


Figure 2-18
RWS Alternative E
(Preferred Alternative)

1. Firm, reliable water supply
   - Rio Grande surface flows, supplemented by operational planning and scheduling of San Juan-Chama Project water supplies and emergency use wells
   - Existing wells analyzed (17)
2. Primary source water collection
   - Horizontal radial well collectors (total of 4) and electrical buildings (total of 2)
3. Water treatment
   - County Road 101D West
4. Short-term storage tanks
   - New storage tanks (ST; total of 7)
   - Existing storage tanks (total of 15)
5. Water transmission and distribution system
   - New transmission pipeline
   - New distribution pipeline
   - Existing pipeline
   - Pumping plants and forebay tanks (PP; total of 6)
   - New access road
   - Staging area, borrow pit, or spoil pile
   - New surge tank (total of 1)
6. Electrical power service
   - New electrical power line
   - General project area
   - Pueblo boundary

Numbers 1–6 follow Figure 2-1, Components and Elements of the Proposed RWS

As permitted under Section 612 of the Settlement Act, under Alternative E, the RWS would be constructed in stages, based on demand. Facilities to serve areas with current water demand could be constructed during the first stage. The remaining facilities described under this alternative that would serve areas with little current demand could be constructed in the future, as development and water demand in those areas increases.

2.6.5.2 Firm, Reliable Water Supply—Rio Grande Subsurface Flows Supplemented by Operational Planning and Scheduling of San Juan-Chama Project Water Supplies and Emergency Use Wells

Under Alternative E, the water rights supplying the RWS would be the same as those described in **Section 2.3.1.1**, Firm, Reliable Water Supply. Reclamation would schedule releases of upstream water supplies to supplement Rio Grande surface flows, as described in **Section 2.3.1.1**. In addition, to provide emergency supplies and to comply with the Safe Drinking Water Act, Reclamation would use existing wells during emergencies lasting longer than 2 days and that cannot be supplied by short-term storage tanks.

The potential emergency use wells supply existing short-term storage tanks that also would be incorporated into the system; therefore, no new water pipelines, electrical power lines, or access roads would be needed for these facilities. The RWS would be flushed and disinfected as necessary before and after the emergency use wells are used. Reclamation or the Regional Water Authority would notify the public of any limitations on RWS use during these emergencies.

The number of existing wells on each Settlement Pueblo and non-Pueblo lands that could be incorporated into the RWS are listed below (see **Figure 2-18** for locations of existing wells that could be used).

- Two wells on the Pueblo de San Ildefonso
- Two wells on the Pueblo of Nambé
- Seven wells on the Pueblo of Pojoaque
- Five wells on the Pueblo of Tesuque
- One well on non-Pueblo land

No new emergency use wells would be constructed in the general project area.

The water rights for emergency use wells could come from one of three sources:

- Pueblo water rights, as quantified in the Settlement Agreement
- Water rights acquired by Santa Fe County for use by the RWS, as allowed by the Settlement Agreement
- RWS surface water, supplied through a hydrologic connection between the Rio Grande and the wells to offset the depletion

2.6.5.3 Primary Source Water Collection—Horizontal Radial Well Collectors

Under Alternative E, Reclamation would install an estimated four horizontal radial well collectors, on the east bank of the Rio Grande, in the bosque of the Pueblo de San Ildefonso, north (upstream) of the Otowi Bridge. The collectors would be spaced

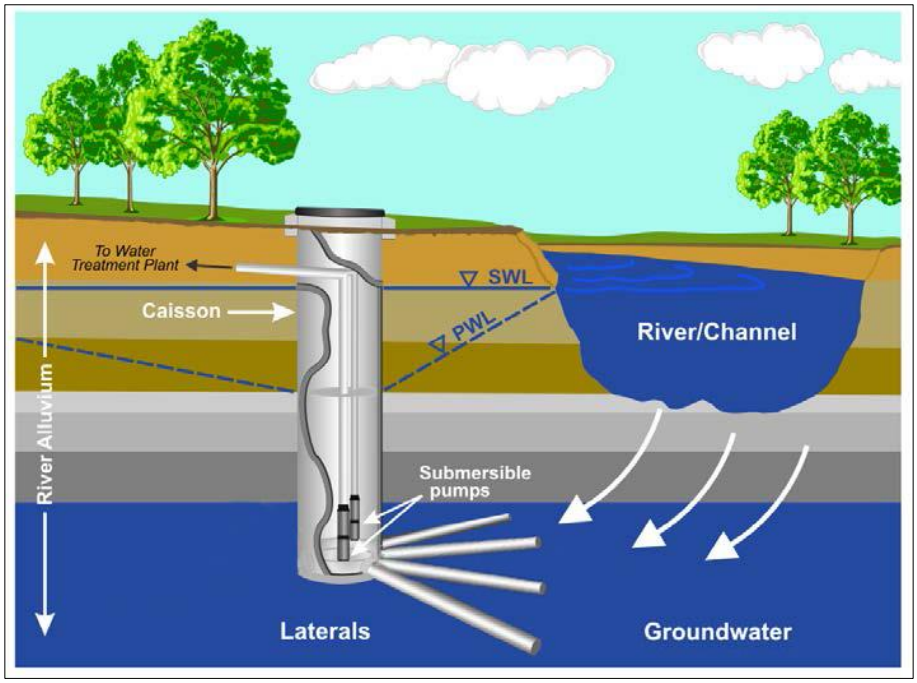
approximately 600 to 1,000 feet apart to allow for maximum production at each. Based on current data, four collector wells are estimated to be sufficient to provide water supply to meet the needs of the RWS. If Reclamation were to determine that a fifth collector well is needed for an adequate supply, it would negotiate with the Pueblo de San Ildefonso to identify a suitable location, and supplemental NEPA analysis may be needed.

A horizontal radial well collector includes a 13- to 20-foot outside diameter caisson. The top caisson would be installed either above the ground surface or flush with the ground. The bottom of the caisson would be installed at the base of the shallow alluvial aquifer. The exact depth of each caisson would vary, due to variations in aquifer depth, but the average bottom depth of the caissons would be 34 feet.

From the caisson, horizontal screened lateral collection pipes (laterals) would radiate into the water table, allowing water to percolate via gravity through the hyporheic zone into the caisson. Water transmitted through the alluvium and the screens eliminates enough of the sediment, microorganisms, and some dissolved solids from the collected water, such that additional pre-sedimentation facilities would not be necessary at the water treatment plant.

Submersible pumps (described in additional detail below) would pump the collected water from the caisson through buried pipelines to the water treatment plant. Under this alternative, a separate pumping plant would not be needed to lift the water to the water treatment plant. The estimated electrical load for each horizontal radial well collector is 200 kVA. Additional information on electrical service to this element can be found under **Section 2.6.5.7**, Electrical Service; **Figure 2-19**, below, illustrates what the well collectors could look like.

Figure 2-19. Conceptual Rendering of Horizontal Radial Well Collector



Source: Reclamation 2015b
Note: Rendering is not to scale. SWL: static water level; PWL: pumping water level.

The reinforced concrete caissons would be poured on-site in lifts. As materials are excavated from the inside of the caisson section, the section would sink into the ground; as each lift is lowered to the ground surface, the next lift would be poured. The process is repeated until the desired depth is reached. A 4-foot-thick concrete slab would be poured to seal the bottom of the caisson. Four 12-inch-diameter, continuous slot-screened, horizontal collector laterals, each of which would be stainless steel and wire wrapped, would extend an average of 150 feet outward from the caisson, approximately 25 feet below the ground surface. The centerline elevation of the laterals would be approximately 7 feet above the base of the shallow alluvial aquifer.

As with the parallel river interceptor drain (see **Section 2.6.3.3**, Primary Source Water Collection—Parallel River Interceptor Drain), either pipe jacking or open-faced pipe ramming would be used to place the laterals. Pipe jacking would install the laterals by boring the front face of the excavation and using hydraulic jacking force to push pipes horizontally through the ground. Open-faced pipe ramming involves ramming pipe through soil using hydraulic or pneumatic force applied with a hammer device. No drilling mud would be required for either of these installation processes.

Temporary construction disturbance is estimated to cover approximately 4 acres. Long-term disturbance from collector well sites and electrical buildings is estimated to be 1 acre. Trees would not be allowed to grow along the riverbank within 100 feet of the horizontal radial well collectors, but grass and shrubs would be allowed to grow. Any water that enters the caisson during construction would be discharged and disposed of. A cofferdam or similar method to temporarily dewater the well construction sites would not be required.

Because the horizontal radial well collectors intake water at a depth of approximately 25 feet in the river alluvium, this element would not be affected by scour or invasive mussels. Therefore, no scour protection, such as riprap or H-piles, or invasive mussel mitigation measures would be necessary.

During periods of low river flow, the horizontal radial well collectors could continue to draw from the water that flows through the riverbed (or alluvium). If flows in the Rio Grande were to cease for an extended period, the ability of the wells to collect water could be limited; however, withdrawals would be subject to water right regulations.

Historically, the Rio Grande has never dried up at the Otowi gage, and no climate change projection scenario through 2080 goes below 100 cfs (44,883 gpm) there (Reclamation 2013b). The maximum expected diversion rate for the RWS is 9.6 cfs (4,326 gpm). Major floods that shift the river channel could expose the top section of the caisson or bury it under rocks, sediment, and debris (if the caisson were installed flush with the ground). Because the intake screens would be subsurface, the wells would be able to continue to operate during times of extreme runoff or high turbidity.

Channel migration from major floods in the vicinity of the horizontal radial well collector site is unlikely due to the proximity of the site to Otowi Bridge. The well collectors would be designed so that flooding and channel migration would not disrupt the RWS water supply.

Collected raw water would be conveyed to the water treatment plant via buried pipelines using submersible pumps in each well. The motors, motor controls, electrical panels, and remote controls would likely be housed inside a watertight compartment of the caisson.

All controls would be off-site. Watertight covers in the top of the caisson would allow access to the pumps, valves, discharge fittings, and other submersible components in the well. Each of the four horizontal radial well collectors would contain one to three pumps, which would provide both the capacity to meet maximum daily demands of the RWS and the redundancy to address potential out-of-service periods.

Two electrical buildings would be constructed in the bosque in the vicinity of the horizontal radial well collectors; one of the buildings would also house an air chamber. Each building would be approximately 44 feet long by 30 feet wide by 14 feet high. These buildings would be elevated, using engineered fill to avoid the flood zone.

An estimated 3,164 feet of new 12-foot-wide, graded dirt or base course, access road would be constructed for the horizontal radial well collectors. Estimated short-term disturbance from this new road is 3 acres; estimated long-term disturbance is 2 acres.

2.6.5.4 Water Treatment—County Road 101D West Location

Under Alternative E, Reclamation would construct a water treatment plant on the north side of SH 502 and the west side of County Road 101D, near the El Rancho substation. The footprint of the water treatment plant would be approximately 4 acres. The water treatment plant electrical load would be the same as described under **Section 2.3.1.3**, Water Treatment. The site would be accessed via an existing road.

Similar to Alternatives C and D, because water would be filtered through the alluvium as it is collected from the horizontal radial well collectors, no pre-sedimentation basin would be needed at the water treatment plant, under Alternative E. An estimated average of 3 cubic yards per day, or 6,400 pounds per day, of dried solids would be transported from the water treatment plant to the landfill under this alternative.

An average of approximately 2,612 gpd of sanitary waste and membrane cleaning wastes would be generated at the water treatment plant after construction. In the short term, these wastes would be stored in septic pits and periodically pumped out and transported away. At full future demand, an average of 5,729 gpd of sanitary and membrane cleaning wastes would be generated. In the long term, these wastes would be piped to a new wastewater treatment plant proposed as part of the Pueblo de San Ildefonso Future Projects (see **Section 2.9.2**, Alternative SI-B—Proposed Wastewater and Water Infrastructure).

As under Alternative B, an average of approximately 27,000 gpd of brine would be generated at the water treatment plant after construction. At full future demand, an average of 149,000 gpd would be generated. Brine from the water treatment process would be discharged into the Rio Grande. Reclamation would obtain any necessary permits under the CWA for this discharge.

Approximately 5,700 cubic yards of material would be excavated from the water treatment plant site, and approximately 20,200 cubic yards of fill material would be added under this alternative. All other water treatment plant processes and facilities would be the same as those described under **Section 2.3.1.3**.

2.6.5.5 Short-Term Storage Tanks—22 Total Tanks in Alternative E Locations

Reclamation would construct seven new short-term storage tanks in Alternative E locations (see **Figure 2-18** for short-term storage tank locations), as follows:

- One on the Pueblo de San Ildefonso
- Two on the Pueblo of Pojoaque
- Two on the Pueblo of Nambé
- One on the Pueblo of Tesuque
- One on non-Pueblo land south of the Pueblo of Tesuque near Tesuque Village and Bishop's Lodge

The proposed Flea Market tank has been removed from Alternative E.

Table 2-26, below, shows the size and tank material for each new or existing short-term storage tank under this alternative, as well as whether the tank would need a new or improved access road. Tank volumes were designed to provide some additional fire protection flows and 48 hours of the maximum daily demand required for the service zones that each tank, or group of tanks in the same location, serves. The total estimated short-term storage capacity under this alternative is 10,182,000 gallons; this is the largest of all the action alternatives.

Table 2-26. Short-Term Storage Tanks, Alternative E

Tank Name	Tank Diameter (Feet)	Tank Height (Feet)	Tank Volume (Gallons)	Tank Material	New or Improved Access Road Needed?
New Tanks					
El Rancho	48	43	576,000	Concrete	Yes
Turtle	70	47	1,339,000	Concrete	No
Pojoaque Industrial Park	70	33	936,000	Concrete	Yes
Nambé	87	31	1,379,000	Concrete	Yes
Nambé South	85	40	1,971,000	Concrete	Yes
Camel Rock Casino	40	34	320,000	Steel	Yes
RKM Property	64	25	602,000	Steel	Yes
Total short-term storage capacity from new tanks			**8,123,000**		
Existing Tanks					
Bishop's Lodge Tank #14 (non-Pueblo)	33	16	120,000	Steel	No
Bishop's Lodge Tank #15 (non-Pueblo)	56	13	216,000	Steel	No
Black Mesa Tank (Pueblo de San Ildefonso)	20	24	55,000	Steel	No

Table 2-26. Short-Term Storage Tanks, Alternative E (cont.)

Tank Name	Tank Diameter (Feet)	Tank Height (Feet)	Tank Volume (Gallons)	Tank Material	New or Improved Access Road Needed?
Buffalo Thunder Tank #22 (Pueblo of Pojoaque)	51	19	300,000	Steel	No
Buffalo Thunder Tank #23 (Pueblo of Pojoaque)	20	22	40,000	Steel	No
Lower Pojoaque Tank #30 (Pueblo of Pojoaque)	39	23	200,000	Steel	No
Lower Pojoaque Tank #31 (Pueblo of Pojoaque)	38	24	200,000	Steel	No
Industrial Area Tank	33	20	114,000	Steel	No
Tewa tank (Pueblo de San Ildefonso; called Main Village Tank in the Draft EIS alternatives)	34	15	100,000	Steel	No
Nambé Tank #25	25	24	88,000	Steel	No
Nambé Tank #27	24	26	88,000	Steel	No
New Pajarito Tank (Pueblo de San Ildefonso)	31	28	150,000	Steel	No
White Sands Storage Tank (Pueblo of Pojoaque; called North Village Tank in the Draft EIS alternatives)	24	38	126,000	Steel	No
IGC Tank (Pueblo of Tesuque)	40	10	170,000	Steel	No
Te Tsu Geh Oweenge School Tank #18 (Pueblo of Tesuque)	30	18	92,000	Steel	No
Total Short-term Storage Capacity from existing tanks			**2,059,000**		

Sources: Reclamation 2015b; R. Hall, Reclamation, personal communication with K. Patterson, EMPSi, July 18, 2017

Tank sites would be designed and constructed as described under **Section 2.3.1.4**, RWS Components, Short-Term Storage Tanks, with the same estimated electrical load (10 kVA) for each tank. Additional information on electrical service to this element can be found under **Section 2.6.5.7**, Electrical Service.

Storage tank sites located far from existing access roads and offset in the hills would require new access roads or improved existing roads, as shown in **Table 2-26**. All other storage tank sites would be accessed via existing roads. Newly constructed access roads would be graded dirt or base course and would follow pipeline alignments to storage tanks.

2.6.5.6 Water Transmission and Distribution System

The design of the water transmission and distribution system under Alternative E would be similar to that under Alternative C, including the installation of a surge tank between the horizontal radial well collectors and the water treatment plant. Pipeline alignments would differ in minor ways to correspond with variances in locations of other RWS elements, such as the short-term storage tanks (see **Figure 2-18**). Radio antenna poles for the SCADA system would be installed on top of short-term storage tanks and next to other RWS facilities, as described in **Section 2.3.1.5**.

Approximately 1,039 feet of new access roads would be constructed to reach pumping plants under this alternative. Short-term and long-term disturbance from these roads would cover an estimated 1 acre.

Approximately 133 miles of transmission and distribution pipeline between 4 and 10 inches in diameter and 21 miles of transmission and distribution pipeline between 11 and 24 inches in diameter would be installed for the RWS under this alternative (Reclamation GIS 2017; Reclamation 2015b). Pipeline between 4 and 10 inches in diameter could be installed using a trencher, while larger pipeline would have to be installed using a backhoe.

Under Alternative E, the water transmission system would include six pumping plants and four forebay tanks (not including the two pumping plants at the horizontal radial well collectors and the water treatment plant).

Table 2-27, below, describes the approximate size of the pumping plant building, the air chamber building, and the forebay tank at each pumping plant site under Alternative E.

Table 2-27. Pumping Plant Facility Approximate Dimensions, Alternative E

Pumping Plant Site	Pumping Plant Building Size[1]	Air Chamber Building Size[1]	Forebay Tank Size
Pojoaque Industrial Park	50 feet long by 30 feet wide by 14 feet high	28 feet long by 20 feet wide by 20 feet high	Not applicable
Pojoaque South	30 feet long by 30 feet wide by 12 feet high	19 feet long by 19 feet wide by 18 feet high	20 feet in diameter by 25 feet high
Camel Rock Casino[2]	30 feet long by 30 feet wide by 14 feet high	19 feet long by 19 feet wide by 20 feet high	20 feet in diameter by 22 feet high
Tesuque	30 feet long by 30 feet wide by 12 feet high	13 feet long by 13 feet wide by 17 feet high	20 feet in diameter by 20 feet high
Bishop's Lodge RKM	30 feet long by 30 feet wide by 12 feet high	13 feet long by 13 feet wide by 14 feet high	Not applicable
Nambé	30 feet long by 30 feet wide by 12 feet high	13 feet long by 13 feet wide by 12 feet high	20 feet in diameter by 20 feet high

Source: Reclamation 2015b
[1] The pumping plant building and air chamber building may be combined
[2] Named the Upper Tesuque Pueblo pumping plant in the Draft EIS alternatives

2.6.5.7 Electrical Service

Some or all of the following components would be needed at each horizontal radial well collector site and at the surge tank, water treatment plant, storage tanks, and pumping plants:

- Distribution lines
- Transformers
- Feeder cables
- Grounding systems
- Backup power sources

General information on electricity sources and electrical line construction are provided in **Section 2.3.1.6**, Electrical Service. Under this alternative, the RWS would be powered using the existing electrical grid and energy mix in the Pojoaque Basin; however, it would be designed to be supplemented by distributed solar generation, as described under Alternative D.

Approximately 7 miles of new electrical distribution lines would be constructed to reach RWS facilities under this alternative. Existing and proposed new electrical distribution lines are shown in **Appendix B**, Alternatives Figures.

Table 2-28, below, shows the estimated power demand for each RWS facility under this alternative.

Table 2-28. Estimated Electrical Loads, Alternative E

Element	Electrical Load (kVA)
Emergency use wells	0
Horizontal radial well collectors[1]	800
Surge tank	10
Water treatment plant	4,300
Short-term storage tanks[2]	70
Pumping plants	
Pojoaque Industrial Park	1,000
Upper Cuyamungue	290
Camel Rock Casino[3]	230
Tesuque	100
Bishop's Lodge	75
Nambé	130
Total	**7,015**

Source: Reclamation 2015b
[1] 200 kVA per well collector
[2] 10 kVA per tank
[3] Named the Upper Tesuque Pueblo pumping plant in the Draft EIS alternatives

All emergency use wells under consideration for use in the RWS have electrical power and would not need new electrical service as part of the RWS.

To power the horizontal radial well collectors, the JMEC would provide a step-down transformer at each collector well site. The transformer would be installed on an approximately 100-square-foot concrete pad. Portable diesel-powered generators would provide backup power. Electrical power lines would be approximately 21,676 feet long and would be mostly overhead. New lines through the bosque near the Rio Grande would be buried.

Electrical service to the surge tank would be the same as that described under Alternative C. Electrical service to the water treatment plant would be similar to that described under Alternative B, except that the overhead electrical distribution line to the water treatment plant would be approximately 201 feet long under Alternative E.

Power would be supplied to short-term storage tanks via a pole-mounted transformer at each tank site. Overhead lines to tank sites would vary in length, from 60 to 3,350 feet. Power would be supplied by either the JMEC or the PNM.

Table 2-29, below, shows the estimated length of new electrical distribution lines that would be constructed to reach each short-term storage tank location.

Transformers at pumping plants would be installed, as described under Alternative B.

Table 2-29. Summary of Electrical Distribution Lines to Short-Term Storage Tanks, Alternative E

Tank	Length (Feet)
El Rancho	790
Turtle	549
Pojoaque Industrial Park	940
Nambé	60
Nambé South	170
Camel Rock Casino	3,350
RKM Property	680

Sources: Reclamation GIS 2017; Reclamation 2015b

Table 2-30, below, shows the configuration by which electricity would reach each pumping plant site. A permanent diesel-powered generator would provide emergency power for the Pojoaque Industrial Park Pumping Plant in case normal power is lost. An additional portable generator would be trailer mounted so that it could be moved between the pumping plants, as needed.

Table 2-30. Summary of Electrical Distribution Lines to Pumping Plants under Alternative E

Pumping Plant	Length (Feet)
Pojoaque Industrial Park	2,740
Pojoaque South	230
Camel Rock Casino[1]	270
Tesuque	160
Bishop's Lodge RKM	680
Nambé	150

Sources: Reclamation GIS 2017; Reclamation 2015b

[1] Named the Upper Tesuque Pueblo pumping plant in the Draft EIS alternatives

2.7 Rio Pojoaque Irrigation Improvement Project Alternatives

2.7.1 Alternative RP-A—No Action

Under Alternative RP-A, the Rio Pojoaque irrigation improvement project would not be completed. The Pueblo de San Ildefonso's objectives described in **Section 1.4**, Other Objectives of the Project and Connected Actions, would not be realized through this project, and the existing Rio Pojoaque Barrier Dam would continue operating with its current design.

2.7.2 Common Features of the Action Alternatives

Under all action alternatives for the Rio Pojoaque irrigation improvement project, Reclamation would help plan and design a project to collect surface water owned by the Pueblo de San Ildefonso from the Rio Pojoaque. This would be done to improve irrigation on the Pueblo.

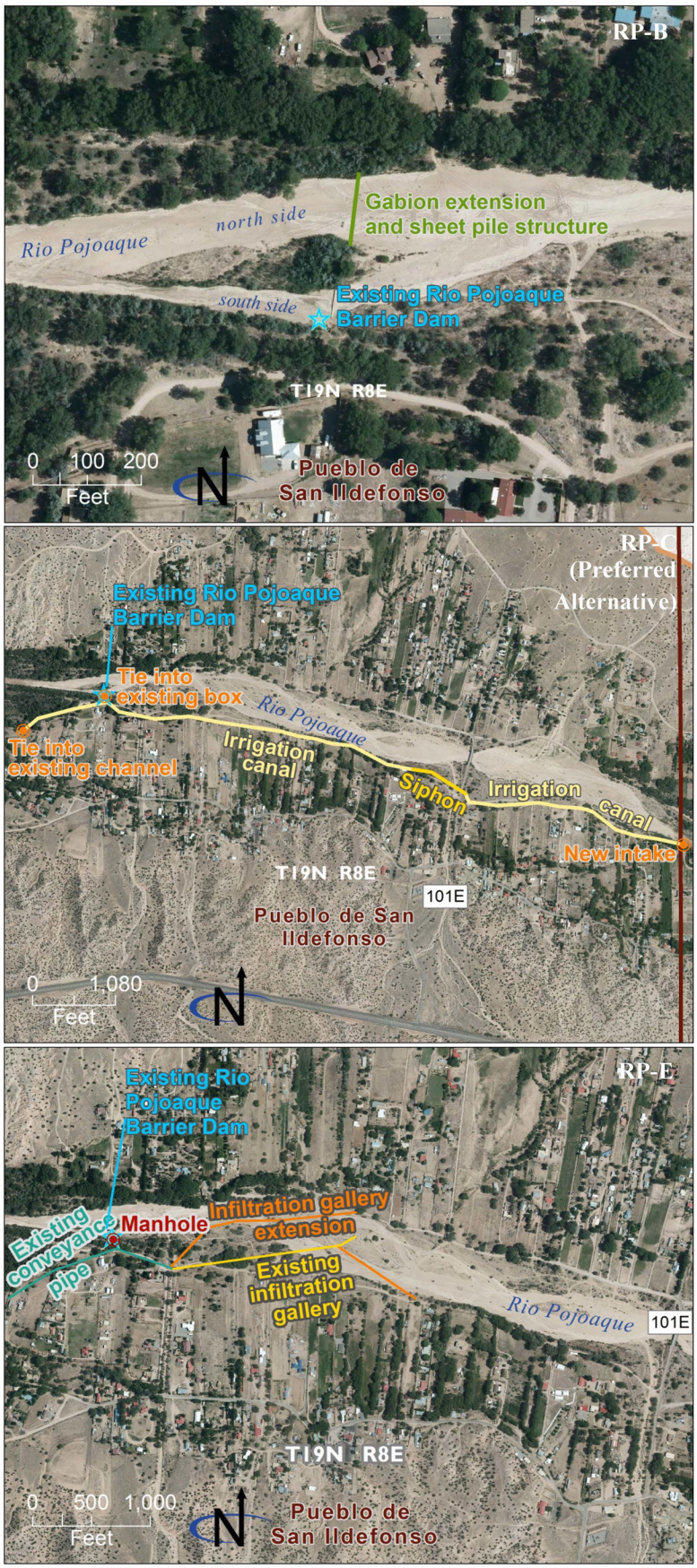
2.7.3 Summary Comparison of Action Alternatives

Figure 2-20, Comparison of Rio Pojoaque Irrigation Improvement Project Alternatives, depicts the project configuration under each action alternative. **Table 2-31**, below, summarizes each action alternative. **Table 2-32**, Rio Pojoaque Irrigation Improvement Project Surface Disturbance, compares estimated disturbance associated with each alternative.

Table 2-31. Summary Comparison of Rio Pojoaque Irrigation Improvement Project Action Alternatives

Alternative RP-B	Alternative RP-C (Preferred Alternative)	Alternative RP-D	Alternative RP-E
Extend existing barrier dam	Pipe water from Acequia de Los Indios or collect it directly from the Rio Pojoaque at the Pueblo boundary into a pipeline, conveyance canal, or combination of the two to the Pueblo's existing irrigation system	Enhance existing infiltration gallery	Extend existing infiltration gallery

Figure 2-20 Comparison of Rio Pojoaque Irrigation Improvement Project Alternatives



Sources: HKM 2008, Reclamation 2014a

Table 2-32. Rio Pojoaque Irrigation Improvement Project Surface Disturbance

	Alternative RP-B		Alternative RP-C (Preferred Alternative)		Alternative RP-D		Alternative RP-E	
Feet	**Short-Term Disturbance**	**Long-Term Disturbance**	**Short-Term Disturbance**	**Long-Term Disturbance**	**Short-Term Disturbance**	**Long-Term Disturbance**	**Short-Term Disturbance**	**Long-Term Disturbance**
Extend existing barrier dam by gabion extension and sheet pile structure	140	140	0	0	0	0	0	0
Extended conveyance system	0	0	9,300	9,300	0	0	0	0
Extend infiltration gallery	0	0	0	0	0	0	2,540	2,540
Acres	**Short-Term Disturbance**	**Long-Term Disturbance**	**Short-Term Disturbance**	**Long-Term Disturbance**	**Short-Term Disturbance**	**Long-Term Disturbance**	**Short-Term Disturbance**	**Long-Term Disturbance**
Extend existing barrier dam by gabion extension and sheet pile structure	<1	<1	0	0	NA	NA	0	0
Extended conveyance system	0	0	11	5	NA	NA	2	0
Extend infiltration gallery	0	0	0	0	NA	NA	36	1

Sources: Reclamation GIS 2017; Reclamation 2015b
NA = Not Applicable
Note: All acreages and mileages are preliminary estimates and will change before final design is complete.
[1] The total short- and long-term disturbance estimated acreages are calculated without any overlapping areas. Estimated disturbance acreages for each element, such as access roads and pipelines, may overlap each other; therefore, the total disturbance estimates for each element cannot be added together to generate the total estimated disturbance for each alternative.

2.7.4 Alternative RP-B

Under Alternative RP-B, the existing Pojoaque River Barrier Dam would be extended from its north edge, across the Rio Pojoaque, to its north bank. The dam spans the southern channel of the Rio Pojoaque on the Pueblo de San Ildefonso. **Figure 2-21**, below, shows the existing dam and the proposed extension. The extended barrier dam would improve the effectiveness of the barrier dam in recharging the alluvium (loose sediment deposited on the riverbank) and diverting alluvial flows to the Rio Pojoaque infiltration gallery under drought conditions. Each winter, the Pueblo de San Ildefonso removes sediment from behind the barrier dam as part of annual maintenance. In addition, sediment would be removed from the proposed extension.

Figure 2-21. Rio Pojoaque Irrigation Improvement Project Alternative RP-B



Source: HKM 2008

The extended section of the dam would be similar to the original dam, which consists of a steel sheet pile next to concrete-capped gabions (rocks or other material enclosed in large cages or boxes). For the extension, steel sheet piling would be driven to between 12 and 15 feet below the riverbed, along the north braid of the Rio Pojoaque. Downstream of the sheet piling, the riverbed would be excavated to allow a 12-foot-wide layer of gabions to be placed next to the sheet piling. The sheet piling and top layer of gabions would provide an approximate drop of 3 feet to the bottom gabions. The bottom gabions would act as an apron to prevent erosion downstream of the top gabions.

Riprap or gabions would also be included as part of the dam extension to prevent riverbank scour and to maintain the course of the channel. The construction of the dam would have to be permitted under Sections 404/401 of the CWA (33 USC, Section 1344).

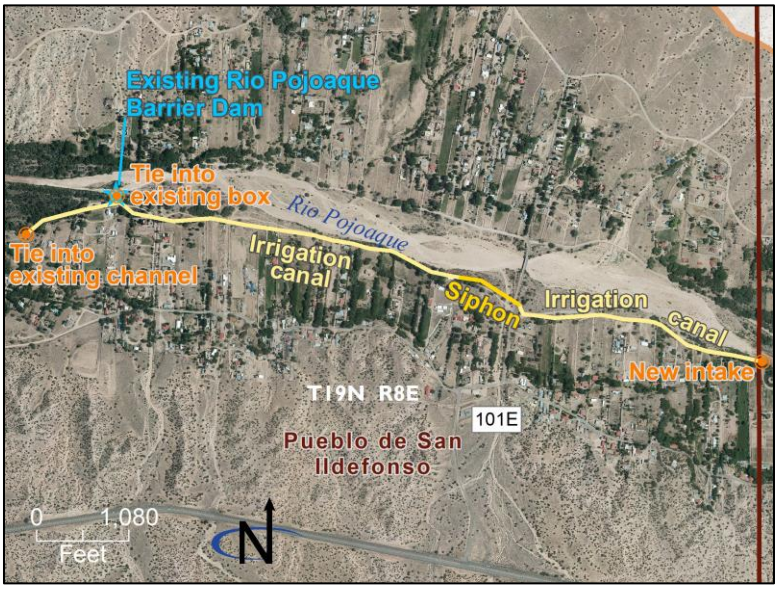
2.7.5 Alternative RP-C (Preferred Alternative)

Under Alternative RP-C, Rio Pojoaque water owned by the Pueblo de San Ildefonso would either be piped from the Acequia de Los Indios into a new conveyance system or collected directly from the Rio Pojoaque into a new conveyance system. This system would be composed of pipe, a concrete-lined conveyance canal, or a combination of the two, and it would tie into the existing Pueblo de San Ildefonso irrigation system.

The water would be collected by installing a new infiltration gallery and intake system on the Rio Pojoaque or by replacing an existing head gate at the downstream end of the Acequia de Los Indios on Pueblo land, north of County Road 84A. The Pueblo would coordinate with the Pojoaque Valley Irrigation District and Acequia de Los Indios to determine the timing of collection. It may enter into an agreement with these parties to ensure that the acequia has enough capacity to deliver the Pueblo's irrigation water, if the acequia is used.

Up to a 9,300-foot-long conveyance system would be constructed from the collection area to the existing Pueblo irrigation system (see **Figure 2-22**, below). The conveyance system would not obstruct any arroyo flows.

Figure 2-22. Rio Pojoaque Irrigation Improvement Project Alternative RP-C (Preferred Alternative)



Source: Reclamation GIS 2017

2.7.6 Alternative RP-D

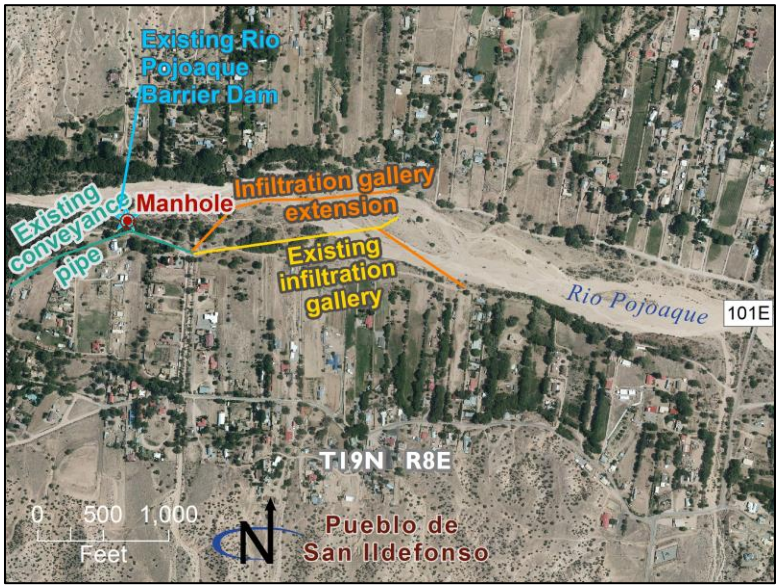
Under Alternative RP-D, Reclamation would analyze the working condition of the existing infiltration gallery (just upstream of the Rio Pojoaque Barrier Dam) in combination with the surrounding stratigraphy. Based on this analysis, Reclamation would identify operational issues that could be addressed to improve infiltration to the Pueblo de San Ildefonso irrigation system. The 15-inch-diameter pipe would be replaced with larger perforated pipe, and new gravel would be added.

2.7.7 Alternative RP-E

Under Alternative RP-E, Reclamation would add approximately 2,540 feet of perforated pipe to the existing Rio Pojoaque infiltration gallery to deliver more water to the Pueblo de San Ildefonso irrigation system. Eighteen-inch perforated pipe would be installed, with a bed of engineered gravel for the infiltration gallery extension.

Figure 2-23, below, shows the approximate location of the existing infiltration gallery, the manhole used for accessing it, and the proposed additions.

Figure 2-23. Rio Pojoaque Irrigation Improvement Project Alternative RP-E



Sources: Reclamation 2014a

2.8 Rio Tesuque Channel Modification Project Alternatives

2.8.1 Alternative RT-A—No Action

Under Alternative RT-A, the Rio Tesuque channel modification project would not be completed. The Pueblo of Tesuque's objectives described in **Section 1.4** would not be realized through this project.

2.8.2 Common Features of the Action Alternatives

Under all action alternatives for the Rio Tesuque channel modification project, Reclamation would help plan and design a project to achieve one or more of the following objectives related to the reach of the Rio Tesuque that flows through the Pueblo of Tesuque:

- Protect and preserve critical wetlands and springs
- Restore the natural characteristics of the river, including meanders, native vegetation, and a connected floodplain
- Improve infrastructure used to store water for agriculture, wildlife, and cultural purposes

Additional objectives for the project are as follows:

- Avoid adverse impacts on previous habitat restoration completed by the Pueblo
- Maximize use of natural materials, versus human-made materials, to achieve project goals

- Provide opportunities for Tribal members and students to help construct the project and learn about habitat and stream restoration

These are all objectives of the Pueblo; however, due to limited funding, they cannot all be implemented at the same time. Therefore, the Pueblo is evaluating which project to select and implement under this EIS, using available funding.

CWA Sections 404/401 permits would be required for all action alternatives.

2.8.3 Summary Comparison of Action Alternatives

Figure 2-24, Comparison of Rio Tesuque Channel Modification Project Alternatives, depicts the general project area for this project under each action alternative. **Table 2-33**, Summary Comparison of Rio Tesuque Channel Modification Project Action Alternatives, summarizes each action alternative. **Table 2-34**, Rio Tesuque Channel Modification Project Surface Disturbance, compares estimated disturbance associated with each alternative. All alternatives represent appraisal-level design.

2.8.4 Alternative RT-B

Under Alternative RT-B, the Rio Tesuque channel modification project would restore the existing incised channel between the Upper Ponds Diversion Dam and the U.S. Highway 84/285 Bridge. This restoration would aim to reconnect the channel with its floodplain, allowing high flows during spring runoff or monsoon season to spill over the channel banks and into the floodplain.

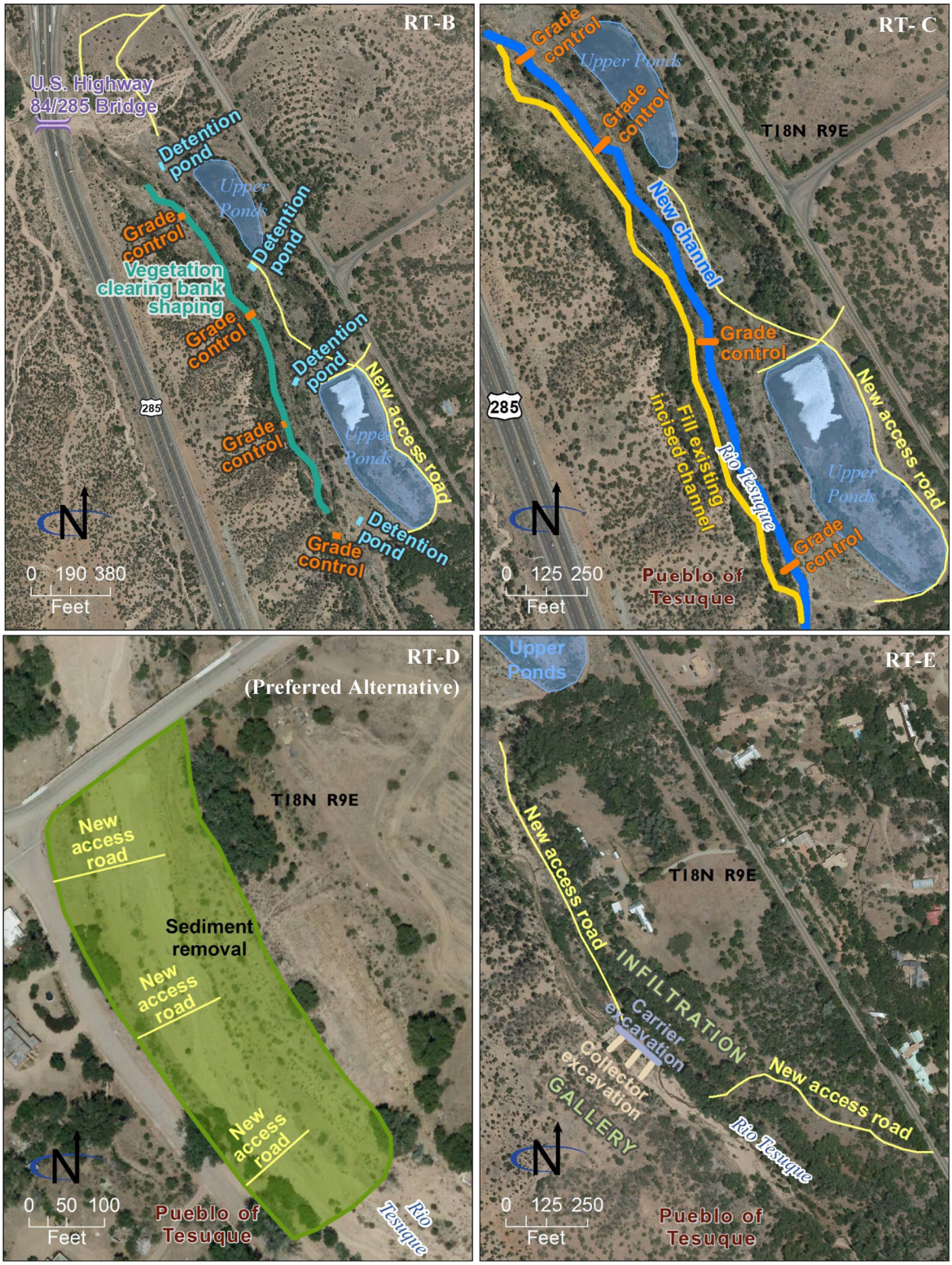
Specific objectives of this project are as follows:

- Restoring natural geomorphic processes to the incised sub-reach of the Rio Tesuque
- Accelerating the natural channel evolution process to allow the channel to reach a more stable and ecologically desirable form
- Improving connection between the river and floodplain
- Reducing main channel velocity and shear stress during high flow events
- Maintaining or reducing risk of damage to adjacent irrigation ponds, either by overtopping or lateral erosion

This alternative would involve clearing vegetation, destabilizing and excavating the bank, raising the main channel bed elevation, and installing grade control features and detention ponds.

Figure 2-25, Rio Tesuque Channel Modification Project Alternative RT-B, shows the planned location of each of these activities or features. The channel widening process will begin with vegetation clearing, bank destabilization, and excavation along the channel margins. Approximately 2 acres of vegetation would be cleared, and 4,600 cubic yards of material would be excavated from the channel margins. Staging areas for construction would also be used. Construction would be completed during periods of little to no flow on the Rio Tesuque.

Figure 2-24
Comparison of Rio Tesuque Channel Modification Project Alternatives



Source: Reclamation 2016b

Table 2-33. Summary Comparison of Rio Tesuque Channel Modification Project Action Alternatives

Alternative RT-B	Alternative RT-C	Alternative RT-D (Preferred Alternative)	Alternative RT-E
Restore existing incised channel	Relocate channel	Remove sediment	Infiltration gallery

Table 2-34. Rio Tesuque Channel Modification Project Surface Disturbance

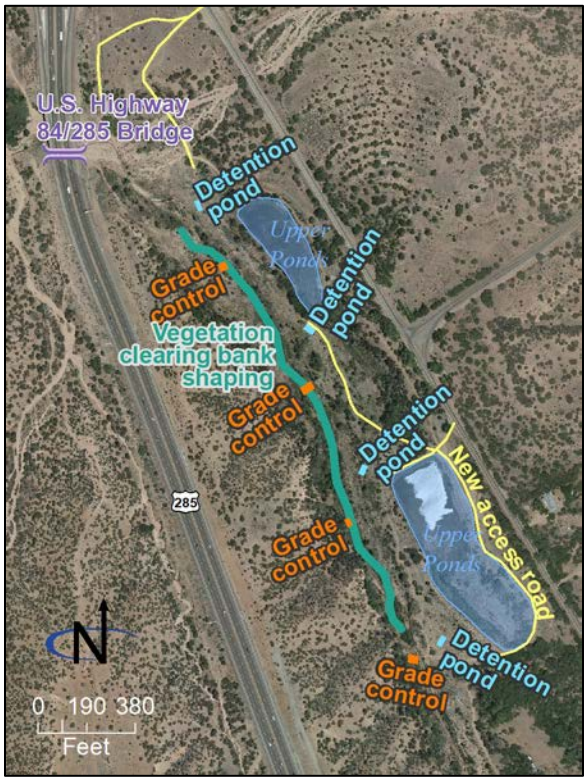
	Alternative RT-B		Alternative RT-C		Alternative RT-D (Preferred Alternative)		Alternative RT-E	
Disturbance (feet)	**Short-Term**	**Long-Term**	**Short-Term**	**Long-Term**	**Short-Term**	**Long-Term**	**Short-Term**	**Long-Term**
Vegetation clearing and bank shaping	1,850	1,850	0	0	0	0	0	0
Detention ponds	100	100	0	0	0	0	0	0
Grade control	150	150	190	190	0	0	0	0
New channel	0	0	2,190	2,190	0	0	0	0
Fill existing incised channel	0	0	2,110	2,110	0	0	0	0
Sediment removal	0	0	0	0	620	620	0	0
Carrier excavation (part of infiltration gallery)	0	0	0	0	0	0	160	160
Collector excavation (part of infiltration gallery)	0	0	0	0	0	0	200	200
Access roads	3,580	3,580	3,580	3,580	380	380	1,710	1,710
Disturbance (acres)	**Short-Term**	**Long-Term**	**Short-Term**	**Long-Term**	**Short-Term**	**Long-Term**	**Short-Term**	**Long-Term**
Vegetation clearing and bank shaping	2	<1	0	0	0	0	0	0
Detention ponds	<1	<1	0	0	0	0	0	0
Grade control	<1	<1	<1	<1	0	0	0	0
New channel	0	0	3	1	0	0	0	0
Fill existing incised channel	0	0	2	1	0	0	0	0

Table 2-34. Rio Tesuque Channel Modification Project Surface Disturbance (cont.)

	Alternative RT-B		Alternative RT-C		Alternative RT-D		Alternative RT-E	
Disturbance (acres)	**Short-Term**	**Long-Term**	**Short-Term**	**Long-Term**	**Short-Term**	**Long-Term**	**Short-Term**	**Long-Term**
Sediment removal	0	0	0	0	3	0	0	0
Carrier excavation (part of infiltration gallery)	0	0	0	0	0	0	<1	<1
Collector excavation (part of infiltration gallery)	0	0	0	0	0	0	<1	<1
Access roads	9	2	8	2	1	<1	4	1
Total Acres	**11**	**3**	**13**	**4**	**4**	**<1**	**5**	**1**

Source: Reclamation GIS 2017
[1] All acreages and mileages are preliminary estimates and will change before final design is complete.
[2] The total short- and long-term disturbance estimated acreages are calculated without any overlapping areas. Estimated disturbance acreages for each element, such as access roads and detention ponds, may overlap each other; therefore, the total disturbance estimates for each element cannot be added together to generate the total estimated disturbance for each alternative.

Figure 2-25. Rio Tesuque Channel Modification Project Alternative RT-B



Source: Reclamation 2016a

Raising the main channel bed elevation would rehabilitate the channel to a form that resembles its pre-incision state. The raised bed elevation would complement the flatter bank slopes to restore connection to the floodplain.

Partially filling the main channel would also provide a means to dispose of some of the sand and gravel excavated from the channel bank. Approximately 800 cubic yards of the excavated sand and gravel would be deposited in the channel bed. It would be an average of 2 feet high and would be compacted in order to reduce the risk of bed erosion.

The average minimum bank height in the channel would be reduced from about 5 feet to about 3 feet. The remaining excavated sand and gravel would be hauled approximately 0.5 mile to a stockpiling site. This material could be used to strengthen or raise the irrigation storage pond embankments, for other maintenance needs on the Pueblo of Tesuque, or for RWS construction.

A series of four grade control structures would stabilize the new channel bed elevation. There are several options for grade control, such as sheet pile, concrete, gabion baskets, loose riprap, and others. Each grade control structure would stretch approximately 20 to 22 feet across the channel. At this length, the structure would extend 5 feet into each bank to protect against flanking.

Approximately four excavated detention ponds would provide a temporary storage area for flood flows. Depending on the depth to groundwater and the excavation depth of the detention ponds, water from the detention ponds may filter into the groundwater aquifer. Native vegetation may be planted along the banks and potentially on the bottom of the detention ponds. The detention ponds would disturb approximately 1 acre in the short term and approximately 1 acre in the long term.

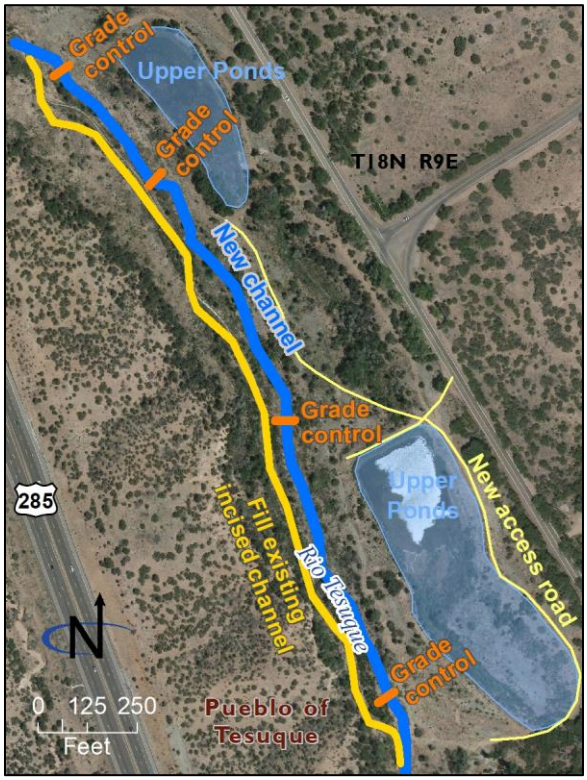
2.8.5 Alternative RT-C

The Rio Tesuque channel modification project under Alternative RT-C would be similar to that under Alternative RT-B and would be constructed along the same sub-reach discussed under that alternative. The major difference under Alternative RT-C is that, rather than encouraging the channel to follow the channel evolution model processes, a new channel would be excavated in the floodplain, to the east of the current channel alignment. This alternative is still intended to restore natural geomorphic processes, improve floodplain connection, reduce main channel velocities during high flow events, and reduce the risk of damage to the irrigation ponds.

This alternative would involve excavating a new channel, partially filling the existing channel, and controlling the grade in the new channel. **Figure 2-26**, below, shows the planned location of each of these activities or features.

This project would restore what the original non-incised channel may have looked like. The new channel would have the following general characteristics: 25-foot bankfull width; 2.5-foot bankfull depth; and 10-foot bottom width. These dimensions would vary, based on natural topography. The new channel would have more meander bends than the existing channel, but the sinuosity would still be very low. Construction would occur during periods of little to- no flow in the Rio Tesuque. Approximately 2 acres of vegetation would be cleared from the site for the new channel. Staging areas for construction equipment would also be used.

Figure 2-26. Rio Tesuque Channel Modification Project Alternative RT-C



Source: Reclamation 2016a

Approximately 5,300 cubic yards of sand and gravel would be excavated from the new channel site; approximately 3,000 cubic yards of this material would be compacted and placed in the existing channel. The existing channel would not be entirely filled, so it could act as a high-flow side channel.

The excess sand and gravel not placed in the channel would be hauled approximately 0.5 mile to a stockpiling site. This material could be used to strengthen or raise the irrigation storage pond embankments, for other maintenance needs on the Pueblo of Tesuque, or for RWS construction.

Four grade control structures would be installed in the new channel, in a manner similar to that described under Alternative RT-B. Because the new channel would be slightly wider than the existing channel, the grade control structures may also be wider.

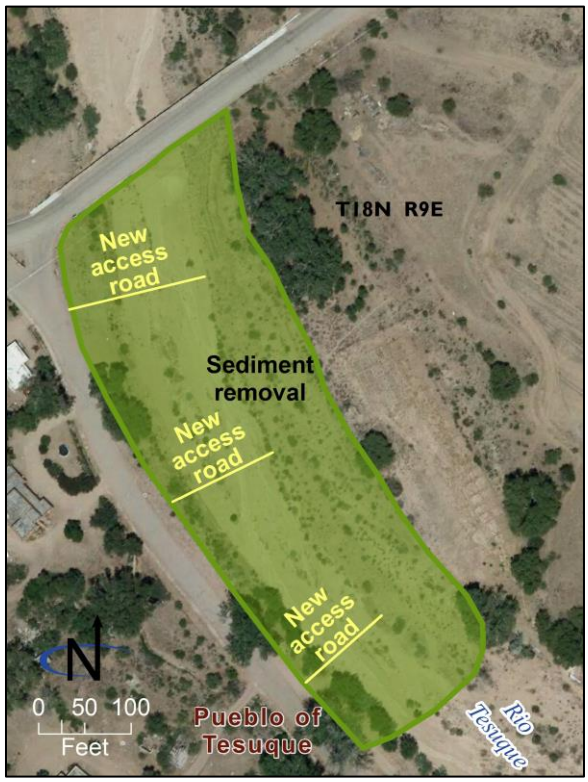
Riprap or bioengineering methods, or both, may be necessary at the upstream location where the existing channel is blocked. These measures may also be necessary at all locations where meanders in the new channel cross the old channel. This would be done to help ensure that the river does not abandon the newly excavated channel and return to the old channel. The new channel would be revegetated with native vegetation.

2.8.6 Alternative RT-D (Preferred Alternative)

Under Alternative RT-D, the Rio Tesuque channel modification project would remove deposited sediment from the east side of the Rio Tesuque, just upstream of the TP-806 Bridge. The goal of this alternative would be to increase the capacity of the river to carry

water and sediment past this bridge during a high flow event. **Figure 2-27**, below, shows the location of the sediment in relation to the Rio Tesuque and the TP-806 Bridge.

Figure 2-27. Rio Tesuque Channel Modification Project Alternative RT-D (Preferred Alternative)



Source: Reclamation 2016a

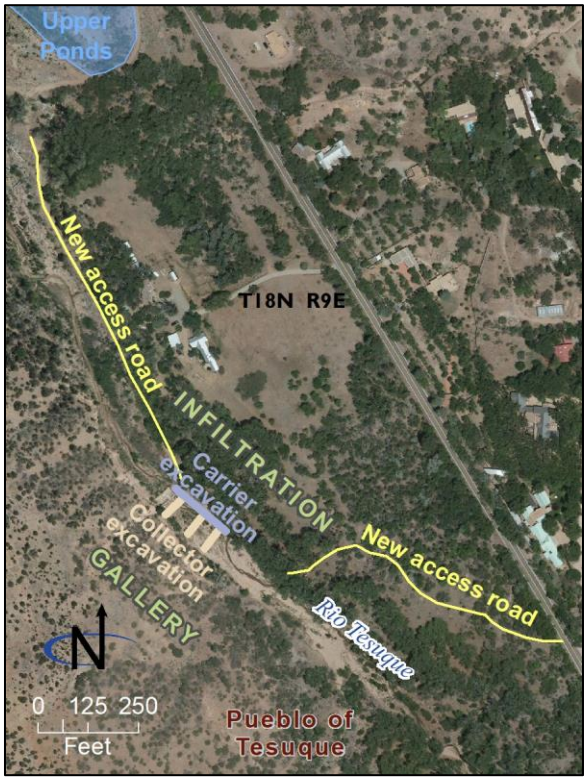
Approximately 1,320 cubic yards of material would be excavated from the project area and hauled to a nearby stockpiling site. If the Pueblo has use for this material, or it is suitable for use as backfill material for RWS construction, the haul distance is estimated to be no more than 3.5 miles. Excavation would be completed during periods of little to no flow on the Rio Tesuque.

2.8.7 Alternative RT-E

Under Alternative RT-E, the Rio Tesuque channel modification project would construct an infiltration gallery upstream of the Upper Ponds Diversion Dam to collect water from the Rio Tesuque and transmit the water to the Pueblo of Tesuque irrigation system. The goals of this alternative would be to allow for low-flow collection so that water can be collected over an extended period of time and to minimize sediment delivery to the Pueblo of Tesuque irrigation ponds.

This alternative would involve excavating and installing a main carrier pipe running longitudinally to the river, three perforated collector pipes running perpendicular (laterally) to the river, and a gravel filter layer surrounding all pipes. **Figure 2-28**, below, shows the planned location of each of these activities or features. Staging areas for construction would also be used.

Figure 2-28. Rio Tesuque Channel Modification Project Alternative RT-E



Source: Reclamation 2016a

Approximately 2,700 cubic yards of material would be excavated for installing the pipes. The excavated material could be used to strengthen or raise the storage pond embankments, for other maintenance needs on the Pueblo, or for RWS construction. The excavation site would be next to the irrigation ponds, so haul distances would be minimal. If the Pueblo can use this material elsewhere, or if it is suitable for backfill material for RWS construction, the haul distance is estimated to be no more than 3.5 miles.

Construction would be completed during periods of little to no flow in the Rio Tesuque. However, the excavation site would need to be dewatered, using four pumps at the edges of the excavation footprint. A coffer dam in the Rio Tesuque would not be required to dewater the site.

The carrier pipe would be designed to deliver up to 6 cfs to the existing Pueblo irrigation infrastructure, with each collector pipe contributing 2 cfs to the carrier pipe. The main carrier pipe would be approximately 240 feet long and would connect into an existing intake well that takes water from the Upper Ponds Diversion Dam and delivers water to the most upstream Pueblo irrigation pond. Each collector pipe would be approximately 95 feet long.

A gravel filter layer would be placed approximately 6 inches below and 12 inches above the pipe to minimize sediment entering the collector pipes and for protection from erosion during high flows. Trenches for pipe installation would be approximately 5.5 feet deep, with a bottom width of 3 feet for the main carrier pipe and 1 foot for the collector pipe trenches. The excavation site would be revegetated with native vegetation.

2.9 Pueblo de San Ildefonso Future Projects Alternatives

2.9.1 Alternative SI-A—No Action

Under Alternative SI-A, No Action, Pueblo de San Ildefonso would not implement wastewater system improvements or expand their water infrastructure. The existing wastewater system and service area would remain the same. Maintenance of the aging infrastructure would continue on an as-needed basis. Residents outside the current service area would remain on septic systems. The Pueblo would not develop future water infrastructure to provide water to new service areas.

2.9.2 Alternative SI-B—Proposed Wastewater and Water Infrastructure

2.9.2.1 Wastewater System Improvements

In accordance with Section 615(d)(7)(A)(ii) of the Settlement Act, the Pueblo de San Ildefonso is considering constructing certain water-related infrastructure improvements, including wastewater system improvements. These could be more cost effective when implemented in conjunction with RWS construction.

There are approximately 905 Tribal-member and nontribal-member homes within the boundary of Pueblo de San Ildefonso. Of these, about 200 homes in the northeastern, northwestern, and central portions of the Pueblo, along with a small day school facility, community center, police station, health center, and two Tribal administrative buildings, are served by three existing wastewater systems.

The Pueblo has a need to upgrade and expand their wastewater system to address the following issues: (1) *Health, sanitation, and security.* Most homes within the Pueblo boundaries use septic systems. Septic tanks discharge an effluent that is rich in nitrogen-based compounds and other contaminants into the ground, which could eventually reach the water supply aquifer. Although water quality analyses of the municipal supply wells have not shown an increase in contaminants, the wells are located downgradient of the primary discharge sources. (2) *Aging infrastructure.* Most of the existing infrastructure is between 29 to 50 years old. As the system exceeds its lifecycle, facilities will fail more frequently and require more maintenance. (3) *Reasonable growth.* Demand on the system is projected to increase from system expansion and infill within the Pueblo boundaries.

The purpose of the project is to connect the system to additional homes in the Pueblo de San Ildefonso and El Rancho area, where physically feasible, and eliminate the use of lagoons and septic systems as a primary means of wastewater treatment.

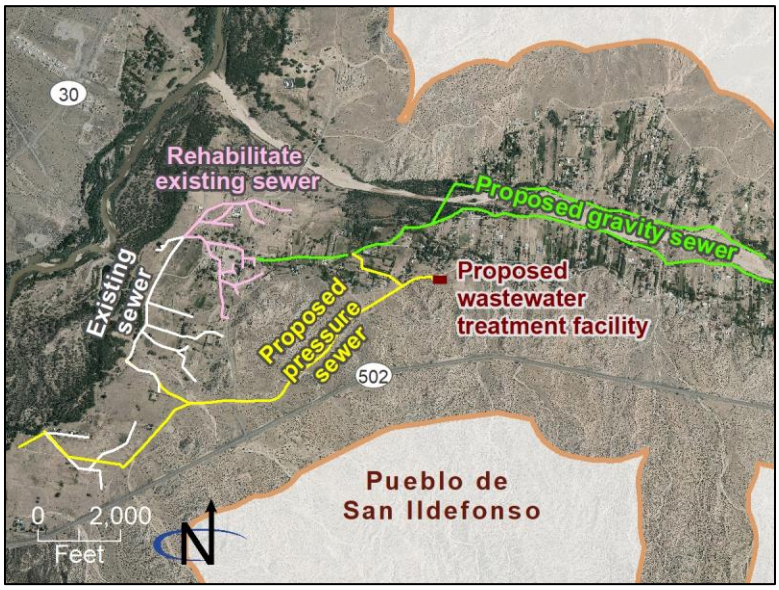
The Pueblo de San Ildefonso is proposing to upgrade the existing system and expand the collection system to homes that are currently not served with community sewer.

The Center/South service area would be combined with the El Rancho Service area. Center/South would be expanded to include approximately 40 homes to the south. In addition to installing new sewer pipes, the Pueblo would rehabilitate or replace old clay pipes by pipe bursting and slip lining. All sewer pipes would flow to a new membrane

bio-reactor treatment plant located at the west end of El Rancho. The membrane bio-reactor treatment system is an advanced activated sludge process that can produce high quality effluent that can be reclaimed or surface-discharged.

The treatment plant site would cover approximately 2 acres and would include a driveway, parking lot, site piping, treatment building, and direct injection wells. The treatment building would be approximately 90 feet long and 87 feet wide. Direct injection wells would dispose of treated wastewater by injecting it into the water table, under a permit issued in compliance with the Safe Drinking Water Act's Underground Injection Control program. The treatment plant building would completely contain any odor resulting from the treatment process. The preliminary wastewater system design is shown below in **Figure 2-29**. **Table 2-35**, Center/South Sewer Pipes, shows the estimated miles of sewer pipes that would be part of the wastewater system. The Pueblo would obtain the necessary permits under the CWA and the Safe Drinking Water Act. (This wastewater system is analyzed in this EIS as a connected action, but it would not be constructed by Reclamation.)

Figure 2-29. Preliminary Wastewater System Design



Source: Souder, Miller & Associates GIS 2017

Table 2-35. Center/South Sewer Pipes

Facility Type	Miles
Proposed pressure sewer pipes	3.0
Proposed gravity sewer pipes	4.2
Rehabilitated existing sewer pipes	2.2
Existing sewer lines	3.1
Total	**13**

Source: Souder, Miller & Associates GIS 2017

Proposed sewer pipes and facilities would be located on previously disturbed roads and lands, as much as possible. Construction of new sewer pipes and rehabilitation of existing pipes would disturb approximately 59 acres in the short term. Roads would either be repaved, in accordance with BIA standards, or returned to pre-construction condition. There would be no long-term disturbance from sewer pipes. New access roads may be required, and the existing electrical distribution lines may be extended.

The system would also require security fencing, lighting, site surface drainage, and erosion features. Wastewater biosolids would be transferred to a municipal wastewater treatment facility or to an approved landfill for disposal.

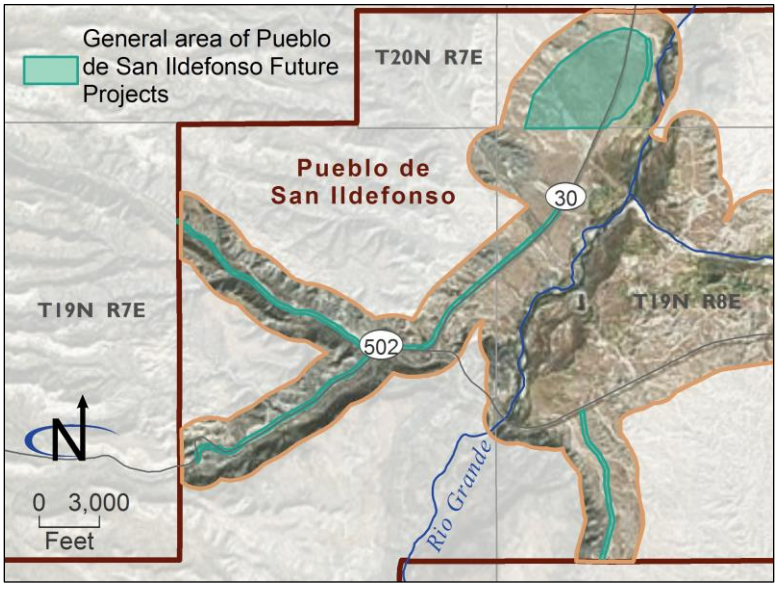
2.9.2.2 Other Water-related Infrastructure

In addition to, and separate from, the wastewater system improvements, the Pueblo de San Ildefonso is considering additional water-related infrastructure in a 680-acre area, near the Pueblo's northern boundary, along with three potential new pipeline alignments. One alignment would extend from the western edge of the RWS general project area, along SH 30 and SH 502 to the western boundary of the Pueblo de San Ildefonso; another would extend from the RWS general project area south, from SH 502 to the southern boundary of the Pueblo de San Ildefonso.

The third alignment would extend from SH 30 northwesterly, up Guaje Canyon. **Figure 2-30**, below, shows the general location of the infrastructure improvements being considered.

This EIS includes a general analysis of cultural and biological resources in the 680-acre area; however, it does not include a detailed analysis of impacts of a specific proposed project in this area. Additional environmental analysis may be conducted by the Pueblo before a specific project is constructed in this area.

Figure 2-30. Pueblo de San Ildefonso Future Projects Area



Source: Reclamation GIS 2017

2.10 Summary Comparison of Impacts

Table 2-36, below, briefly describes the impacts on resources and resource uses under each alternative, including the No Action Alternative, for the proposed RWS, Rio Pojoaque irrigation improvement project (Rio Pojoaque in the table headings), and Rio Tesuque channel modification project (Rio Tesuque in the table headings). **Table 2-37**, Summary Comparison of Impacts for the Pueblo de San Ildefonso Future Projects Alternatives, briefly describes the impacts on resources and resource uses under those alternatives. For detailed analysis of the impacts of each project under each alternative, see **Chapter 4**, Environmental Consequences.

Table 2-36. Summary Comparison of Impacts by Project

Resource Topic	Alternative A (No Action)	Alternative B	Alternative C	Alternative D	Alternative E
Surface Water	RWS: May impact surface water levels due to continued groundwater pumping Rio Pojoaque: None Rio Tesuque: None	RWS: No measurable impacts annually—existing water rights would provide RWS supply Rio Pojoaque: Minor—project would improve irrigation efficiency, induce river seepage, and reduce downstream flows and erosion Rio Tesuque: Channel velocities and stresses would be reduced; overbank retention storage would increase seepage	RWS: Same as Alternative B Rio Pojoaque: Minor—project would improve irrigation efficiency and decrease river seepage Rio Tesuque: Channel velocities and stresses would be reduced at a smaller scale	RWS: Same as Alternative B Rio Pojoaque: Minor—project would improve irrigation efficiency and capture existing river seepage Rio Tesuque: Some reduction in channel water surface elevations during infrequent floods	RWS: Same as Alternative B Rio Pojoaque: Same as Alternative D Rio Tesuque: Irrigation diversions would occur over a longer period but at a reduced rate
Groundwater	RWS: Groundwater use would increase, affecting depths to groundwater and surface flows Rio Pojoaque: None Rio Tesuque: None	RWS: Impacts on Groundwater would decrease with declines in pumping Rio Pojoaque: Minor possible changes due to increased river seepage Rio Tesuque: May influence groundwater table; no large influence on deeper aquifer	RWS: Operation of subsurface collection could locally change groundwater levels Rio Pojoaque: Same as Alternative B Rio Tesuque: May alter gradient between surface water and depth to groundwater; no large influence on deeper aquifer	RWS: Same as Alternative C Rio Pojoaque: Same as Alternative B Rio Tesuque: No influence on deeper aquifer	RWS: Same as Alternative C Rio Pojoaque: Same as Alternative B Rio Tesuque: Increased extraction of water for irrigation; no influence on deeper aquifer

Table 2-36. Summary Comparison of Impacts by Project (cont.)

Resource Topic	Alternative A (No Action)	Alternative B	Alternative C	Alternative D	Alternative E
Water Quality	RWS: Continued increases in groundwater use could lead to reduced baseflows affecting surface water quality Rio Pojoaque: None Rio Tesuque: None	RWS: Changes in surface water quality may improve with increased baseflows generated by reduced groundwater use; some localized increased sedimentation may occur; drinking water quality would improve Rio Pojoaque: Minor short- and long-term impacts would occur Rio Tesuque: Minor short-term impacts would occur during construction	RWS: Changes in surface water quality may improve with increased baseflows generated by reduced groundwater use; drinking water quality would improve Rio Pojoaque: Minor short-term impacts would occur during construction Rio Tesuque: Same as Alternative B	RWS: Same as Alternative C Rio Pojoaque: Same as Alternative C Rio Tesuque: Same as Alternative B	RWS: Same as Alternative C Rio Pojoaque: Same as Alternative C Rio Tesuque: Same as Alternative B
Geology and Soils	RWS: None Rio Pojoaque: None Rio Tesuque: None	RWS: Short-and long-term impacts on sensitive and corrosive soils would occur; potential for geologic hazards associated with deep injection ASR wells Rio Pojoaque: Minimal short- and long-term impacts would occur Rio Tesuque: Minimal short- and long-term impacts would occur	RWS: Short-and long-term impacts on sensitive and corrosive soils would occur Rio Pojoaque: Similar to Alternative B Rio Tesuque: Moderate short- and long-term impacts would occur	RWS: Similar to Alternative C Rio Pojoaque: Similar to Alternative B Rio Tesuque: Similar to Alternative B	RWS: Similar to Alternative C Rio Pojoaque: Similar to Alternative B Rio Tesuque: Similar to Alternative B

Table 2-36. Summary Comparison of Impacts by Project (cont.)

Resource Topic	Alternative A (No Action)	Alternative B	Alternative C	Alternative D	Alternative E
Paleontological Resources	RWS: None Rio Pojoaque: None Rio Tesuque: None	RWS: Long-term impacts on Potential Fossil Yield Classification (PFYC) Class 4 units would occur; paleontological resources may or may not be affected Rio Pojoaque: None Rio Tesuque: None	RWS: Similar to Alternative B Rio Pojoaque: None Rio Tesuque: None	RWS: Similar to Alternative B Rio Pojoaque: None Rio Tesuque: None	RWS: Similar to Alternative B Rio Pojoaque: None Rio Tesuque: None
Air Quality	RWS: Impacts on air quality would continue from the emissions from groundwater pumps and drilling rigs Rio Pojoaque: None Rio Tesuque: None	RWS: Minimal short- and long-term impacts would occur Rio Pojoaque: Minimal short-term impacts would occur Rio Tesuque: Minimal short-term impacts would occur	RWS: Same as Alternative B Rio Pojoaque: Same as Alternative B Rio Tesuque: Same as Alternative B	RWS: Same as Alternative B Rio Pojoaque: Same as Alternative B Rio Tesuque: Same as Alternative B	RWS: Same as Alternative B Rio Pojoaque: Same as Alternative B Rio Tesuque: Same as Alternative B
Climate Change	RWS: Minimal greenhouse gas (GHG) emissions would continue from the operation of individual well pumps; residents may experience greater periods of water stress under	RWS: Minimal short- and long-term impacts would occur due to increased GHG emissions generated during construction; operations should have a more limited impact on GHG emissions; project may provide greater reliability during periods of water stress under future climate change	RWS: Same as Alternative B Rio Pojoaque: Same as Alternative B Rio Tesuque: Same as Alternative B	RWS: Same as Alternative B Rio Pojoaque: Same as Alternative B Rio Tesuque: Same as Alternative B	RWS: Same as Alternative B Rio Pojoaque: Same as Alternative B Rio Tesuque: Same as Alternative B

Table 2-36. Summary Comparison of Impacts by Project (cont.)

Resource Topic	Alternative A (No Action)	Alternative B	Alternative C	Alternative D	Alternative E
	future climate change Rio Pojoaque: Performance of the existing barrier dam and irrigation infrastructure may be reduced if there are reductions in future river flows Rio Tesuque: The Rio Tesuque may be influenced by potential encroaching riparian vegetation if river flows are reduced in the future	Rio Pojoaque: Minimal short-term impacts would occur due to increased GHG emissions associated with construction; increased efficiency in diverting irrigation water would be offset if there were reductions in future river flows Rio Tesuque: Minimal short-term impacts would occur due to increased GHG emissions associated with construction; potential future flooding impacts would be reduced			
Vegetation	RWS: Increases in groundwater pumping could decrease water supplies available for vegetation Rio Pojoaque: None Rio Tesuque: None	RWS: Short- and long-term impacts on vegetation and native habitat would occur Impacts on mature cottonwoods would be measured at a rate of 10 young trees for every healthy, mature tree and five young trees for every young or diseased cottonwood removed Rio Pojoaque: Minimal impacts	RWS: Similar to Alternative B Rio Pojoaque: Similar to Alternative B Rio Tesuque: Similar to Alternative B	RWS: Similar to Alternative B Rio Pojoaque: None Rio Tesuque: Minimal impacts on vegetation would occur	RWS: Similar to Alternative B Rio Pojoaque: Similar to Alternative B Rio Tesuque: Similar to Alternative B

Table 2-36. Summary Comparison of Impacts by Project (cont.)

Resource Topic	Alternative A (No Action)	Alternative B	Alternative C	Alternative D	Alternative E
		on vegetation would occur Rio Tesuque: Impacts on vegetation would occur			
Wetlands, Non-wetland Waters, and Floodplains	RWS: Increases in groundwater pumping could decrease the nature and extent of wetlands and non-wetland waters; no impacts on floodplains Rio Pojoaque: None Rio Tesuque: None	RWS: Short- and long-term impacts on wetlands, non-wetland waters, and floodplains would occur Rio Pojoaque: No impacts on wetlands; short- and long-term impacts on non-wetland waters; minimal impacts on floodplains Rio Tesuque: Short-and long-term impacts on wetlands, non-wetland waters, and floodplains would occur	RWS: Similar to Alternative B Rio Pojoaque: None Rio Tesuque: Similar to Alternative B	RWS: Similar to Alternative B Rio Pojoaque: None Rio Tesuque: No impacts on wetlands; minor impacts on floodplains would occur	RWS: Similar to Alternative B Rio Pojoaque: None Rio Tesuque: None
Wildlife	RWS: Increases in groundwater pumping could decrease supplies available for wildlife Rio Pojoaque: None Rio Tesuque: None	RWS: Short-term impacts on wildlife and their habitat would occur during construction; permanent facilities and operations would have minimal long-term impacts Rio Pojoaque: Minimal short-term impacts Rio Tesuque: Minimal short-term impacts	RWS: Similar to Alternative B Rio Pojoaque: Similar to Alternative B Rio Tesuque: Similar to Alternative B	RWS: Similar to Alternative B Rio Pojoaque: None Rio Tesuque: Similar to Alternative B	RWS: Similar to Alternative B Rio Pojoaque: Similar to Alternative B Rio Tesuque: Similar to Alternative B

Table 2-36. Summary Comparison of Impacts by Project (cont.)

Resource Topic	Alternative A (No Action)	Alternative B	Alternative C	Alternative D	Alternative E
Aquatic Resources	RWS: Increases in groundwater pumping could decrease supplies available for aquatic resources Rio Pojoaque: None Rio Tesuque: None	RWS: Minor short-term impacts during construction would occur; limited long-term impacts on a small amount of bed and bank habitat; weak and juvenile fish, and/or drifting life stages, including larval fish, may be entrained near the intake structures; no net depletion of annual flows downstream Rio Pojoaque: Minimal short-term impacts possible Rio Tesuque: Minimal short-term impacts possible	RWS: Minimal short-term impacts during construction; no net depletion of annual flows downstream Rio Pojoaque: None Rio Tesuque: Same as Alternative B	RWS: Similar to Alternative C Rio Pojoaque: None Rio Tesuque: Similar to Alternative B	RWS: Similar to Alternative C Rio Pojoaque: None Rio Tesuque: Similar to Alternative B

Table 2-36. Summary Comparison of Impacts by Project (cont.)

Resource Topic	Alternative A (No Action)	Alternative B	Alternative C	Alternative D	Alternative E
Federally Listed Threatened and Endangered (T&E) Species	RWS: Increases in groundwater pumping could decrease water supplies available for T&E species Rio Pojoaque: None Rio Tesuque: None	RWS: Minimal short-term indirect impacts could occur on avian T&E species; no impacts on New Mexico meadow jumping mouse (jumping mouse) or on the Rio Grande silvery minnow would occur Rio Pojoaque: Minimal short-term indirect impacts could occur on avian T&E species; no impacts on the New Mexico meadow jumping mouse or on the Rio Grande silvery minnow would occur Rio Tesuque: Minimal short-term indirect impacts could occur on avian T&E species; no impacts on the jumping mouse or on the Rio Grande silvery minnow would occur	RWS: Same as Alternative B Rio Pojoaque: Same as Alternative B Rio Tesuque: Same as Alternative B	RWS: Same as Alternative B Rio Pojoaque: Same as Alternative B Rio Tesuque: Same as Alternative B	RWS: Same as Alternative B Rio Pojoaque: Same as Alternative B Rio Tesuque: Same as Alternative B

Table 2-36. Summary Comparison of Impacts by Project (cont.)

Resource Topic	Alternative A (No Action)	Alternative B	Alternative C	Alternative D	Alternative E
Cultural Resources	RWS: None Rio Pojoaque: None Rio Tesuque: None	RWS: Impacts would occur on historic properties, including archaeological sites, historic buildings, and historic structures Rio Pojoaque: None Rio Tesuque: None	RWS: Same as Alternative B Rio Pojoaque: One historic acequia would be temporarily affected if water is conveyed through the Acequia de Los Indios Rio Tesuque: None	RWS: Same as Alternative B Rio Pojoaque: None Rio Tesuque: Minor possibility for impacts	RWS: Same as Alternative B Rio Pojoaque: Similar to Alternative C Rio Tesuque: None
Indian Trust Assets (ITAs)	RWS: None Rio Pojoaque: None Rio Tesuque: None	RWS: No net loss, damage, depletion, or waste of assets, property, or property rights Rio Pojoaque: No net loss, damage, depletion, or waste of assets, property, or property rights Rio Tesuque: No net loss, damage, depletion, or waste of assets, property, or property rights	RWS: Same as Alternative B Rio Pojoaque: Same as Alternative B Rio Tesuque: Same as Alternative B	RWS: Same as Alternative B Rio Pojoaque: Same as Alternative B Rio Tesuque: Same as Alternative B	RWS: Same as Alternative B Rio Pojoaque: Same as Alternative B Rio Tesuque: Same as Alternative B

Table 2-36. Summary Comparison of Impacts by Project (cont.)

Resource Topic	Alternative A (No Action)	Alternative B	Alternative C	Alternative D	Alternative E
Land Use	RWS: None Rio Pojoaque: None Rio Tesuque: None	RWS: Short- and long-term impacts would occur with the construction of permanent facilities; no long-term conflict with private property is anticipated Rio Pojoaque: None Rio Tesuque: None	RWS: Similar to Alternative B Rio Pojoaque: Short- and long-term impacts would occur by preventing trespass road use Rio Tesuque: None	RWS: Similar to Alternative B Rio Pojoaque: None Rio Tesuque: None	RWS: Similar to Alternative B Rio Pojoaque: None Rio Tesuque: None
Visual Resources	RWS: None Rio Pojoaque: None Rio Tesuque: None	RWS: Short- and long-term impacts would occur Rio Pojoaque: Short-term impacts would occur Rio Tesuque: Short-term impacts would occur	RWS: Similar to Alternative B Rio Pojoaque: Similar to Alternative B Rio Tesuque: Similar to Alternative B	RWS: Similar to Alternative B Rio Pojoaque: Similar to Alternative B Rio Tesuque: Similar to Alternative B	RWS: Similar to Alternative B Rio Pojoaque: Similar to Alternative B Rio Tesuque: Similar to Alternative B

Table 2-36. Summary Comparison of Impacts by Project (cont.)

Resource Topic	Alternative A (No Action)	Alternative B	Alternative C	Alternative D	Alternative E
Traffic	RWS: None Rio Pojoaque: None Rio Tesuque: None	RWS: Short-term impacts on traffic and access would occur during construction Rio Pojoaque: Minimal short-term impacts would occur during construction Rio Tesuque: Minimal short-term impacts would occur during construction	RWS: Similar to Alternative B Rio Pojoaque: Short- and long-term impacts would occur by preventing trespass road use and changing traffic patterns Rio Tesuque: Similar to Alternative B	RWS: Similar to Alternative B Rio Pojoaque: Similar to Alternative B Rio Tesuque: Similar to Alternative B	RWS: Similar to Alternative B Rio Pojoaque: Similar to Alternative B Rio Tesuque: Similar to Alternative B
Noise	RWS: None Rio Pojoaque: None Rio Tesuque: None	RWS: Short-term impacts would occur during construction; minor impacts from motor vehicle noise would occur during operations and maintenance Rio Pojoaque: Short-term impacts would occur during construction Rio Tesuque: Short-term impacts would occur during construction	RWS: Similar to Alternative B Rio Pojoaque: Similar to Alternative B Rio Tesuque: Similar to Alternative B	RWS: Similar to Alternative B Rio Pojoaque: Similar to Alternative B Rio Tesuque: Similar to Alternative B	RWS: Similar to Alternative B Rio Pojoaque: Similar to Alternative B Rio Tesuque: Similar to Alternative B
Solid and Hazardous Materials	RWS: None Rio Pojoaque: None Rio Tesuque: None	RWS: Minimal, localized short-term impacts could occur during construction; long-term impacts are unlikely to occur Rio Pojoaque: None Rio Tesuque: None	RWS: Similar to Alternative B Rio Pojoaque: None Rio Tesuque: None	RWS: Similar to Alternative B Rio Pojoaque: None Rio Tesuque: None	RWS: Similar to Alternative B Rio Pojoaque: None Rio Tesuque: None

Table 2-36. Summary Comparison of Impacts by Project (cont.)

Resource Topic	Alternative A (No Action)	Alternative B	Alternative C	Alternative D	Alternative E
Socioeconomic Resources	RWS: None Rio Pojoaque: None Rio Tesuque: None	RWS: Short-term impacts would occur during construction affecting quality of life for residents, increased local employment, and increased spending and taxes that could benefit the local economy; long-term impacts could include employment for operations and maintenance personnel and potential increases in property values Rio Pojoaque: Minor short-term impacts would occur during construction Rio Tesuque: Minor short-term impacts would occur during construction	RWS: Similar to Alternative B Rio Pojoaque: Same as Alternative B Rio Tesuque: Same as Alternative B	RWS: Similar to Alternative B Rio Pojoaque: Same as Alternative B Rio Tesuque: Same as Alternative B	RWS: Similar to Alternative B Rio Pojoaque: Same as Alternative B Rio Tesuque: Same as Alternative B
Environmental Justice	RWS: Impaired water quality would continue to impact minority and low-income populations Rio Pojoaque: Limited distribution of irrigation water would continue to	RWS: Short-term impacts would occur during construction affecting the quality of life for minority and low-income residents; also increased access to employment for these same populations. Long-term impacts would include improved water quality and reliability; potential	RWS: Same as Alternative B Rio Pojoaque: Same as Alternative B Rio Tesuque: Same as Alternative B	RWS: Same as Alternative B Rio Pojoaque: Same as Alternative B Rio Tesuque: Same as Alternative B	RWS: Same as Alternative B Rio Pojoaque: Same as Alternative B Rio Tesuque: Same as Alternative B

Table 2-36. Summary Comparison of Impacts by Project (cont.)

Resource Topic	Alternative A (No Action)	Alternative B	Alternative C	Alternative D	Alternative E
	impact Pueblo populations Rio Tesuque: The limited health of the river and the distribution of irrigation water would continue to impact Pueblo populations	increases to the cost of domestic water could impact low-income residents Rio Pojoaque: Minor short-term impacts would occur during construction; in the long term, residents would have greater access to dependable subsistence and commercial agriculture Rio Tesuque: Minor short-term impacts would occur during construction; in the long term, Alternative B would enhance the traditional social setting of the analysis area, supporting traditional cultural practices of the Pueblo population			
Energy and Utilities	RWS: None Rio Pojoaque: None Rio Tesuque: None	RWS: Short- and long-term impacts would occur; no opportunities for renewables Rio Pojoaque: Very limited short-term impacts would occur Rio Tesuque: Very limited short-term impacts would occur	RWS: Similar to Alternative B, but fewer overall impacts. Also, opportunities for renewables Rio Pojoaque: Same as Alternative B Rio Tesuque: Same as Alternative B	RWS: Similar to Alternative C Rio Pojoaque: Same as Alternative B Rio Tesuque: Same as Alternative B	RWS: Similar to Alternative C Rio Pojoaque: Same as Alternative B Rio Tesuque: Same as Alternative B

Table 2-37. Summary Comparison of Impacts for the Pueblo de San Ildefonso Future Projects Alternatives

Resource Topic	No Action Alternative	Proposed Wastewater and Water Infrastructure
Surface Water	None	No measurable impacts. Taking people off of septic systems would decrease groundwater recharge, which could impact surface water flows
Groundwater	None	No measurable impacts. Infiltration of treated water from lagoons could increase groundwater recharge. Removal of septic systems could reduce groundwater recharge.
Water Quality	Potential water quality issues associated with the disposal of wastewater would continue	Limited impacts may occur during construction. Beneficial impacts to groundwater quality from removal of septic systems.
Geology and Soils	None	Short-and long-term impacts on sensitive and corrosive soils would occur.
Paleontological Resources	None	Project area includes PFYC Class 4 units; therefore, potential for long-term impacts if resources cannot be avoided.
Air Quality	None	Minimal short- and long-term impacts would occur.
Climate Change	Continued use of existing infrastructure would be a minimal source of GHG emissions	Minimal short-term impacts would occur due to increased GHG emissions generated during construction; operations would have a more limited impact on GHG emissions.
Vegetation	None	Short- and long-term impacts would occur from vegetation removal and potential for the spread of noxious weeds. Potential short-term disturbance to vegetation communities that may provide special status plant species habitat.
Wetlands, Non-wetland Waters, and Floodplains	None	Short-term impacts on floodplains may occur during construction; no impacts on wetlands.

Table 2-37. Summary Comparison of Impacts for the Pueblo de San Ildefonso Future Projects Alternatives (cont.)

Resource Topic	No Action Alternative	Proposed Wastewater and Water Infrastructure
Wildlife	None	Short-term impacts may occur from removal of habitat and disturbance during construction. Most facilities would be located on already disturbed lands, so no long-term impacts would occur.
Aquatic Resources	None	No impacts would occur.
Federally Listed Threatened and Endangered Species	None	No impacts would occur.
Cultural Resources	None	Impacts would occur on archeological sites and historic properties unless routing can avoid the sites.
ITAs	None	No net loss, damage, depletion, or waste of assets, property, or property rights.
Land Use	None	Proposal is in compliance with land use plans; short-term impacts to access during construction.
Visual Resources	None	Minor short- and long-term impacts would occur.
Traffic	None	Short-term impacts would occur during construction. Minor long-term impacts from transporting bio-solids to an approved landfill.
Noise	None	Short-term impacts would occur during construction.
Solid and Hazardous Materials	None	Minimal, localized short-term impacts could occur during construction.

Table 2-37. Summary Comparison of Impacts for the Pueblo de San Ildefonso Future Projects Alternatives (cont.)

Resource Topic	No Action Alternative	Proposed Wastewater and Water Infrastructure
Socioeconomic Resources	None	Construction would provide short-term economic benefits from employment and increased spending. Minor long-term impact from increased employment at the new treatment plant at El Rancho.
Environmental Justice	None	Project would benefit Tribal members.
Energy and Utilities	None	Minor impacts from increased demand during operations.

2.11 Alternatives Considered but Eliminated from Detailed Study

Federal agencies are required to rigorously explore and objectively evaluate all reasonable alternatives and to discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR, Subpart 1502.14).

Some alternative elements of the proposed RWS and the Rio Pojoaque irrigation improvement project were eliminated from detailed study, because they would not meet the stated purpose of and need for the RWS (see **Section 1.3**, Purpose of and Need for Action), or because they would not be technically, economically, or legally feasible. Alternatives considered but eliminated from detailed study are summarized below.

2.11.1 Horizontal Collection from the West Bank of the Rio Grande

Reclamation considered placing a horizontal radial well collector for the RWS on the west bank of the Rio Grande, but this element was determined to be not technically feasible. The geology on the west bank of the Rio Grande is not suitable for collecting water through a horizontal radial well collector. Therefore, this element was eliminated from further consideration.

2.11.2 Side Channel Surface Diversion on the West Bank of the Rio Grande

In a study on potential intake and water treatment plant locations, Reclamation considered constructing a surface intake on the west bank of the Rio Grande, approximately 0.25 mile north of the Otowi Bridge. However, it would be economically and technically infeasible to transport the water back across the Rio Grande to the RWS service area. Therefore, this element was eliminated from further consideration.

2.11.3 Series of Vertical Wells

For primary source water collection, Reclamation considered drilling and installing approximately 54 vertical wells spread throughout the east riverbank of the Rio Grande, north of Otowi Bridge, on the Pueblo de San Ildefonso. Production from each well was estimated to be 100 gpm.

The number of wells required would vary, depending on data collected from the hydrogeology of the area. Water from each well would be pumped to a clear well. This element would cover a large area of Pueblo de San Ildefonso land and would not be compatible with Pueblo land use planning.

The wells would have significant impacts on the habitat and traditional uses of the bosque by humans and wildlife; thus, they are unacceptable to the Pueblo de San Ildefonso, and this element was eliminated from further consideration.

2.11.4 Pipe from Abiquiu Lake (Value Planning Study)

As an alternative method of primary source water collection, Reclamation considered constructing a 40-mile pipeline from Abiquiu Lake to the project delivery area. Abiquiu Lake has 140,498 af of storage contained within 8.13 square miles. About 20,000 afy are released, and the RWS requires 4,000 afy. Under the Settlement Agreement, 1,079 afy of water is proposed for release through Abiquiu for the RWS.

Because native Rio Grande water rights obtained for the RWS do not flow into Abiquiu Lake, the federal government and Santa Fe County would need to acquire or transfer water rights to the remaining 2,921 afy to points above Abiquiu Lake. Acquiring these water rights may not be possible. The time and capital cost associated with constructing the pipeline and acquiring the land or easements for the pipeline route would be significantly higher than the time and costs of other primary source water collection methods. Additional water rights transfers would be necessary, which could further delay completion of the pipeline.

The pipeline was estimated to be $40 million in capital costs, not including land acquisition costs for the route. This is approximately four times the estimated capital cost of the next most expensive primary source water collection element. Therefore, this element was eliminated from further consideration.

2.11.5 Treated Water Surface Ponds or Reservoir

Reclamation considered storing treated water in surface ponds or a single reservoir as a major secondary supply and collection element. However, this element was found to be too expensive in terms of capital costs. This is because Reclamation would have to purchase land to construct the ponds or reservoir. Reclamation assumed that the reservoir would be approximately 120 acres (similar in size to Nambé Falls Reservoir and Bonito Lake). In addition to land acquisition costs, the cost and engineering challenges of covering a 120-acre reservoir to protect the treated water from contamination make this element infeasible. Therefore, it was eliminated from further consideration.

2.11.6 Raw Water Surface Ponds

Reclamation considered expanding the pond on the Pueblo de San Ildefonso, which is currently used for recreation. With this expansion, the pond would hold approximately 1,200 af of water as a major secondary supply and collection element. However, this expansion would more than double the existing pond's size and would be incompatible with Pueblo de San Ildefonso land use planning. Therefore, this element was eliminated from further consideration.

2.11.7 Nambé Falls Reservoir as a Backup Supply

Reclamation considered acquiring storage rights in Nambé Falls Reservoir as a major secondary supply and collection element for the RWS. However, there are no unallocated storage rights in the reservoir at this time, and the full authorized amount of water from the reservoir is already being used. Reclamation would have to negotiate water leases with the Pojoaque Valley Irrigation District, the Pueblo of Nambé, the Pueblo of Pojoaque, and the Pueblo de San Ildefonso.

Additionally, this element could not be completed in a timely manner. This is because Congress would have to authorize a change of purpose and use of Nambé Falls Reservoir. Cost allocations for the RWS would also need to be adjusted, and Congress would need to authorize and fund additional studies, which then would have to be completed. This element would require agreement from the Pojoaque Valley Irrigation District, the Pueblo of Nambé, the Pueblo of Pojoaque, and the Pueblo de San Ildefonso. Therefore, it was eliminated from further consideration.

2.11.8 Interconnect with Santa Fe Basin via Bishop's Lodge for Redundancy

Reclamation considered constructing an interconnect to join the RWS with the City of Santa Fe's waterline off SH 590 as a major secondary supply and a collection element for the RWS. The interconnect would run from the city line downhill to Bishop's Lodge and would connect with the RWS. This would also allow the RWS to provide water to the Santa Fe Basin. It is the County's prerogative to decide what areas to serve with the RWS and how water is delivered in the service area. Santa Fe County could construct an interconnection with the Santa Fe Basin after RWS construction is completed and ownership of the RWS facilities has been transferred to the Regional Water Authority.

Concerns about this alternative include the fact that it is not in substantial compliance with the HKM Engineering Report. Another concern is the requirement that permits and approvals be issued, in accordance with Section 614(d) of the Settlement Act; this would need to be incorporated into this element. Therefore, it was eliminated from further consideration.

Since publication of the Draft EIS in January 2017, the New Mexico Office of the State Engineer has issued a permit authorizing interim uses anywhere within the County Water Utility service area. This satisfied the requirement of Section 614(d)(2) of the Settlement Act. While the County may decide to use RWS water for interim uses outside the basin, no specific plans for such use have been proposed. If a future interim use were proposed, it would be subject to appropriate environmental compliance requirements.

2.11.9 ASR Well (Deep) at Chupadero

Santa Fe County requested that Reclamation consider siting a deep ASR well at Chupadero as a major secondary supply and collection element. This element was found to be too expensive in terms of capital costs. This is because Reclamation would need to build water lines to the ASR well, even though Santa Fe County does not plan to serve Chupadero with the RWS. Reclamation has estimated that extending pipelines to Chupadero would cost $6 million; this element would cause the cost of the RWS to exceed the $177.3 million being provided by Reclamation, the State of New Mexico, and Santa Fe County. Therefore, it was eliminated from further consideration.

2.11.10 Water Treatment Plant near the Southern Border of the Pueblo de San Ildefonso

In a study on potential intake and water treatment plant locations, Reclamation considered locating the water treatment plant approximately 1.5 miles south of SH 502, on Buckman Road, next to Buckman Mesa and the southern border of the Pueblo de San

Ildefonso. However, there are no power lines in the immediate vicinity of this area. Reclamation would need to construct 4.5 miles of electrical distribution lines from the power substation on County Road 101D to provide power to this location. An additional 1.5 miles each of raw and treated water transmission pipeline would need to be installed along Buckman Road to transport water to and from this location.

Additionally, water from the Rio Grande would have to be transported approximately 300 feet uphill, which would increase reliability risks and operational costs. Because of the decreased reliability and high capital and operational costs associated with this element, it was eliminated from further consideration.

2.11.11 Water Treatment Plant 0.5 Mile East of SH 30 and Approximately 1.0 Mile North of SH 502

In a study on potential intake and water treatment plant locations, Reclamation considered locating the water treatment plant on the west side of the Rio Grande, 0.5 mile east of SH 30 and approximately 1 mile north of SH 502. However, treated water would have to be piped across or under the Rio Grande, through large-diameter transmission pipelines that would then traverse the center of the Pueblo de San Ildefonso. Additionally, this location is far from an electrical substation. The grid would have to be significantly upgraded in order to supply the treatment plant with adequate power. These factors combined to make this element's capital costs high enough that it was considered infeasible. Therefore, it was eliminated from further consideration.

2.11.12 Water Treatment Plant 1,000 Feet East of SH 30 next to an Existing Wastewater Pond

In a study on potential intake and water treatment plant locations, Reclamation considered locating the water treatment plant on the west side of the Rio Grande, approximately 1,000 feet east of SH 30, next to an existing wastewater leach field. However, as with the location 0.5 mile east of SH 30, treated water would have to be piped across or under the Rio Grande, through large-diameter transmission pipelines that would then traverse the center of the Pueblo de San Ildefonso. Additionally, this location is far from an electrical substation. Significant grid upgrades would have to be constructed to supply the treatment plant with adequate power. These factors combined to make this element's capital costs high enough that it was considered infeasible. Therefore, it was eliminated from further consideration.

2.11.13 Water Treatment Plant at Eastern Border of the Pueblo de San Ildefonso

In a study of potential intake and water treatment plant locations, Reclamation considered locating the water treatment plant on the east side of the Rio Grande, approximately 4 miles east of the Otowi Bridge and just south of SH 502, next to the eastern border of the Pueblo de San Ildefonso. This location was incompatible with Pueblo land use planning and was eliminated from further consideration.

2.11.14 Parallel Pipelines for Potable and Nonpotable Water

Scoping comments suggested constructing two parallel networks of transmission and distribution pipes, pumps, and storage for the RWS. These parallel pipelines would not be the same as the "red pipe" discussed in the HKM Engineering Report. One pipeline would be for potable water and the other for nonpotable water, suitable only for fire protection and for outdoor watering. This would reduce treatment costs by reducing the amount of water treated to potable standards. Customers would have 2 meters: one for outdoor use, billed at a lower rate, and the other for indoor use, billed at a higher rate. However, Reclamation determined that the capital costs of building a parallel system would be too high, making this element infeasible. Operations and maintenance costs of a parallel system would also approximately double, compared to a single system. The reduced treatment costs would not offset these other increases in costs, so this element was eliminated from further consideration.

2.11.15 Distributed Renewable Generation at RWS Facilities

Reclamation considered powering the RWS solely through renewable energy facilities collocated with RWS facilities. Powering the RWS with renewable energy would not provide a reliable supply of treated drinking water. This is because renewable generation by itself would not supply enough power to reliably run the RWS. Additionally, renewable energy facilities generally have a high vulnerability to interruption, which further decreases reliability as the sole power supply of the RWS. Therefore, this element was eliminated from further consideration.

2.11.16 Include Chupadero in the RWS Service Area

At Santa Fe County's request, Reclamation considered extending the RWS to add a water transmission line to Chupadero. The water transmission line would connect to the proposed water transmission line that parallels County Road 73 on the Pueblo of Tesuque. The Chupadero Extension would run northeast in the ROW along SH 592 to the existing storage tank. However, Santa Fe County, which would have to fund this extension, has determined that its capital costs are prohibitively high. The County has sent a formal letter to Reclamation stating that it does not want to include Chupadero as part of the RWS service area. The County could construct this or any other extended service area separately after RWS construction is completed and ownership of the RWS facilities has been transferred to the Regional Water Authority. Therefore, this element was eliminated from further consideration.

2.11.17 Include the Tano Road Area in the RWS Service Area

During alternatives development, Reclamation considered expanding the RWS to distribute water along Tano Road to serve County residents still using groundwater west of U.S. Highway 84/285 and south of the Pueblo of Tesuque. In order to do this, the Santa Fe County Commission would need to approve the expenditure of funds for planning and design in the Tano Road area, which it has not done. This is not included in the service area that was approved by the County. It is the County's prerogative to decide what areas to serve with the RWS. It could construct this or any other extended service area separately after RWS construction is completed and ownership of the RWS facilities

has been transferred to the Regional Water Authority. Therefore, this element was eliminated from further consideration.

2.11.18 Exclude Bishop's Lodge from the RWS Service Area

During public scoping, commenters suggested excluding Bishop's Lodge from the RWS service area and instead serving Bishop's Lodge through the existing water utility infrastructure in the Santa Fe Basin. This would be achieved by changing the point of diversion for a portion of Santa Fe County's water rights secured under the Settlement Agreement. Santa Fe County would apply for a permit with the New Mexico Office of the State Engineer to change the point of diversion for these water rights.

This element was eliminated because Santa Fe County has decided to serve the Bishop's Lodge area with the RWS. It is the County's prerogative to decide what areas to serve with the RWS. The County is considering the alternative of providing fire protection for all County portions of the RWS service area described in the HKM Engineering Report. Residents in the Bishop's Lodge area would have the option to hook up to the RWS or remain on their existing groundwater wells, in accordance with options provided by the Settlement Agreement. Therefore, this element was eliminated from further consideration.

2.11.19 Exclude Tesuque Village from the RWS Service Area

During public scoping, several commenters suggested excluding the Tesuque Village area from the RWS service area. Most advocated serving the Tesuque Valley using water from the existing water utility infrastructure in the Santa Fe Basin. This is not feasible for the same reason it would not be feasible to serve Bishop's Lodge from the existing water utility infrastructure in the Santa Fe Basin (see **Section 2.11.18**, Exclude Bishop's Lodge from the RWS Service Area); therefore, this element was eliminated from further consideration.

One commenter suggested that residents in Tesuque Village would rather remain on their existing groundwater wells than hook up to the RWS. However, excluding the Tesuque Village area from any water system service was not considered in this EIS.

One of the objectives of the Settlement Agreement is to reduce groundwater use in the basin. This alternative is inconsistent with this objective. In addition, it is the County's prerogative to decide what areas to serve with the RWS. The County is considering the alternative of providing fire protection for all County portions of the RWS service area described in the HKM Engineering Report. The RWS would be routed through the Tesuque Village area in order to serve Bishop's Lodge. Therefore, Tesuque Village is expected to be a part of the larger RWS. Residents in the Tesuque Village area would have the option to hook up to the RWS or remain on their existing groundwater wells, in accordance with options provided by the Settlement Agreement. Therefore, this element was eliminated from further consideration.

2.11.20 Include Los Alamos County, Española, and the Ohkay Owingeh Pueblo in the RWS Service Area

During public scoping, one commenter suggested expanding the RWS service area to provide San Juan-Chama Project water to Los Alamos County, Española, and the Ohkay Owingeh Pueblo. Under this alternative, water allocated to these entities would be diverted and treated at the same facilities used by the RWS. Water would then flow through additional transmission and distribution pipelines (paid for by the entities mentioned above) to serve this area. However, this alternative was eliminated from detailed study because it would not meet the purpose of and need for the project.

As described in **Section 1.3**, Purpose of and Need for Action, the scope of the project is limited to areas within the Pojoaque Basin. This scope (see Section 611[a][2] of the Settlement Act) directs the Secretary of the Interior to plan, design, and construct an RWS, consisting of facilities necessary to supply up to 4,000 afy of water within the Pojoaque Basin. Because Los Alamos County, Española, and the Ohkay Owingeh Pueblo are neither within the Pojoaque Basin nor parties to the Settlement Agreement, expanding the RWS to serve these areas would not satisfy the purpose of and need for the RWS. Therefore, this element was eliminated from further consideration.

2.11.21 Operating New Diversion Structure on the River to Divert Rio Pojoaque Water into the Acequia de Los Indios

In addition to the pipe buried in the Acequia de Los Indios on the Pueblo de San Ildefonso, it appears that the acequia could also be fed by a diversion that originates on the Rio Pojoaque, roughly 1,000 feet east of the manhole and head gates. Reclamation considered operating this diversion structure to improve infiltration and irrigation flows on the Pueblo de San Ildefonso. However, this would require significant maintenance, including constructing a temporary earthen berm across the Rio Pojoaque and periodically clearing sediment from the acequia. The maintenance required would exceed that needed to operate the existing barrier dam farther downstream. Much of the water in the Rio Pojoaque will have already infiltrated into the riverbed before it reaches the Pueblo de San Ildefonso; therefore, in order to effectively divert the additional supply, the diversion would need to be constructed farther upstream, outside of the Pueblo de San Ildefonso boundary. For that reason, this element was eliminated from further consideration.

This page intentionally left blank.

CHAPTER 3 AFFECTED ENVIRONMENT

3.1 Introduction

This chapter describes the current environmental resources (physical, biological, cultural, recreational, and socioeconomic) that could be directly, indirectly, or cumulatively affected by the alternatives discussed in **Chapter 2**, Alternatives. The scope for each resource topic is defined by the relevant issues identified during public scoping (Reclamation 2013a) and other coordination activities, as described in **Chapter 5,** Consultation and Coordination. A summary of issues and associated indicators are presented in **Table 3-1**, Resource Condition Indicators. These indicators have been developed to provide an issue-focused analysis.

The affected environment is described using both existing information and primary survey data to describe the existing conditions and provide a baseline for the assessment of impacts, as presented in **Chapter 4**, Environmental Consequences. Reclamation completed numerous engineering and environmental studies to have a comprehensive understanding of the regional conditions. These studies are summarized and referenced as appropriate. Relevant technical reports for the EIS are included as appendices.

3.2 Setting

The proposed RWS and Pueblo-proposed projects are in the Pojoaque Basin in north-central New Mexico, north of the City of Santa Fe (**Figure 1-1**, Pojoaque Basin). The Pojoaque Basin, as defined in the Settlement Act, covers approximately 147,300 acres and includes the drainage area contributing to waterways that drain to the Rio Pojoaque, to the two unnamed arroyos immediately south, and to two arroyos (including the Arroyo Alamo) that are north of the confluence of the Rio Pojoaque and the Rio Grande. Further, the Pojoaque Basin includes the San Ildefonso Eastern Reservation. To provide context as to where construction and development is proposed, a general project area is defined (**Figure 3-1**, General Project Area). The general project area (30,400 acres) encompasses approximately a 0.25-mile buffer surrounding all proposed project features, including the RWS, the Rio Pojoaque irrigation improvement project, the Rio Tesuque channel modification project, and the Pueblo de San Ildefonso future projects.

Unless otherwise defined below, the general project area represents the primary area of analysis in which most direct and indirect impacts of the RWS would be realized. Some resource programs will define different areas of analysis to account for the nature of impacts on those resources. For example, impacts on air quality and socioeconomics are not described within the bounds of the general project area because they are measured, and better described, by broader regions. Some resources are more location-specific, such as cultural resources, and have a narrower area of analysis within the general project area. Specific resource areas of analysis are tailored to describe conditions only in areas where the applicable resource is likely to be affected by the alternatives.

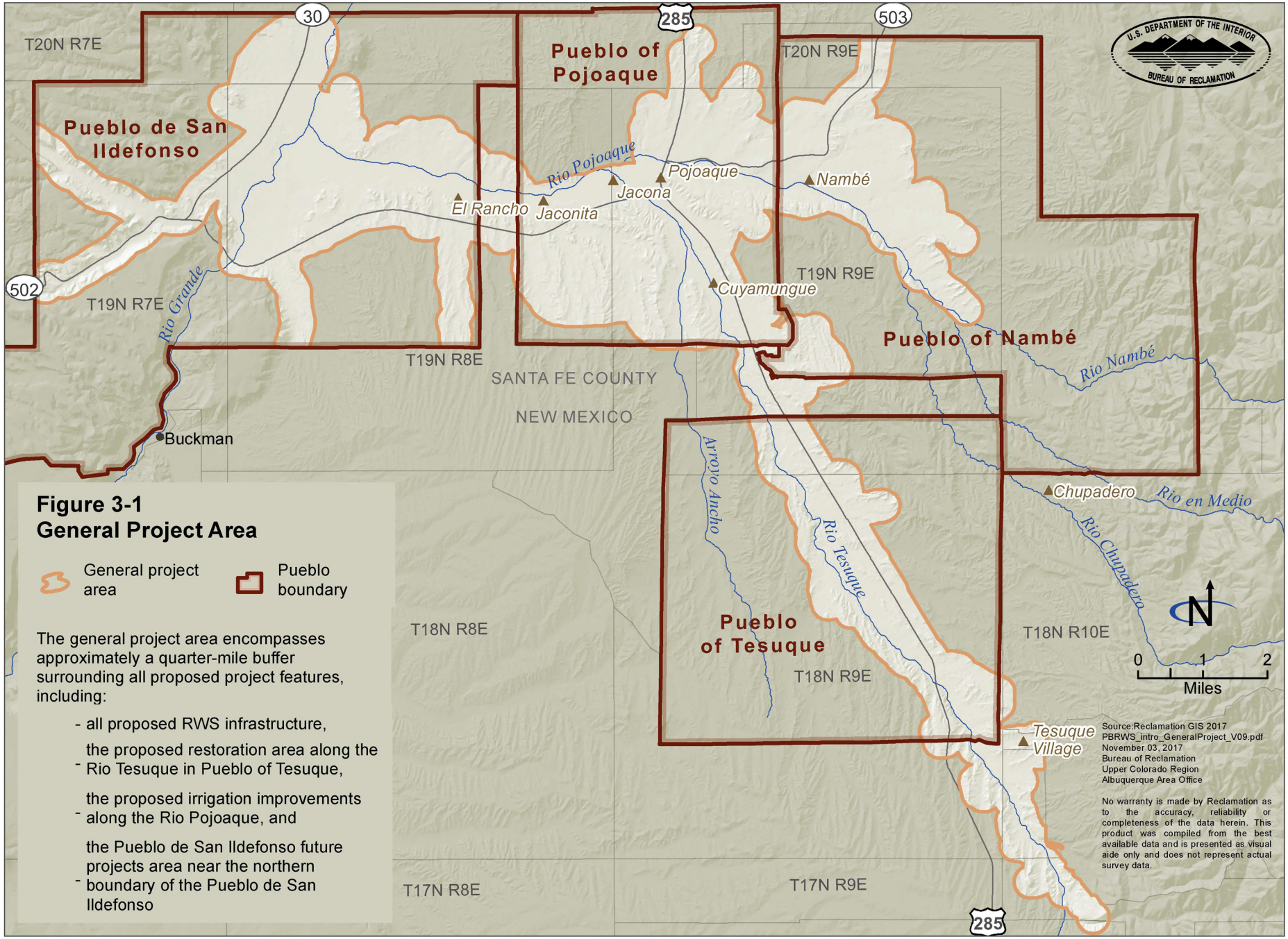


Figure 3-1
General Project Area

General project area

Pueblo boundary

The general project area encompasses approximately a quarter-mile buffer surrounding all proposed project features, including:

- all proposed RWS infrastructure,
- the proposed restoration area along the Rio Tesuque in Pueblo of Tesuque,
- the proposed irrigation improvements along the Rio Pojoaque, and
- the Pueblo de San Ildefonso future projects area near the northern boundary of the Pueblo de San Ildefonso

Table 3-1. Resource Condition Indicators

Section Number - Resource Category/Issue	Indicators
3.3 Surface Water	
Flow regime and hydrology from an additional 4,000 af of water	*Indicator:* Change in annual average flows on the Rio Grande downstream of the project at the Otowi Bridge gage
Changes in river channels, including the composition and erodibility of the bed and banks, the availability of sediment, the size and composition of the sediment moving through the channel, and the rate of sediment transport through the channel and the rate of deposition	*Indicator:* Changes in sediment loads and flows in river channels *Indicator:* Estimated near bank stress (NBS) and bank erosion hazard indices
3.4 Groundwater	
Elevation of groundwater tables from operation of the RWS	*Indicator:* Modeled changes in groundwater elevations
3.5 Water Quality	
Changes in surface water or groundwater quality from construction and operation of the RWS	*Indicator:* Conditions of CWA Sections 401, 402 and 404 permits *Indicator:* Water quality of any discharges and changes to impaired waterways.
Drinking water quality and potential for contamination	*Indicator:* Contaminant levels and potential for contamination in drinking water supply
3.6 Geology and Soils	
Soil erosion	*Indicator:* Acres of disturbance
Geologic hazard risks, such as earthquakes or landslides, from the construction, operation, and maintenance of ASR wells	*Indicator:* Change in geological characteristics that influence geological hazard risks
3.7 Paleontological Resources	
Degradation of paleontological resources	*Indicator:* Acres disturbed in Potential Fossil Yield Class (PFYC) of 4 or 5
3.8 Air Quality	
Dust from construction activities, including traffic, ground disturbance, and quarrying	*Indicator:* Acres of surface disturbance
Emissions from construction and operation of the RWS	*Indicator:* Fuel use or total hours of operation of on-road and off-road vehicles and equipment
3.9 Climate Change	
Increase in GHG emissions	*Indicator:* The level of GHG emissions resulting from construction of the RWS and other proposed actions
Changes in daily flows	*Indicator:* The adequate availability of daily flows in the Rio Grande at Otowi for the RWS and other proposed actions under a range of 19 climate change scenarios

Table 3-1. Resource Condition Indicators (cont.)

Section Number - Resource Category/Issue	Indicators
3.10 Vegetation	
Loss of vegetation and potential spread of noxious weeds.	*Indicator:* Acres and location of different vegetation communities that could be disturbed *Indicator:* Loss of special status plant species *Indicator:* Potential for the spread of noxious weeds
Loss of large trees, notably mature cottonwoods	*Indicator:* Estimated number of cottonwood trees removed per acre
3.11 Wetlands, Non-wetland Waters, and Floodplains	
Alterations to wetland hydrology and wetland plant communities	*Indicator:* Acres and location of wetlands that would be disturbed during construction
Alterations to non-wetland waters	*Indicator:* Changes to the ordinary high water mark (OHWM)
Floodplain capacity and flood hazards	*Indicator:* Change in flooded areas within the FEMA-designated special flood hazard zones
3.12 Wildlife	
Loss of wildlife habitat	*Indicator:* Acres and location of different types of vegetation that would be disturbed
Disturbance to wildlife	*Indicator:* Level of noise that would be generated during construction near habitat
3.13 Aquatic Resources	
Changes in aquatic habitat	*Indicator:* Number of acres of instream disturbance and number of linear feet of downstream river potentially exposed to sedimentation or turbidity *Indicator:* Changes to aquatic habitat measured by flows and the wetted channel width and depth
3.14 Federally Listed Threatened and Endangered Species	
Loss of southwestern willow flycatcher habitat or disturbance to the species	*Indicator:* Acres of suitable habitat disturbed
3.15 Cultural Resources	
Loss of integrity of historic properties	*Indicator:* Number of historic properties adversely affected, per 36 CFR, Part 800
Nature and location of sacred sites relative to construction and operation	*Indicator:* Changes in access to Indian sacred sites, either temporary or permanent
Nature and location of Pueblo resources of concern	*Indicator:* Changes to resources of Pueblo concern, including plants and wildlife

Table 3-1. Resource Condition Indicators (cont.)

Section Number - Resource Category/Issue	Indicators
3.16 ITAs	
Actions that result in the loss, damage, depletion, or waste of assets, property, or property rights for one or more Pueblos	*Indicator:* Whether any assets are adversely affected
3.17 Land Use	
Conflicts with or reduced viability of proposed land uses or desired future land use conditions	*Indicator:* Acres that would be permanently acquired/altered for RWS facilities *Indicator:* Linear miles (with variable widths) of ROW acquired where ownership or use changes temporarily (for construction) and permanently
3.18 Visual Resources	
Impacts on the characteristic landscape due to RWS facilities, including tanks and pumping plants	*Indicator:* Degree of short-term and long-term contrast between current and anticipated features of the landscape from key observation points (KOPs)
3.19 Traffic	
Access and congestion on local roads during construction and operation	*Indicator:* Change in traffic patterns and volume in the road network
3.20 Noise	
Increase in noise during construction and operation of the RWS facilities	*Indicator:* Change in ambient noise level in the general project area and near sensitive receptors
3.21 Solid and Hazardous Materials	
Hazardous material exposure risk	*Indicator:* Hazardous materials over reportable quantities being used, stored, or potentially released in the general project area
3.22 Socioeconomic Resources	
Housing availability, demand for local services, and local spending during construction and operation	*Indicator:* Change in economic activity for key sectors in the local economy, including government, housing, service industry, and construction
Property values and property taxes	*Indicator:* Changes in assessment values for other new water systems that provide an alternative to groundwater
Cost of residential water supply	*Indicator:* Cost of individual user rates
3.23 Environmental Justice	
Distribution of potential adverse impacts upon low-income or minority populations	*Indicator:* Disproportionately high and adverse human health or environmental impacts on minority populations and low-income populations
3.24 Energy and Utilities	
Utility grid capacity and availability for construction, operation, and maintenance of the RWS	*Indicator:* Peak power load

3.3 Surface Water

The following sections provide the methods used to analyze the existing conditions of surface waters, followed by a description of existing surface water conditions in the Rio Grande and Pojoaque Basins. The Rio Grande watershed and Pojoaque Basin comprise the area of analysis for surface water. The general project area is in this area of analysis. For surface water resources, the Rio Grande would play an important role in conveying water into the proposed RWS from upstream of the Pojoaque Basin. The proposed Rio Pojoaque irrigation improvement project and Rio Tesuque channel modification project also contribute to the larger surface water analysis of the general project area, detailed in **Chapter 4**, **Section 4.3**.

3.3.1 Methods

Data from previous studies by Reclamation, the New Mexico Interstate Stream Commission, the Jemez y Sangre Water Planning Council, and others provided existing surface water and hydrologic conditions. Additional details on existing conditions are provided in **Appendix I**, Water Resources Technical Report.

Historical surface water availability and variations were assessed through published water budgets, along with measured data from the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS), the National Oceanic and Atmospheric Administration, and the U.S. Geological Survey (USGS). Historical data reviewed included those for snowpack, precipitation, maximum and minimum temperatures, stream flows, and reservoir storages. Published water budgets also provided information on water uses including consumptive uses in the Pojoaque Basin.

3.3.2 Rio Grande Watershed

The Rio Grande originates in the San Juan Mountains of southern Colorado and traverses New Mexico into Texas, where it forms the boundary between Texas and Mexico until it reaches the Gulf of Mexico. The Rio Grande Basin contains 7,500 square miles in Colorado and 6,500 square miles in New Mexico above the general project area (USDA et al. 2014).

The Rio Grande Basin has several reaches of interest for the RWS, as follows:

- The reach from Embudo to the Rio Chama confluence
- The Rio Chama watershed
- The reach from the Rio Chama confluence to the Otowi Bridge (the Rio Pojoaque, Santa Clara River, and Santa Cruz River contribute to this reach)
- The reach downstream of Otowi Bridge to Cochiti Lake

Cochiti Lake is downstream of the Rio Pojoaque confluence. Major streams in neighboring basins to the north are the Rio Frijoles, Santa Cruz River, and Santa Clara Creek. South of the watershed are the Santa Fe River, Arroyo Calabasas, and Cañada Ancha.

3.3.2.1 Existing and Planned Projects

A number of projects affect surface water flows in the Rio Grande watershed. The primary relevant and existing projects are described below.

San Juan-Chama Project

The San Juan-Chama Project is part of the larger Colorado River Storage Project. It is a system of diversions, tunnels, conveyance channels, dams, and reservoirs that allows water to be diverted from tributaries of the San Juan River and delivered to users in the Rio Grande Basin. The San Juan-Chama Project was initiated by legislation in 1962 (Glaser, undated) and was largely operational in 1971. The project's firm yield is 96,200 afy (Reclamation and City of Albuquerque 2004); however, the San Juan-Chama Project originally included irrigation units on four tributaries, but only the Pojoaque Unit was completed. The project, without the three additional irrigation units, has yielded an average of 92,172 afy (gage USGS 08284160).

Reservoirs

The reservoirs in the Rio Grande Basin reaches of interest are listed in **Table 3-2**, Reservoirs. The oldest of these reservoirs is El Vado, located in the Rio Chama watershed. The initial authorized purpose of El Vado was storage of native Rio Chama water for irrigation for the Middle Rio Grande Conservation District. Congress also allocated federal funding toward the construction of El Vado to supply water for a fixed amount of irrigated acreage on six Middle Rio Grande Pueblos (Cochiti, Santo Domingo, San Felipe, Santa Ana, Sandia, and Isleta).

Table 3-2. Reservoirs

Reservoir	Year of First Fill	Conservation Storage Capacity (af)	Owner	Authorized Uses
Heron	1971	399,960	Reclamation	San Juan-Chama contracts, recreation (incidental)
El Vado	1935	184,770	Reclamation	Middle Rio Grande Conservation District, Irrigation, Pueblo Prior and Paramount Irrigation incidental storage of San Juan-Chama water
Abiquiu	1963	1,198,500	USACE	Flood and sediment management, water supply, and recreation (since March 1976)
Nambé Falls	1976	1,726	Reclamation	Irrigation, recreation
Cochiti	1973	502,330	USACE	Flood and sediment management, recreation

Sources: USGS, various years; Reclamation 2013c

The San Juan-Chama Project provides an interbasin transfer of Colorado River Basin water. This water was allocated to New Mexico under the Colorado River Compact, via San Juan-Chama Project facilities into the Rio Chama. Although El Vado can incidentally store San Juan-Chama water, it was modified to pass this water from Heron Reservoir. Constructed in 1971, Heron Reservoir is upstream of El Vado and downstream of the Azotea tunnel. It provides storage for San Juan-Chama Project water, as well as an incidental recreational benefit. Reclamation owns and operates both reservoirs.

The USACE owns and operates the Abiquiu and Cochiti Reservoirs. Abiquiu was constructed in 1963 on the Rio Chama, and Cochiti was constructed in 1973 on the Rio Grande. The authorized uses of these reservoirs are flood and sediment management and recreation. The sediment management aspect of this system was intended to reduce bed aggradation in downstream Rio Grande reaches and to provide increased channel flood flow capacities and protection (Reclamation 2007a). A permanent pool in Cochiti Lake with a surface area of 1,200 acres is authorized by Public Law 88-293; maintenance of this pool is coordinated between Reclamation and the USACE (Reclamation 2015a).

Evaporation losses from Cochiti Lake are replaced with San Juan-Chama Project water to maintain the minimum pool. The quantity of San Juan-Chama water needed to maintain the minimum pool is not mandated by law and varies by year. A supply of up to 5,000 afy of San Juan-Chama water to Cochiti Lake typically offsets this evaporation loss in nearly all years.

Table 3-3, below, lists the San Juan-Chama Project water contracts in Heron Reservoir and through exchange in the Nambé Falls Reservoir.

Rio Grande Compact

The Rio Grande at Otowi Bridge stream gage serves as the index of New Mexico's obligation for delivering water to Texas under the Rio Grande Compact. The compact, enacted in 1939, provides for the allocation of Rio Grande waters among Colorado, New Mexico, and Texas. The annual uncertainty of river flows was considered in the formation of the compact, which establishes a supply index that provides allocation based on runoff. Since 1948, the Rio Grande at Otowi Bridge stream gage has been the primary index for the compact. As native Rio Grande waters passing the Otowi Bridge contribute to the obligation for deliveries to Texas, the New Mexico State Engineer has not administratively approved water transfers across the gage boundary (Jemez y Sangre Water Planning Council and Daniel B. Stephens & Associates 2002). Water deliveries by Colorado at the New Mexico Stateline are indexed using separate gages in Colorado.

3.3.2.2 Historical Stream Flows

Stream flow above the Rio Grande at Otowi Bridge (USGS 08313000) is characterized here as the following components:

- Flow on the Rio Grande past the Embudo gage (USGS 08279500) measures native Rio Grande Basin runoff from the upper basin.

Table 3-3. San Juan-Chama Project Contracts

Contract	Annual Maximum Allocation (af)
Albuquerque Bernalillo County Water Utility Authority	48,200
Middle Rio Grande Conservancy District	20,900
Jicarilla Apache Nation	6,500
City of Santa Fe	5,230
Pueblo of Taos	2,215
Ohkay Owingeh Pueblo	2,000
County of Los Alamos	1,200
County of Santa Fe	375
Pojoaque Valley Irrigation District	1,030[1]
City of Española	1,000
City (Town) of Belen	500
Village of Los Lunas	400
Town of Taos	400
Town of Taos Settlement	366
City of Bernalillo	400
Town of Red River	60
El Prado Water and Sanitation District	40
Village of Taos Ski Valley	15
Permanent Pool, Cochiti Reservoir	5,000[1]
Pueblos of Nambé, Pojoaque, and Tesuque and the Pueblo de San Ildefonso Contract	369
Total	**96,200**

Sources: Reclamation 2011; 78 *Federal Register* 147

[1] Variable amount to offset depletions or evaporation losses. For Pojoaque Valley Irrigation District the amount offsets depletions from storage in Nambé Falls Reservoir; for Cochiti, the amount offsets evaporation losses to maintain a minimum pool of 1,200 acres. This table does not include contractual changes for the RWS, because these changes would not occur if the No Action Alternative were selected.

- Flow on the Rio Chama, as measured at the Rio Chama near Chamita gage (USGS 08290000). This tributary contains native Rio Grande Basin runoff and imported water from the San Juan/Colorado River Basin. A series of reservoirs on the Rio Chama alter the timing and generate losses from evaporation.
- Rio Grande tributary inflows. In addition to the Rio Pojoaque, notable tributaries include the Santa Clara and Santa Cruz Rivers.

Rio Grande—Embudo Gage. The period of record starts in water year 1889; water years 1894 and 1903 to 1912 were not recorded. The average volume (using a 10-year moving average) in the early part of the 1900s was around 860,000 to 1 million afy. This average declined to around 440,000 afy during the 1960s drought years. The average volume increased during the 1980s to above 800,000 afy, before declining during the 2000s drought years to below 500,000 afy. The minimum runoff was 201,109 af in 2002,

and the maximum was 1,541,911 af in 1941. Average runoff was 586,630 afy during water years 1971 to 2012.

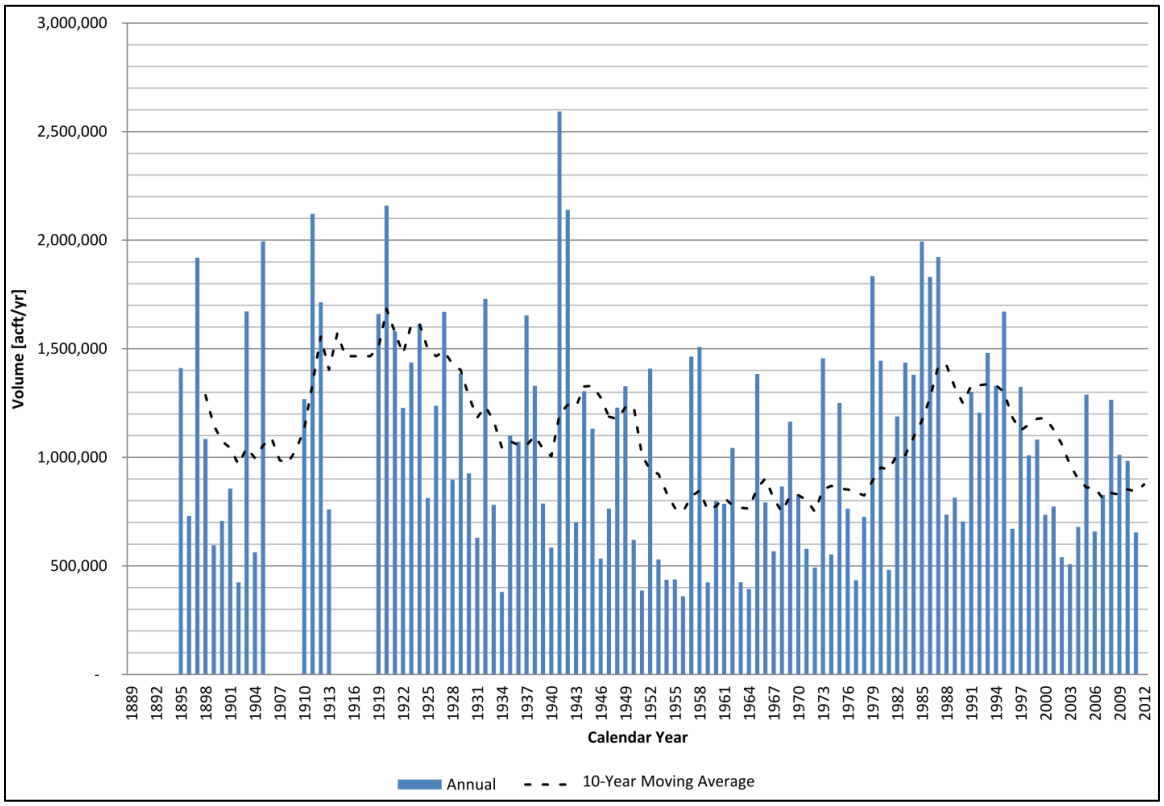
Rio Chama—Chamita Gage. The San Juan-Chama Project is a trans-basin diversion and series of diversion and storage reservoirs designed to allow New Mexico's use of the state's share of the Colorado River allocation in the more populous Rio Grande Basin. The trans-basin diversion is measured at the Azotea Tunnel. The State of Colorado operated gage at the tunnel outlet (also published by the USGS as gage USGS 08284160) has recorded information from 1971 to 2014. Diversions range from 6,113 afy (calendar year 2002) to 164,051 afy (calendar year 1979). The average diversion from 1971 to 2012 was 92,172 afy. Peak use of the Azotea Tunnel typically is in August.

The flows on the Rio Chama are influenced by watershed runoff, imports of Colorado River Basin water via the San Juan-Chama Project facilities, and operations and evaporation of Rio Chama reservoirs. The measurements of flows at the Chamita gage (USGS 08290000), downstream of the series of reservoirs and upstream of the Rio Grande confluence, began in 1913 with consistent measurements in 1930. Average flows approached 500,000 afy in the 1940s and declined to around 320,000 afy during the 1950s and 1960s drought years. The flows increased to just over 500,000 afy on average during the 1980s and early 1990s. The 2000s drought years resulted in average annual runoff of 340,000 afy.

Rio Grande—Tributary Inflows. Two other Rio Grande tributaries are noted here as additional sources of flow at the Otowi gage. The Santa Cruz River near the Cundiyo gage (USGS 08291000) was operational from 1933 to 2012. From 1971 to 2012 the average flow was 24,028 afy, or 2.32 percent of Otowi average flows. The Jemez y Sangre Regional Water Plan (Jemez y Sangre Water Planning Council 2008) summarized the average Santa Cruz surface water outflows at 8,470 afy. The Santa Clara Creek near the Española gage (USGS 08292000) was operational from 1936 to 1941, from 1949 to 1950, and from 1984 to 1994. Additional years were estimated using long-term regional gages. The estimated 1971 to 2012 average was 2,489 afy, or 0.24 percent of Otowi average volumes. The Jemez y Sangre Regional Water Plan summarized the average Santa Clara Creek surface water outflows at 3,780 afy.

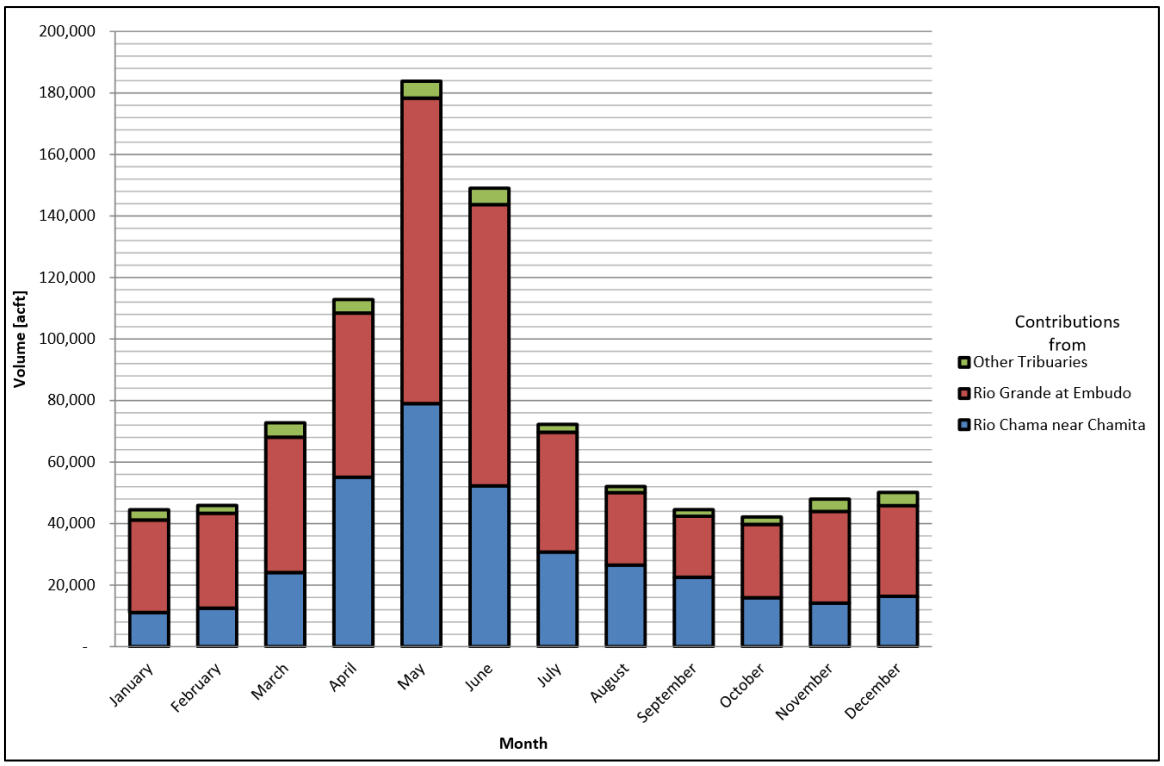
Rio Grande—Otowi Bridge Gage. The Rio Grande at Otowi Bridge gage (USGS 08313000) was established in 1895. The periods from 1906 to 1909 and from 1914 to 1918 are missing from the record. **Figure 3-2**, Historic Rio Grande **at Otowi Bridge Flows**, provides the annual flows and **Figure 3-3**, Average Monthly Stream Flows for Rio Grande at **Otowi Bridge (1971 to 2012)**, shows average monthly flows. Average flow volume was 1.3 million afy in the 1940s. During the 1950s and 1960s drought, the average dropped to around 800,000 afy. After rising to an average of 1.4 million afy in the 1980s and early 1990s, the volume decreased to around 830,000 afy during the 2000s and 2010s drought years. The 1971 to 2012 average flow volume was 1,036,998 afy. The highest recorded volume was 2,592,837 afy in 1941, and the lowest was 359,480 afy in 1956.

Figure 3-2. Historic Rio Grande at Otowi Bridge Flows



Source: Appendix I

Figure 3-3. Average Monthly Stream Flows for Rio Grande at Otowi Bridge (1971 to 2012)



Source: Appendix I

3.3.3 Pojoaque Watershed

According to FEMA (2012), the Rio Pojoaque watershed (the portion of the Pojoaque Basin contributing to the Rio Pojoaque) has a drainage area of 196 square miles, extending from the Sangre de Cristo Mountains, which define its eastern boundary, to the Rio Grande. The center of the Pojoaque Basin has developed areas, including the highway system, along with cultivated areas throughout. The median land uses are forested areas in the upper portions of the Pojoaque Basin, at 41 percent of the basin's area, and shrub areas, at 35 percent. The lower basin is composed of primarily shrub and herbaceous vegetation. Impervious areas are generally concentrated on roads and highly developed areas along U.S. Highway 84/285 and SH 502.

Elevations in the Pojoaque Basin range from 5,520 feet near the Rio Pojoaque's confluence with the Rio Grande to about 12,620 feet at Santa Fe Baldy. The higher slopes are in the upper mountainous portion. Basin slopes range from 80 percent, in the upper portions of the basin, to near flat by the Rio Grande; the average slope is 7 percent (Bohannan-Huston, Inc. 2002; Gesch 2007).

The climate in the basin is generally semiarid below elevations of 7,000 feet (FEMA 2012). Lower, more populated areas receive most of their moisture from rainfall during summer, though high mountain areas do receive a significant amount of snowfall. Snow water equivalents in the Pojoaque Basin have historically ranged from an average maximum of 4.0 inches at lower elevations to 17.7 inches at higher elevations (**Appendix I**). The overall watershed precipitation average is estimated at 18.3 inches per year, ranging from 10.7 inches at 5,535 feet elevation to 40.6 inches at 10,965 feet elevation (Daly et al. 2008).

The soils survey estimates the composition of the soil in percentages by weight of sand, silt, and clay. Sand is defined as mineral grains between 0.05 and 2 millimeters; silt is defined as soil particles between 0.002 and 0.05 millimeters; clay soil particles are less than 0.002 millimeters in diameter. The distribution of sandy soils indicates one potential for fine sediment supply in a watershed. The upper portion of the Pojoaque Basin is generally around 60 to 65 percent sand components.

A median sand composition in the remainder of the Pojoaque Basin is 62 percent, which is consistent with what is found in the general project area. Many of the arroyos and rivers have high percent sand compositions. The Arroyo Ancho, for example, has an estimated sand composition of 86 percent. There are areas with low sand composition, primarily along the rivers, but also along some arroyos. These have higher silt and clay compositions.

As discussed below, important relevant water features in the basin include the Rio Pojoaque, Rio Tesuque, and Nambé Reservoir.

3.3.3.1 Rio Pojoaque and Rio Nambé

At its headwaters, the Rio Pojoaque begins as the Rio Nambé in the Sangre de Cristo Mountains. The river descends through portions of Santa Fe County before entering the Pueblo of Nambé. Rio Nambé is regulated by Nambé Falls Dam.

Below Nambé Falls Dam the river is joined by several tributaries, including the Rio Chupadero. The headwaters of the Rio Chupadero are in the Sangre de Cristo Mountains. Surface water in the long, narrow basin travels westerly through Pacheco Canyon and

then follows a northwesterly course until it reaches Pojoaque Creek between Nambé Falls and the Pueblo of Nambé. Below the confluence of Rio en Medio, the stream is named Pojoaque Creek. Continuing westerly, the stream enters the Pueblo of Pojoaque and joins with Rio Tesuque to form the Rio Pojoaque about 1 mile downstream of U.S. Highway 84/285.

The Rio Pojoaque traverses portions of the Pueblo of Pojoaque, Santa Fe County, and the Pueblo de San Ildefonso. It is an intermittent, left-bank tributary to the Rio Grande; the confluence of these rivers is about 2.75 miles upstream of the Otowi Bridge. The Rio Pojoaque receives flows from Pojoaque Creek, the Rio Tesuque, and numerous arroyos.

The Jemez y Sangre Regional Water Plan (Jemez y Sangre Water Planning Council 2003) estimated surface water runoff into the Pojoaque-Nambé River system at an average of 10,540 afy. An additional 4,000 afy of inflows was estimated from springs and 4,460 afy from irrigation return flows. The total estimated average surface water inflows were 19,000 afy. Irrigation diverted 44 percent of the total inflows. Irrigated acreage estimates have varied between 1,127 acres (taken from 1992 satellite imagery), 2,375 acres (from a 1997 study), and 3,538 acres (from a 1966 hydrographic survey; Brinkman and West 2005).

Seepage into the aquifer was estimated at 26 percent of inflows and riparian evapotranspiration at 15 percent of surface inflows. Surface outflow to the Rio Grande was estimated at 2,705 afy on average.

Brinkman and West (2005) also cited these estimates of the Pojoaque-Nambé River system annual surface water budget as the best available set of water budget information. Brinkman and West (2005) also noted that return flows to surface water from septic fields could be a significant factor when groundwater levels were within 100 feet of the surface, a condition noted to occur for 78 percent of the area's groundwater wells. Return flows to surface water originating from domestic sources were estimated to be between 50 and 67 percent of all return flows.

The Rio Pojoaque Barrier Dam, located about 1.27 miles upstream of the confluence with the Rio Grande, was constructed in the 1980s of concrete-capped gabions and sheet pile (HKM 2008). The low-head structure, about 3 feet high, is on the Pueblo de San Ildefonso.

At the dam location, the Rio Pojoaque is divided into two channels; the existing structure spans the left (southern) channel of the river. It was built to improve flow to the Pueblo's infiltration gallery and surface water diversion into Ortiz Ditch for irrigation. Irrigation project water for the Pojoaque Valley Irrigation District, stored in Nambé Falls Reservoir, cannot be fully captured by surface turnouts. The Rio Pojoaque Barrier Dam aids in improving irrigation diversions. These diversions are limited by the irrigation water right, and depletions to the Rio Grande are offset by contracted San Juan-Chama water.

3.3.3.2 Rio Tesuque

Fed by Big Tesuque Creek, Little Tesuque Creek, and several other streams and arroyos, the Rio Tesuque flows northwesterly through Santa Fe County, the Pueblo of Tesuque, and the Pueblo of Pojoaque.

Big Tesuque Creek originates in the Sangre de Cristo Mountains and flows westerly through Santa Fe County. Below Bishop's Lodge, Big Tesuque and Little Tesuque Creeks join to form the Rio Tesuque.

Similar to Big Tesuque Creek, Little Tesuque Creek originates in the Sangre de Cristo Mountains and flows primarily westerly. Near Bishop's Lodge, the stream turns to the north and joins Big Tesuque Creek, as described above. The drainage area of Little Tesuque Creek is 8.9 square miles, and the drainage area of Big Tesuque Creek is 12.3 square miles at the confluence (FEMA 2012). The Rio Tesuque joins with Pojoaque Creek to form the Rio Pojoaque. At this confluence, the drainage area of the Rio Tesuque is 77.8 square miles (FEMA 2012). U.S. Highway 84/285 roughly parallels the Rio Tesuque through most of the river's length.

The surface water budget from the Jemez y Sangre Regional Water Plan (Jemez y Sangre Water Planning Council 2003) estimates an average inflow to the Rio Tesuque and upper contributing tributaries from mountain front runoff at 3,500 afy. An additional 1,815 afy are introduced to the Rio Tesuque from springs, and 1,115 afy on average are estimated from return flows from irrigation. Total surface water availability for the Rio Tesuque was estimated at an average of 6,430 afy. The contribution of the Rio Tesuque to the Rio Pojoaque was estimated at 540 afy. The difference between the surface water inflows and surface water outflow was due to irrigation use (33 percent of inflows), seepage to groundwater (39 percent), and evapotranspiration from riparian vegetation (20 percent).

3.3.3.3 Nambé Falls Reservoir

With the exception of smaller ponds, the Nambé Falls Reservoir is the only reservoir in the Pojoaque Basin. Constructed in 1976 as part of the San Juan-Chama Project, the 150-foot-high reservoir provides 1,726 af of active storage of Rio Nambé water for irrigation (Reclamation 2013c). The reservoir also provides recreation, including flows over the Nambé Falls, located just downstream of the outlet works. Reclamation owns the dam, and the Pojoaque Valley Irrigation District operates it.

3.3.4 Channel Morphology

Within the Rio Pojoaque watershed, the predominant Montgomery-Buffington classification of reaches is pool-riffle; the reaches closest to the Rio Grande confluence are considered very close to dune-ripple reaches. The reaches are dominated by arid southwest compound and discontinuous ephemeral channel forms, with the exception of the alluvial fan at the confluence of the Rio Grande. Channels range from moderately to severely confined. Severely confined reaches are in the upper portions of the Rio Tesuque and the Rio Nambé. Within the Rio Tesuque reaches, there is an incised channel between the Upper Ponds Diversion Dam and the U.S. Highway 84/285 bridge crossing (Reclamation 2016a).

The extent, density, and diversity of riparian vegetation impact the ability of a streambank to withstand erosive processes related to flow. Cottonwoods (*Populus deltoides*) and Siberian elm (*Ulmus pumila*) dominate the infrequent and sparse overstory; willows (*Salix* spp.) and piñyon pine (*Pinus edulis*) are less prevalent. Understory species are prevalent in the riparian areas, though at very low cover densities. These are Russian olive (*Elaeagnus angustifolia*), Siberian elm (*Ulmus pumila*), rubber

rabbitbrush (*Ericameria nauseosa*), one seed juniper (*Juniperus monosperma*), and three-leaf sumac (*Rhus trilobata*).

Sedges (*Cyperaceae* spp.), hare's tail grass (*Lagurus ovatus*), Indian grass (*Sorghastrum nutans*), and several unidentified annuals provide little total coverage of bare ground and are limited to reaches with more extensive overstory cover and shallow groundwater.

Bank vegetation in the Rio Tesuque between the Upper Ponds Diversion Dam and the U.S. Highway 84/285 bridge crossing creates stabilized banks (Reclamation 2016a). Flood flows tend to incise and lower channel bottoms along this reach.

Sinuosity, or the degree of curves or bends in a river, is measured by taking the distance water travels along a river, divided by the straight-line distance of the river from the start of a reach to the outlet. A sinuosity ratio of 1.0 indicates that there is no sinuosity; the river is essentially straight. Higher ratios of sinuosity indicate higher numbers of curves or bends.

Sinuosity throughout the general project area is low, indicating a low degree of channel meander. The highest sinuosity ratios (more than 1.1) are in the Rio Tesuque, Rio Pojoaque (downstream of the Rio Tesuque confluence), an unnamed arroyo above Pojoaque Creek, and the Acequia de Los Indios. Several of the unnamed arroyos have low ratios of 1.0, which also includes the Rio Pojoaque at the confluence with the Rio Grande. Other reaches have sinuosity ratios of 1.0 to 1.1.

The bankfull width is the width of the channel when it is full of water. Bankfull width on the Rio Tesuque, upstream of the Arroyo Ancho confluence, ranges from 50 feet in the upper reaches to 180 feet in the lower reaches (2012 conditions). The Arroyo Ancho has an average bankfull width of 270 feet; Pojoaque Creek has an average bankfull width of 50 feet; the Rio Pojoaque average bankfull width ranges from 200 to 300 feet. Many of the named and unnamed arroyos' bankfull widths average between 40 and 60 feet. The average bankfull width of the Rio Grande, between the Otowi Bridge and the Rio Pojoaque confluence, is about 200 feet. The average active channel width, typically the width of the channel that is free of vegetation, is generally about 85 percent of the average bankfull width.

Reaches with little or no depositional features have active channel widths similar to the bankfull widths. These reaches are the upper portion of the Rio Tesuque in the Bishop's Lodge area, the lower portion of Pojoaque Creek, and several unnamed arroyos. Reaches with more depositional features have active channel widths of around 50 to 60 percent of the average bankfull width. Examples of these reaches are the lower portion of the Acequia de Los Indios, the Rio Pojoaque (near the confluence with the Rio Tesuque), and several unnamed arroyos above the Rio Tesuque and Rio Pojoaque.

A review of the various depositional formations in a reach can provide information on the stability of a channel. In some river types, for instance, point bars indicate a stable state, while in others they suggest accelerated sediment supply and an increasing width-to-depth ratio. This represents accelerated bank erosion rates, excessed deposition, or aggradation and overwidening.

In the channel forms in the general project area, several mid-channel bars and chute cutoffs indicate excess deposition, leading to channel enlargement. Point bars with few mid-channel bars occurred in approximately half of the reaches, with roughly a third

supporting main channel branching. Numerous mid-channel bars and islands occur in one-third of the sites; the remaining reaches support diagonal bars or point bars.

Historical aerial photographs show that the sinuosity ratios generally have not changed much over time. The photographs displayed regular, irregular, and truncated meanders, with regular and confined meanders dominating. Meanders described as regular, irregular, and truncated suggest a more stable geomorphic past, while confined meanders are associated with lateral migration through time in response to past events.

The bankfull and active channel widths either have remained the same (mainly on arroyos) or, in many cases, have appeared to decrease. A comparison of aerial photographs from 1982 and 2012 show increased understory vegetation growth in many of the reaches. This trend is also apparent in a comparison of 1935 to 1982 and later photographs.

Reclamation (2012) noted that channel narrowing is a regional trend in the larger Rio Grande watershed; drought conditions promoting lower peak flows lead to vegetation colonization and the narrowing of active channel widths. This trend was noted as potentially generating additional river maintenance needs, due to channel narrowing, incision, and lateral migration.

Banks of many of the named and unnamed arroyos have migrated 175 feet since 1935. The upper portion of the Pojoaque Creek and the Rio Pojoaque near the confluence with the Rio Grande have banks that migrated between 225 and 350 feet since 1935. Migrations of 125 to 175 feet since 1935 are characteristic of most of the Rio Tesuque (downstream of the Bishop's Lodge area) and Arroyo Ancho. This is also characteristic of portions of Pojoaque Creek.

Bank stability can be characterized using the bank erosion hazard index (BEHI) and NBS Index (Rosgen 2006). The BEHI is a measure of a bank's ability to resist erosion, influenced by the degree of incision and bank vegetation. The NBS is a measure of expected stress that water flow has on a bank. No study reaches were classified as stable, with respect to depositional pattern types, meander patterns, dominant bank erosion hazard indices and NBS indices, and the degree of confinement. Based on 24 bank surveys of sites in the Rio Pojoaque watershed, one site was categorized as highly unstable, 30 percent of the survey sites were moderately unstable, and 65 percent of the survey sites were unstable.

Human influences on flow were evident in or next to each reach in the general project area. Past projects have altered the geomorphologic conditions in the Pojoaque Basin. Notable existing project features are the following:

- U.S. Highway 84/285 improvements between 1996 and 2005 that changed bridge alignments
- SH 502 improvements between 1982 and 1996 that changed culvert locations
- The Pueblo of Pojoaque Regional Septage System that realigned an arroyo channel and added road and bridge crossings
- Other regional transportation changes
- Installation of bendway weirs in 2007 and 2012, intended to prevent Rio Grande bank migration toward the Pueblo de San Ildefonso fishing pond

The TP-806 bridge crossing near the Pueblo of Tesuque proper has a large spoil pile deposited upstream of the bridge site (Reclamation 2016a). Aggradation has occurred on both upstream and downstream sides of the bridge. The bridge may be acting as a grade control, facilitating sediment deposition and reduced velocities. Heavy equipment has been used in the past to clear a portion of the channel by piling sediment on the east side of the channel.

Past geomorphology studies for the Rio Grande pertain to river maintenance priority sites and other reaches of the river. Reclamation (2005) documented erosion of the west bank of the river at the Pueblo de San Ildefonso River Maintenance Priority Site (near the Pueblo de San Ildefonso fishing pond) and estimated the future potential migration of the river bend. The river had increased sinuosity and bank migration toward the pond.

Seven bendway weirs were installed in 2007 as part of the effort to arrest the Rio Grande bend migration in the area. A temporary diversion berm was constructed to facilitate the construction of additional bendway weirs. The bendway weirs are on the left riverbank along a distance of about 660 feet, beginning nearest to the fishing pond and moving upstream (USACE 2012a). Additional bank migration and growth of a bar have occurred since this project; supplemental work in 2012 included its partial removal.

Reclamation (2007b) noted the deleterious impacts of past gravel mining in the areas of the Pueblo de San Ildefonso and the Rio Pojoaque. The Rio Grande was the location of gravel mining in the 1980s; this also occurred in parts of the Pojoaque Basin, such as the Totavi area of the Pueblo de San Ildefonso, which lowered the riverbed. Some in-stream mining was observed along the Rio Nambé, altering the channel cross section and flow patterns from natural conditions.

Urbanization, agriculture, river channelization, flow diversions, levees, grazing, and roads are likely the most important long-term land use drivers of channel destabilization in the general project area. Perhaps the most likely influence has been flow diversion related to water use, which includes diversion structures and channel modifications for low-flow channels. Observations of aggradation immediately below diversions and road crossings suggest decreased sediment transport capacity in these areas. To some extent, vegetation removal, headwaters fires, and in-channel mining have also played a role in bank failure and migration.

3.4 Groundwater

The following sections provide the analysis methods for aquifers and existing groundwater conditions of the Pojoaque Basin.

3.4.1 Methods

This section describes existing conditions related to groundwater, including geology and aquifers, existing and planned projects, the regional water budget, and water rights and uses. For information on groundwater quality, see **Section 3.5.3**, Groundwater Quality.

The Pojoaque Basin is the area of analysis for groundwater. Background data sources for the groundwater evaluation consisted of aquifer and regional geology descriptions, studies and datasets, and local project-specific studies. Additional detail on groundwater

resources and projects affecting those resources in the Pojoaque Basin can be found in **Appendix I**.

Descriptions of the regional aquifer systems and current and historical groundwater levels were obtained from papers and resources presented at the annual Española Basin workshops and from New Mexico Bureau of Geology and Mineral Resources open file reports. Information was compiled from the New Mexico Office of the State Engineer of known wells, which included the locations of existing wells, the uses of these wells (e.g., domestic and commercial), and the year when the wells were finished.

3.4.2 Aquifers

The Pojoaque Basin includes areas in the Española Basin and more particularly the Pueblo de San Ildefonso, the Pueblo of Nambé, the Pueblo of Pojoaque, and the Pueblo of Tesuque and intervening non-Pueblo areas along the Rio Pojoaque and Rio Tesuque. The Pojoaque Basin has historically relied on groundwater withdrawals to meet local drinking water needs, which has resulted in aquifer depletion and declines in water levels (Balleau Groundwater, Inc. 2003).

The Pojoaque Basin is west of the Sangre de Cristo Mountains, a range of faulted and folded metamorphic and sedimentary deposits of the Paleozoic and Mesozoic (Lewis and West 1995). Paleozoic rocks are found intermittently along the west flank of the Sangre de Cristo Mountains; however, most of the sediments in the Española Basin comprise the geologic unit known broadly as the Santa Fe Group of the Tertiary period.

Quaternary-age shallow alluvial deposits overlay the Santa Fe Group in and next to the Rio Grande and its main tributaries throughout the Pojoaque Basin. These unconsolidated deposits are better sorted and have a larger average grain size than the sediments comprising the Santa Fe Group. The extent of the shallow alluvial deposits varies from about 2 miles wide along the Rio Grande to less than a few hundred feet wide along the tributaries. The deposits are at least 55 feet thick along the Rio Grande (Galusha and Blick 1971) and less than 100 feet thick along the tributaries (Hearne 1985). The Santa Fe Group, consisting of the Tesuque and Chamita Formations, forms the principal aquifer system in the Española Basin.

Groundwater flow in the basin is generally topographically driven west and slightly north toward the Rio Grande. Subsurface inflow along the Sangre de Cristo Mountains of up to 14,700 afy, or about 13 percent of annual precipitation, recharges the Tesuque aquifer system of the Española Basin just west of the mountain range (Wasiolek 1995). This area consists of five drainage basins: the Rio Nambé, Rio en Medio, Tesuque Creek, Little Tesuque Creek, and Santa Fe River. Of these, the Rio Nambé and Santa Fe River drainage basins contribute most of the subsurface inflow, at 5,520 afy and 4,170 afy.

A model developed by McAda and Wasiolek (1988) simulates a total subsurface inflow of 9,600 afy to the Tesuque aquifer system along the mountain front between and including the Rio Nambé and Santa Fe River drainage basins. The amount of direct recharge in the Santa Fe area is difficult to estimate, but studies have shown that sites that have neither runoff nor flooding have not been recharged in the recent past (Anderholm 1994).

The potentiometric surface of the aquifer system generally slopes from east to west. Precipitation in the east recharges the groundwater, which flows westward and, if not

intercepted by wells, ultimately discharges in the Rio Grande (Lewis and West 1995). To a lesser extent, this water flows to the Rio Pojoaque, Rio Tesuque, and other nearby tributaries (McAda and Wasiolek 1988).

Several theories regarding geologic control on groundwater flow have been hypothesized for the Española Basin, as follows:

- Confining beds causing artesian conditions (Purtymun and Johanson 1974)
- Buried highly permeable Rio Grande deposits causing parallel flow to the Rio Grande (Hawley 1998)
- Dipping Santa Fe Group beds causing preferential flow parallel to the strike (Hearne 1985)
- Cemented fault zones acting as flow barriers (Spiegel and Baldwin 1963)

It is likely all of these factors are at play, but the influence of these factors on regional flow patterns is unclear (Keating 2002). The Tesuque Formation is the principal groundwater-bearing unit in the general project area and is sometimes referred to as the Tesuque Formation aquifer. The Tesuque Formation consists of consolidated reddish-brown and pinkish-tan silty sand and gravel, derived largely from the Sangre de Cristo Mountains (Spiegel and Baldwin 1963). It has interbedded layers of sand, silt, clay, and some volcanic ash beds. Near the Rio Grande, the Tesuque Formation thickness can exceed more than 9,000 feet (Kelley 1978).

There is a hydraulic connection between the Rio Grande and the shallow alluvial aquifer system near Buckman, where alluvium water levels fluctuate in response to Rio Grande stage. Generally, water from the alluvium and the underlying Tesuque Formation in the Buckman area is 0.15 and 2.8 feet higher, respectively, than the Rio Grande stage level (Balleau Groundwater, Inc. 1995).

Buckman alluvium is capable of providing about 1,400 afy on average. Because of its stratification and the dipping of its sedimentary beds, the aquifer is considered anisotropic (having a different value when measured in different directions), with the primary hydraulic conductivity direction occurring along its bedding planes. The Tesuque depositional environment has resulted in a discontinuity of its deposits, causing it to be very heterogeneous locally (Lewis and West 1995).

3.4.3 Existing and Planned Projects

The City of Santa Fe draws groundwater from the Buckman wellfield, located about 4 miles south of the Pueblo de San Ildefonso and 6 miles west of the Pueblo of Tesuque. It also draws from wells within the city limits. While this wellfield is not in the general project area, withdrawals from it have a significant documented impact on the Rio Pojoaque groundwater resources.

The Buckman wellfield provides more than one-third of the City of Santa Fe's municipal water supply, and its withdrawal rates are among the highest in the region (Vesselinov and Keating 2002). The largest observed groundwater declines in the area are near the Buckman wellfield and in the City of Santa Fe. Near the City of Santa Fe, water levels have declined 2.5 feet per year in the production zone over the past 40 years. At the

Buckman wellfield, water levels declined up to 56 feet per year in the production wells from approximately 1985 to 1995 (Lewis and West 1995).

The City of Santa Fe has reduced pumping from the Buckman wellfield in recent years by using the Buckman Direct Diversion Project (BDD; Forest Service and BLM 2006). This has resulted in modest recovery of groundwater levels, compared to historical conditions. The City of Santa Fe continues to monitor water levels, which are anticipated to continue to recover in the future.

Other major municipal wellfields (Balleau Groundwater Inc. 2003) are those as Los Alamos, Guaje Canyon, Otowi, and Pajarito. The City of Española operates four groundwater wells. This wellfield had contained additional wells, which have been retired, due to high levels of contamination (City of Española 2012). Other permitted wells are in the Pueblo of Santa Clara, Pueblo of Ohkay Owingeh, and Santa Fe and Rio Arriba Counties, in the vicinity of the Santa Cruz River. In these areas there are 543 wells primarily for domestic uses, at a combined maximum permitted withdrawal of 4,343 afy (New Mexico Office of the State Engineer 2011).

The EPA designated the Española Basin Aquifer System as a sole source aquifer (SSA; 73 *Federal Register* 14), a designation authorized under the Safe Drinking Water Act of 1974. After petitioning for inclusion in the SSA program, the EPA determined that the Española Basin Aquifer supplied 50 percent of the drinking water of the area, with limited alternatives to the aquifer at the time. The SSA designation requires the EPA to review federally funded projects that have the potential to contaminate the aquifer; however, this project is a direct federal action, which is exempt under the SSA.

3.4.4 Regional Groundwater Conditions

Valley fill alluvium and the Tesuque Formation are the predominant units in the general project area, with lower coarse units of the Tesuque outcropping near the Sangre de Cristo Mountains. Many of the wells in the general project area are in alluvial soils near the Rio Pojoaque and Rio Tesuque. Groundwater in the general project area is affected by water use in the basin and by significant projects outside the basin noted in **Section 3.4.3,** Existing and Planned Projects.

Groundwater withdrawal is composed of the following sources:

- 5 percent from Pojoaque Basin streams
- 13 percent from the Rio Grande
- 82 percent from groundwater aquifers (Balleau Groundwater Inc. 2003)

In the general project area, the most common use of groundwater is for domestic single homes, comprising 90 percent of the total wells and 85 percent of the permitted pumping. Roughly 40 percent of the domestic wells are on the Pueblo of Pojoaque, with other high concentrations of pumping on the Pueblo of Nambé, the Pueblo de San Ildefonso, and the Bishop's Lodge area.

The Pojoaque Basin is part of the Rio Grande declared underground water basin. There are 1,537 documented wells within a quarter of a mile of the proposed RWS infrastructure, with a maximum allowable withdrawal of 4,471 afy, as shown in **Table 3-4**, below.

Table 3-4. Maximum Allowable Withdrawals

Study Area	Current Diversion Maximum (afy)
Bishop's Lodge area	587
Pueblo of Tesuque	178
Pueblo of Nambé	848
County area between the Pueblo of Tesuque and the Pueblo of Pojoaque	168
Pueblo of Pojoaque	1,756
County area between the Pueblo of Pojoaque and the Pueblo de San Ildefonso	106
Pueblo de San Ildefonso	828
Service Area	**4,471**

Source: New Mexico Office of the State Engineer 2011

Average groundwater budgets of both the Pojoaque-Nambé and Tesuque Basins show more outflow than inflow to the aquifer, indicating the potential for reductions in groundwater levels or impacts on surface water springs. Monitoring data compiled by Balleau Groundwater, Inc. (2003) between the mid-1940s and 2000 showed groundwater level declines of between 0.2 and 20.4 feet in the general project area. Out-of-basin uses, as described in **Section 3.4.3**, have affected the Pueblo de Ildefonso and the southern portion of the Pueblo of Tesuque.

3.5 Water Quality

The following sections provide the methods used to analyze the existing conditions of water quality, followed by a description of existing water quality conditions in the Pojoaque Basin.

3.5.1 Methods

The Pojoaque Basin, including the general project area, is the area of analysis for water quality. A literature review provided an inventory of the water quality constituents of concern in streams and in the groundwater. This inventory was supplemented by regional water quality studies on constituents of concern with concentrations exceeding water quality standards. The affected environment was derived from analyzing water quality data from the EPA, the USGS, the NMED, and other sources, along with National Pollutant Discharge Elimination System (NPDES) permits.

3.5.2 Surface Water Quality

Water quality standards and designated uses exist for New Mexico, the Pueblo of Nambé, the Pueblo of Pojoaque, and the Pueblo of Tesuque. The Pueblo de San Ildefonso does not have EPA-approved water quality standards; without approved water quality standards, the EPA has primacy to regulate based on federal CWA standards. The New Mexico Water Quality Act was adopted in 1967. It established authority for state programs consistent with the CWA, including the adoption of water quality standards. The approval of water quality standards programs was granted for the Pueblo of Nambé

on August 18, 1995, for the Pueblo of Pojoaque on March 21, 1996, and for the Pueblo of Tesuque on April 29, 1997.

3.5.2.1 Designated Uses

States and authorized Tribes specify designated uses to be achieved and protected based on purposes such as public water supply; protection of fish, shellfish, and wildlife; recreation; and agricultural and industrial use. The designated uses for New Mexico waters in the Rio Grande Basin are shown in **Table 3-5**, below. Designated uses are assigned to ephemeral, intermittent, and perennial waters in the state in 20.6.4.97 NMAC; additional or modified designated uses are assigned to specific waters in subsequent sections.

Table 3-5. State of New Mexico Designated Uses for Waters in the Rio Grande Basin

	Irrigation	Limited Aquatic Life	Livestock Watering	Marginal Cold Water Aquatic Life	Marginal Warm Water Aquatic Life	Primary Contact	Public Water Supply	Secondary Contact	Warm Water Aquatic Life	Wildlife Habitat
Ephemeral waters		X	X					X		X
Intermittent waters			X		X	X				X
Perennial waters			X			X			X	X
Rio Grande Basin (main stem)	X		X	X		X	X		X	X
Rio Grande Basin (reach 114)[1]	X		X	X		X			X	X

Source: NMED 2013

[1] Reach 114 is the main stem of the Rio Grande, from the Cochiti Pueblo boundary upstream to Rio Pueblo de Taos. It excludes waters on the Pueblo de San Ildefonso and Santa Clara and Ohkay Owingeh Pueblos; Embudo Creek from its mouth on the Rio Grande upstream to the Picuris Pueblo boundary; the Santa Cruz River from the Santa Clara Pueblo boundary upstream to the Santa Cruz dam; the Rio Tesuque except waters on the Pueblos of Tesuque and Pojoaque; and the Rio Pojoaque from the Pueblo de San Ildefonso boundary upstream to the Pueblo of Pojoaque boundary. Some Rio Grande waters in this segment are under the joint jurisdiction of the State and the Pueblo de San Ildefonso.

The Pueblo of Nambé, the Pueblo of Pojoaque, and the Pueblo of Tesuque have specified similar designated uses for waters on their lands, as shown in **Table 3-6**, below. The Pueblo de San Ildefonso defines designated uses as "…the uses of water resources on the Pueblo which we wish to ensure continuation without degradation" (Pueblo de San Ildefonso 2014). The Pueblo de San Ildefonso monitors specific water resource features for degradation using NMAC water quality standards. Monitoring locations are as follows (EPA 2014a):

- The Rio Pojoaque reach, between the boundaries of the Pueblo of Pojoaque and the Pueblo de San Ildefonso
- The Rio Pojoaque, near the confluence with the Rio Grande
- The Rio Grande at the Rio Pojoaque confluence and near Otowi Bridge

Table 3-6. Pueblo Designated Uses for Waters in the General Project Area

	Fish Culture	Groundwater Recharge	High Quality Cold Water Fishery	Irrigation	Livestock Watering and Wildlife Habitat	Marginal Cold Water Fishery	Municipal and Industrial Water Supply	Recharge of Domestic Water Supply	Primary Contact	Warm Water Fishery
Pueblo of Nambé										
Rio Nambé above the Nambé Falls Dam and Nambé Lake and their perennial tributaries	X		X	X	X		X	X	X	
Waters below the Nambé Falls Dam, including Pojoaque Creek, Rio Nambé, and perennial streams				X	X	X		X	X	X
All intermittent or ephemeral streams, including Rio en Medio and Rio Chupadero				X	X				X	
Pueblo of Pojoaque										
Rio Pojoaque and tributaries		X		X	X	X			X	
Rio Tesuque and tributaries		X		X	X	X			X	
Rio Nambé and tributaries		X		X	X	X			X	
Pueblo of Tesuque										
Rio Tesuque, Rio en Medio, and the Rio Chupadero and their perennial tributaries	X	X		X	X				X	X
Aspen Ranch and the Vigil Grant		X	X		X				X	
All other intermittent or ephemeral streams					X				X	

Sources: Pueblo of Nambé 2006; Pueblo of Pojoaque 1999; Pueblo of Tesuque 2005

3.5.2.2 Water Quality Assessment and Total Maximum Daily Loads

The CWA Section 101(a)(2) establishes as a national goal "water quality which provides for the protection and propagation of fish, shellfish, and wildlife, recreation in and on the water." Waters, including limited segments, not meeting the goals or water quality are identified and placed on the Section 303(d) list of impaired waters requiring action to improve water quality. The results of the assessment for New Mexico are provided in the CWA Section 303(d)/305(b) Integrated Report (NMED 2014a). Currently, the Pueblo de San Ildefonso, the Pueblo of Nambé, the Pueblo of Pojoaque, and the Pueblo of Tesuque do not have treatment in a similar manner as a state authority for defining impaired features under the 303(d) program; however, at the time of this writing, the EPA is considering rulemaking to provide for this (EPA 2014b).

The CWA and supporting water quality protection regulations require each entity to monitor and assess water quality and categorize the water resources in the State's CWA

The CWA and supporting water quality protection regulations require each entity to monitor and assess water quality and categorize the water resources in the State's CWA Section 303(d)/305(b) Integrated Report. Reaches are categorized based on level of impairment, as follows:

- Category 1—All designated uses are supported.
- Category 2—Available data or information indicates that some designated or existing uses are supported based on numeric and narrative parameters that were tested.
- Category 3—Inadequate data is available for evaluating supported uses. No reaches in the study area were designated Category 3.
- Category 4A—Available data or information indicate that at least one designated or existing use is not being supported, but a total maximum daily load (TMDL) is not needed because TMDLs have already been established.
- Category 4B—A pollution control program has been established and directed at the pollution issue. No reaches in the study area were designated Category 4B.
- Category 4C—The impairment is caused by a non-pollution issue, such as diversions causing low flow on a main stem river. No reaches in the study area were designated Category 4C.
- Category 5/5A/5C—Available data or information indicate that at least one designated or existing use is not being supported, and necessary supporting studies and development of TMDLs are underway or scheduled. A Category 5A designation means that a TMDL is required for the unattained water quality criteria. A Category 5C designation means that a TMDL may be required, with the cause of the unattained water quality criteria suspected as naturally occurring.

Impaired waters in the Rio Grande Basin are shown in **Table 3-7**, below. Impaired waters require TMDL studies and implementation plans to address the impairments. Some of these waters are in higher elevations, above the western Pueblo de San Ildefonso future projects study area. These impaired waters are the Guaje Canyon, Pueblo Canyon, and Los Alamos Canyon. The NPDES permittees are associated with Los Alamos County or Los Alamos National Laboratory (LANL).

LANL (2008, 2011), Lyman et al. (2005), and NMED (2007, 2008) previously completed investigations of the nature, extent, transport, and potential risk from legacy chemicals and radionuclides of potential concern from LANL facilities and lands. This potential pollutant source could enter the Rio Grande from several west bank tributaries, including the Los Alamos Canyon below the Otowi Bridge. Some of these studies examined the transport of polychlorinated biphenyls (PCBs) in stormwater. One study determined background conditions at a site at Santa Clara Pueblo, upstream of the Los Alamos Canyon and Rio Grande confluence.

An evaluation of the BDD site farther downstream, along the Rio Grande, mostly found trace metals and radiochemical measurements indistinguishable from background. The

Table 3-7. Impaired Waters in the Rio Grande Basin

Reach	Category	Impaired Use	Probable Causes
Guaje Canyon	5/5A	Livestock watering, marginal warm water aquatic life	Aluminum, gross alpha
Los Alamos Canyon	5/5C	Limited aquatic life, livestock watering, wildlife habitat	Aluminum, copper, gross alpha, mercury, PCBs, zinc
Mortandad Canyon	5/5C	Limited aquatic life, livestock watering	Aluminum, copper, gross alpha
Pueblo Canyon	5/5C	Livestock watering, marginal warm water aquatic life, wildlife habitat	Aluminum, copper, gross alpha, PCBs, zinc
Rio Grande (Embudo Creek to Ohkay Owingeh boundary)	5/5C	Marginal cold water aquatic life, Warm water aquatic life	PCBs in fish tissue, turbidity

Source: NMED 2012
Note: At the time of this writing, NMED 2012 is the effective 303(d) listing. A revised list (NMED 2014a) has been prepared, but the EPA has not yet approved it. NMED refers to Rio Pojoaque as the Pojoaque River.

exception was in specific areas, such as slough-filled sediments originating from the LANL, containing legacy contamination (New Mexico Bureau of Mines and Mineral Resources 1990). Most of the legacy contaminants in Rio Grande sediments are in the White Rock Canyon to Cochiti Lake reach.

Suspended sediment and related constituents were found to be slightly increased in the samples. In particular, certain samples had Plutonium-239/240 and Strontium-90 concentrations exceeding water quality standards. There were no indications that the legacy contamination from LANL contributed to the higher sample concentrations.

Impaired waters in the Pojoaque Basin are shown in **Table 3-8**, below.

There are two TMDLs in the Pojoaque Basin. The TMDL target for the Little Tesuque Creek for chronic aluminum is 0.64 pound/day (EPA 2012a). There is no waste load allocation, a load allocation of 0.48 pound/day, and a margin of safety of 0.16 pound/day. The calculated load reduction for dissolved aluminum from nonpoint sources is 3.19 pounds/day, or 87 percent. The TMDL target for the Rio Grande, non-Pueblo Santa Clara to Embudo Creek, for turbidity is 443,391 pounds/day. There is no waste load allocation, a load allocation of 332,544 pounds/day, and a margin of safety of 110,847 pounds/day. The calculated load reduction for turbidity (expressed as total suspended solids) from nonpoint sources is 699,047 pounds/day, or 68 percent.

A pilot water treatment plant was operated at the site of the proposed collection system from October 2014 to November 2015 (HDR-CDM Joint Venture 2016). Past raw water quality was compiled as part of this effort, along with raw water quality at the time of the pilot water treatment plant operation. **Table 3-9**, Rio Grande Source Water Quality, provides water quality sampling results for the source water. Calcium was the most abundant cation, followed by sodium. The most abundant anion was bicarbonates,

Table 3-8. Impaired Waters in the Pojoaque Basin

Water	Category	Designated Use	Attainment Status	Probable Causes of Impairment
Little Tesuque Creek (Rio Tesuque to headwaters)	4A	Domestic water supply	Fully supporting	Aluminum
		High quality cold water aquatic life	Not supporting	
		Irrigation	Fully supporting	
		Livestock watering	Fully supporting	
		Primary contact	Fully supporting	
		Public water supply	Not assessed	
		Wildlife habitat	Fully supporting	
Rio Pojoaque (Pueblo de San Ildefonso boundary to Pueblo of Pojoaque boundary)	5/5A	Irrigation	Fully supporting	PCBs
		Livestock watering	Fully supporting	
		Marginal cold water aquatic life	Not supporting	
		Primary contact	Not assessed	
		Warm water aquatic life	Not supporting	
		Wildlife habitat	Fully supporting	

Source: NMED 2012
Note: At the time of this writing, NMED 2012 is the effective 303(d) listing. A revised list (NMED 2014a) has been prepared, but the EPA has not yet approved it. NMED refers to Rio Pojoaque as Pojoaque River.

followed by sulfate. Radionuclides were measured at a maximum level of 31.8 picocuries per liter (pCi/l) (gross alpha) and 20.30 pCi/l (gross beta).

Suspended solids in the Rio Grande raw water can be high and variable, ranging from 1,000 milligrams per liter (mg/l) to 35,000 mg/l. High suspended solid concentrations have historically curtailed or suspended surface water collections at the BDD project (City of Santa Fe 2012). Water can have high suspended sediment loads at various times over a year and during different river flow conditions. Several recent and significant fires have occurred in the Rio Grande Basin, affecting sediment loading.

The largest of the regional and recent fires were the Cerro Grande (in 2000), the Las Conchas (2011), Pacheco (2011), Thompson Ridge (2013), and Jarosa (2013). These wildfires have affected surface water resources in the general project area in various ways. For example, wildfires can increase runoff and flood flows from burned areas (McLin et al. 2001; USACE 2012b). Burned areas have less vegetation to intercept and store rainfall. High burn severity areas can volatilize organic soils, which reduces water infiltration. Fires can also increase sedimentation rates (Lavine et al. 2005).

Both the BDD and Albuquerque Bernalillo Drinking Water Project surface diversions were affected by the Las Conchas fire, which created daily shutdowns of the BDD. The primary concern was ash washed and blown into drainages and watercourses from precipitation and wind during storms (*Albuquerque Journal* 2011a). The Albuquerque Bernalillo County Water Utility Authority Water Treatment Plant reduced, although did not completely shut

Table 3-9. Rio Grande Source Water Quality

Constituent	Units	MCL	Raw Source Water Concentrations from Pilot Plant Data		
			Minimum	Average	Maximum
Antimony	mg/l	0.006	ND	ND	ND
Arsenic	mg/l	0.01	0.0016	0.0037	0.0130
Barium	mg/l	0.002	0.06	0.50	2.90
Bicarbonate	mg/l	—	77.00	97.83	110.60
Calcium	mg/l	—	36	138	630
Chloride	mg/l	250	3.20	4.96	6.80
Chromium	mg/l	0.1	0.01	0.04	0.10
Copper	mg/l	1.3	0.0016	0.03	0.12
Cyanide	mg/l	0.2	ND	ND	ND
Fluoride	mg/l	2	0.31	0.34	0.39
Gross α	pCi/L	15	-0.52	9.95	31.80
Gross β	pCi/L	50	-0.08	6.65	20.30
Iron	mg/L	0.0003	0.63	17.60	120.00
Magnesium	mg/L	—	6.60	20.02	75.00
Nitrate (as N)	mg/L	44	0.11	0.12	0.13
Nitrite (as N)	mg/L	1	ND	ND	ND
Radium 226	pCi/L	5	0.18	1.86	7.36
Selenium	mg/L	0.05	0.0020	0.0020	0.0020
Silver	mg/L	0.1	ND	ND	ND
Sulfate	mg/L	250	24	36.50	49
Uranium	mg/L	0.03	0.00	0.01	0.06
Zinc	mg/L	5	0.01	0.08	0.34

Source: HDR-CDM Joint Venture 2016
Notes: MCL = maximum contaminant level; ND = not detected. Boron, cobalt, molybdenum, nickel, phosphate, potassium, sodium, and strontium were not measured.

down, its diversion in 2011 due to Las Conchas ash content being washed into the Rio Grande during high-precipitation storm events (*Albuquerque Journal* 2011b).

3.5.2.3 National Pollutant Discharge Elimination System Permits

The NPDES permit program addresses water pollution by regulating point sources that discharge pollutants into waters of the U.S. Existing individual and Tribal NPDES permits are summarized in **Table 3-10**, below. Additional statewide general NPDES permits are issued for animal confinement, discharges from small municipal separate storm sewer systems, pesticide general permit, stormwater general permit for construction, and stormwater general permit for multi-sector industrial activities.

3.5.3 Groundwater Quality

The USGS historically sampled three groundwater sites in the general project area, but the latest sample was nearly 40 years ago (**Appendix I**). More recent studies (McQuillan et al. 2009 and Linhoff et al. 2016) evaluated groundwater quality of private domestic

Table 3-10. NPDES Permits in the Rio Grande Basin

Permit No.	Permittee	Receiving Waters
NM0020141 Major	Los Alamos County Department of Public Utilities—Los Alamos Wastewater Treatment Facility	Pueblo Canyon, thence to Los Alamos Canyon, thence to the Rio Grande, immediately downstream of the Otowi Bridge
NM0028355 Major	Los Alamos National Security, LLC Management Contractor for Operations and U.S. Department of Energy Los Alamos Area Office	Perennial portion of Sandia Canyon and Mortandad Canyon, Cañada del Buey, Los Alamos Canyon, ephemeral portion of Sandia Canyon, Ten Site Canyon, Cañon de Valle, and Water Canyon of the Rio Grande Basin
NM0028436	Pojoaque Terrace Mobile Home Park	Arroyo Destierro, thence to Pojoaque Creek, thence to the Rio Pojoaque of the Upper Rio Grande Basin
NM0030601	Towa Resort Wastewater Facility	Unnamed arroyo, thence to the Rio Tesuque, thence to the Rio Pojoaque, thence to the Rio Grande of the Rio Grande Basin
NM0030759 Stormwater	Los Alamos National Security, LLC Management Contractor for Operations and U.S. Department of Energy Los Alamos Area Office	Tributaries or main channels of Mortandad Canyon, Cañada del Buey, Los Alamos Canyon, DP Canyon, Sandia Canyon, Ten Site Canyon, Canyon de Valle, Water Canyon, Ancho Canyon, Bay Canyon, Chaquehui Canyon, Fence Canyon, Pajarito Canyon, Twomile Canyon, Threemile Canyon, Potrillo Canyon, Pueblo Canyon, and Rendija Canyon of the Rio Grande Basin

Source: NMED 2014b

wells in the project area and the overall Santa Fe area, which is reviewed in detail in **Appendix I**. These studies sampled 749 volunteer private well owners. The studies evaluated constituents, based on EPA maximum contaminant levels (MCLs) for municipal water systems and the New Mexico Water Quality Control Commission (WQCC) groundwater standards.

Wells in the general project area were noted to be influenced by unique geochemical characteristics, when compared to the overall Española Basin. For example, the presence of volcanic ash (volcaniclastics) and uranium ore resulted in higher concentrations of arsenic and uranium in water samples. The median uranium concentration was 0.06 mg/l (exceeding the regional median value of 0.006 mg/l); the average uranium concentration exceeded 0.1 mg/l. Shallow wells had higher concentrations than deeper wells. Most samples exceeded water quality standards for arsenic and fluoride. Well samples had concentrations of constituents indicative of domestic wastewater influences.

Table 3-11, below, lists the range of concentrations for the constituents of regional concern.

Table 3-11. Summary of Groundwater Samples in the Region

Statistic	Concentration in Micrograms per Liter (mg/l)								
	Arsenic	Barium	Fluoride	Iron	Manganese	Nitrate	Sulfate	Uranium	Total Dissolved Solids
Median	0.0029	0.1	0.5	0.034	0.005	6	30	0.006	402
Average	0.0055	0.12	0.7	0.292	0.044	9	77	0.044	525
Maximum	0.0895	1.42	6.5	26	1.394	191	7,050	1.82	11,351
EPA/WQCC standards	0.01	0.002	4/2	0.3	0.05	44	250	0.03	500
Exceeds Standard	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Source: Linhoff et al. 2016
Note: Wells sampled around Nambé were influenced by geochemically distinct characteristics.

Bent (2013) presented potential return flow indications of septic fields to the Rio Nambé. During a field inspection near Tera Verde, County Road 113, and County Road 117 on March 3, 2013, Bent found estimated return flows of 30 gpm with algal growth. On May 22, 2014, a Reclamation survey team also found algae between Rio Nambé river miles (RMs) 3.8 and 4.5. They also found evidence of grazing in the riparian area. Lieutenant Governor Arnold Garcia of the Pueblo of Nambé noted during the Reclamation survey that the Pueblo has upgraded and modernized three centralized sewage and wastewater treatment facilities to serve Pueblo residents; the Pueblo will soon implement plans to upgrade and modernize its fourth centralized sewage and wastewater treatment facility.

Brinkman and West (2005) noted that return flows to surface water from septic fields could be a significant factor when groundwater levels were within 100 feet of the surface, a condition that occurs in 78 percent of the area's groundwater wells. Return flows to surface water originating from domestic sources were estimated to be between 50 and 67 percent of all return flows.

3.6 Geology and Soils

The following sections provide the methods used to analyze the existing conditions of geology and soils, followed by a description of existing geology and soils conditions.

3.6.1 Methods

The data for this analysis were collected from local, state, and federal sources, including NRCS and USGS.

Within the general project area, a narrower area of potential disturbance was developed. It focuses on areas of soils likely to be affected by surface-disturbing activities associated with the RWS and the other proposed actions. The area of analysis for soil resources is similar to that for cultural resources. It is a 100-foot-wide buffer along all project infrastructure, although the buffer may be wider in certain areas.

The area of potential disturbance contains several sensitive soils that are described below, with complete definitions provided in the **Glossary**.

- Erosive soils are sensitive to erosion by wind, water, or both (NRCS 2016). Increased soil erosion can reduce vegetation and increase bare ground, dust pollution, and sediment in streams, with the consequent potential to impact wildlife and habitat.
- Expansive clays are soil units that have high shrink-swell potential. They are generally considered inappropriate areas for developing buildings, pipelines, or other infrastructure unless the soils are extensively amended (NRCS 2008).
- Corrosive soils have the potential to corrode concrete or steel and may be considered inappropriate for buildings, pipelines, or other infrastructure unless the soils are extensively amended.

3.6.2 Geology

The Española Basin is a part of the Rio Grande Rift, which is a general north-south alignment of large geologic basins extending from southern Colorado to Mexico. The

basins developed as the Colorado Plateau pulled away from the High Plains at the plate tectonic level, which causes the Earth's crust to be stretched, thinned, faulted, and broken. The northern part of the rift is relatively narrow, consisting of a series of westward-stepping basins flanked by rugged mountains. The rift broadens considerably south of Socorro and merges with the Basin and Range province in southwestern New Mexico. As the basins formed, the rift filled with large volumes of sediment washed in from the sides of the rift. The sediments that fill the Española Basin comprise an aquifer system that provides the primary source of water for most residents in the City of Santa Fe, on six Pueblos, and in the surrounding areas (USGS 2011).

The Pojoaque Basin is in the southeast region of the greater Española Basin. As a result, the geologic features resemble those of the Española Basin. Due to the plate tectonic stresses of the Rio Grande Rift, the basin contains both igneous and sedimentary rock. The western portion of the Pojoaque Basin is composed of igneous rock from the Jemez Volcanic Field (Ferguson et al. 1995). The crystalline rocks typically host metallic and other locatable minerals, primarily gold and silver, which have been mined at various locations in the Pojoaque Basin (Lazarus and Drakos 2014). The eastern portion of the Pojoaque Basin is composed primarily of sedimentary rock, created from sediment washed in from the side of the rift or from the neighboring Sangre de Cristo Mountains. The crystalline rocks do not store water in large quantities, although the sedimentary rocks underlying the plains and valleys have greater storage capacity.

The Pojoaque Basin is subject to the geologic hazards of mass wasting (a general term for the mass-movement of landforms, such as rockfalls, landslides, and debris flows), earthquakes, subsidence, shallow bedrock, arroyo (or wash) erosion, erosion and sedimentation, and flooding. Earthquakes generally occur along faults or breaks in the Earth's crust, such as the Rio Grande Rift. In the general project area, the Barrancos fault system was interpreted using aeromagnetic data (Grauch et al. 2009). Gravel mining and flooding in the general project area causes arroyos to overload and erode. The erosion and resulting sedimentation can overload the riparian corridor with sediment along the Rio Grande.

The geology of the Pojoaque Basin dictates the types of soils found throughout the area of analysis. The Soil Survey of Santa Fe County (NRCS 2008) provides an introduction to the soil types and parent material in the area. (Parent material is bedrock in the area that has eroded to provide the mineral component in the soils.) The soil parent material in the Pojoaque Basin is generally composed of igneous and sedimentary rocks formed from the processes discussed above. The Pojoaque Basin consists mostly of unconsolidated alluvial deposits (material deposited by rivers), with smaller outcroppings of limestone, sandstone, and shale.

3.6.3 Soils

Specific soil types in the Pojoaque Basin are loam, urban complexes, and river-wash complexes (NRCS GIS 2014). Variations of loam soil types are composed of varying sized particles. They have differing ratios of sand and clay and generally have a moderate-to-high capacity to transmit water. Urban complex soils are a combination of several soils on or near older alluvial fan landforms that have been or are being eroded. They typically consist of silt and clay loams and have a moderately high capacity to transmit water. River wash complex soils are a combination of several soils on

floodplains and valley floors. They are typically alluvium, derived from mixed parent material; they are generally mixed grain sizes, ranging from sand to course gravelly sand. They are frequently flooded and have a moderate-to-high capacity to transmit water. The Farmland Protection Policy Act (7 USC, Section 4201) defines prime and unique farmlands. There are no such farmlands in the general project area.

Most soils in the Pojoaque Basin are subject to increased wind or water erosion from surface disturbances. This is especially the case where the disturbance results in a loss of vegetation cover, which reduces erosion by limiting the amount of wind across the land surface. Vegetation also provides stability for soil. Smaller grained soil, such as clay and silt, are more susceptible to wind erosion, due to their weight and size.

Soils in the general project area often have high corrosiveness on steel and low corrosiveness on concrete, a high sensitivity to erosion by wind or water, and relatively few acres of expansive clays. More specifically, within the area of potential disturbance similar trends in sensitive soils persist. **Table 3-12**, below, lists the relevant soil properties.

Table 3-12. Sensitive Soils in the Area of Potential Disturbance (Acres)

Rating	Corrosion of Steel	Corrosion of Concrete	Erosive Soil	Expansive Clay
Low		4,790		
Moderate	360	210		
High	4,630	0	4,830	90
Unknown	170	170		

Source: NRCS GIS 2014
Note: Erosive soil and expansive clay calculates the presence of these soil types; as such, the rating categories are not applicable to these two soil types.

3.7 Paleontological Resources

Paleontological resources are any fossilized remains or traces of organisms that are preserved in, or on, Earth's crust, that are of scientific interest, and that provide information about the history of life. Paleontological resources, whether invertebrate, plant, trace, or vertebrate fossils, constitute a fragile and nonrenewable record of the history of life on our planet.

The potential for paleontological resources is based on the regional geology; therefore, the analysis area for paleontological resources is the Pojoaque Basin for context, with an emphasis on the general project area. To assess the potential for paleontological resources, a literature review was conducted and the U.S. Department of the Interior, Bureau of Land Management's (BLM) PFYC geographic information system (GIS; BLM GIS 2014) layer was overlaid with the Pojoaque Basin.

3.7.1 Paleontological Potential

The PFYC System is used to assess the relative paleontological resource sensitivity of geological units crossed by the RWS. This is a five-tiered system that classifies geological units based on the relative abundance of vertebrate fossils or scientifically significant invertebrate and plant fossils and their potential to be adversely affected, with a higher class number indicating a higher potential level. Each class is defined briefly as follows:

- **Class 1, Very Low Potential**—Geological units not likely to contain recognizable fossil remains, such as igneous, metamorphic, and Precambrian rocks.
- **Class 2, Low Potential**—Sedimentary geological units not likely to contain vertebrate fossils or scientifically significant invertebrate fossils, such as altered formations or Holocene sediments.
- **Class 3, Moderate or Undetermined Potential**—Fossiliferous sedimentary geological units where fossil content varies in significance, abundance, and predictable occurrence; or sedimentary units of unknown fossil potential. Class 3 is divided into two parts:
  - **Class 3a, Moderate Potential—**Units are known to contain vertebrate fossils or scientifically significant invertebrate fossils, but these occurrences are widely scattered; common invertebrate or plant fossils may be found in the area.
  - **Class 3b, Undetermined Potential—**Units exhibit geological features that suggest significant fossils could be present, but little information about the paleontological resources of the unit or area is known. This may indicate the unit or area is poorly studied and field surveys may uncover significant fossils.
- **Class 4, High Potential—**Geological units that contain a high occurrence of significant fossils; vertebrate fossils or scientifically significant invertebrate or plant fossils are known to occur and have been documented but may vary in occurrence and predictability.
- **Class 5, Very High Potential—**Highly fossiliferous geological units that consistently and predictably produce vertebrate fossils or scientifically significant invertebrate or plant fossils (BLM 2007).

The classification is based on coarse mapping of formations and does not necessarily include information from ground surveys for fossil localities. It indicates potential sensitivity that should be considered in project planning, but not necessarily the presence or absence of the resource.

The potential for paleontological resources in the Pojoaque Basin is variable. There is a low potential in the highest elevations and near rivers, roads, and arroyos; however, the upland badland exposures and foothills have a high potential for Miocene age (about 10 to 16 million years ago) vertebrate fossils. There are extensive museum collections of fossils from the Pojoaque Basin and surrounding areas (Galusha and Blick 1971).

There are no very high potential (Class 5) areas in the general project area; however, there are high potential Class 4 geological units that may contain a high occurrence of scientifically important vertebrate or invertebrate fossils or plant fossils (**Figure 3-4**, Potential Fossil Yield Classification). Much of the general project area is classified as Class 2, low potential. However, the general project area has not been surveyed in support of the RWS for fossil localities, nor has it been field checked for consistency with the mapped classifications.

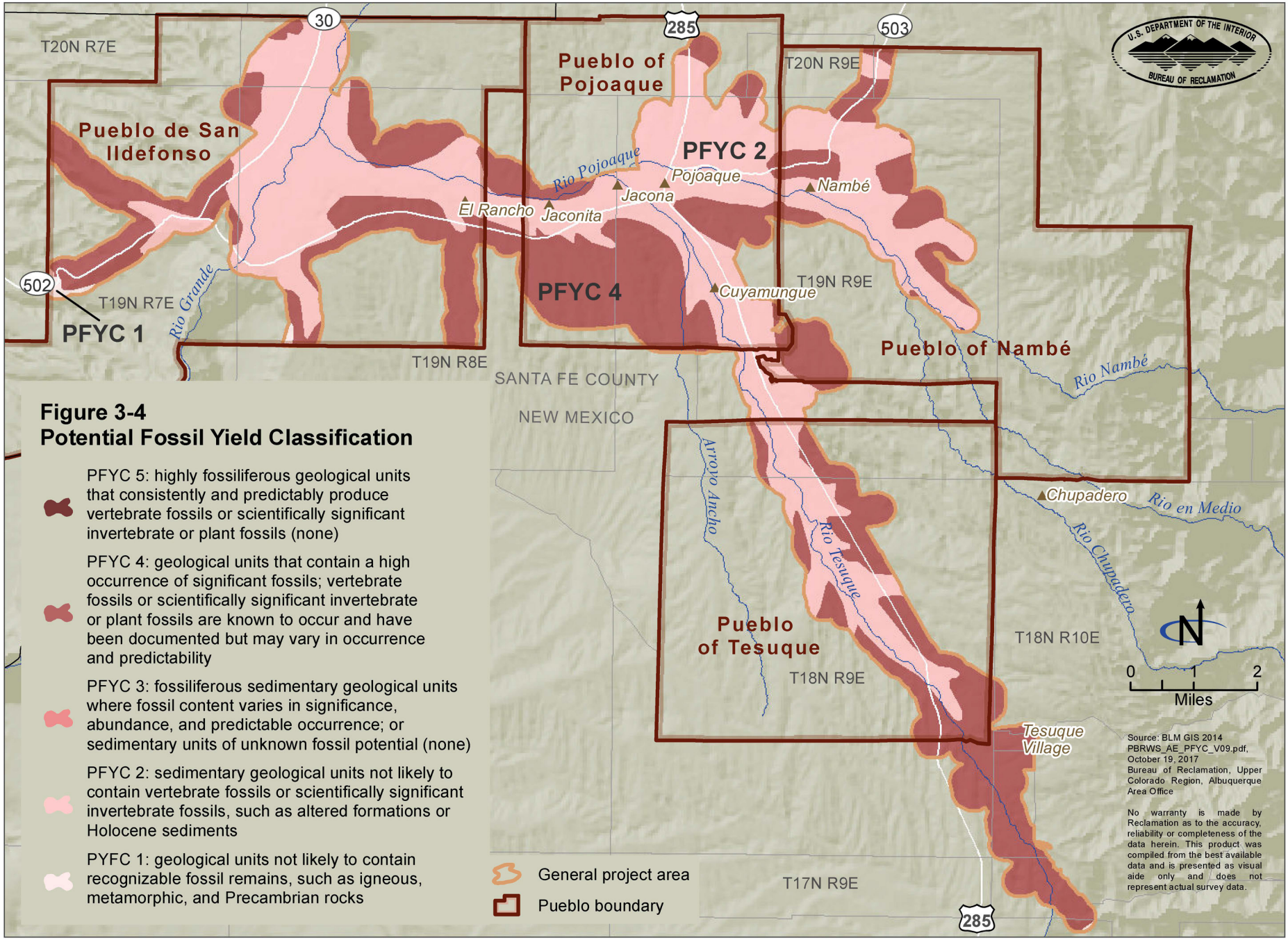


Figure 3-4
Potential Fossil Yield Classification

- PFYC 5: highly fossiliferous geological units that consistently and predictably produce vertebrate fossils or scientifically significant invertebrate or plant fossils (none)
- PFYC 4: geological units that contain a high occurrence of significant fossils; vertebrate fossils or scientifically significant invertebrate or plant fossils are known to occur and have been documented but may vary in occurrence and predictability
- PFYC 3: fossiliferous sedimentary geological units where fossil content varies in significance, abundance, and predictable occurrence; or sedimentary units of unknown fossil potential (none)
- PFYC 2: sedimentary geological units not likely to contain vertebrate fossils or scientifically significant invertebrate fossils, such as altered formations or Holocene sediments
- PYFC 1: geological units not likely to contain recognizable fossil remains, such as igneous, metamorphic, and Precambrian rocks

3.8 Air Quality

The following sections provide the methods used to analyze the existing conditions of air quality, followed by a description of existing air quality.

3.8.1 Methods

The general project area is in Santa Fe County and includes the Settlement Pueblos. The dispersive nature of air pollutants makes it appropriate to consider a broader air quality area of analysis that includes all of Santa Fe County.

This section examines the existing air quality in the area of analysis. It is based on the County attaining the National Ambient Air Quality Standards (NAAQS) and the concentrations of criteria air pollutants measured by air monitoring stations in various locations throughout the county.

Detailed background information on air quality and the regulations for air quality are provided in **Appendix H**, Air Technical Report.

3.8.2 Ambient Air Quality

The Clean Air Act of 1970 (CAA; 42 USC sections 7401-7642) established the principal framework for national, state, and local efforts to protect air quality. The EPA sets regulations and standards to implement the CAA.

The CAA authorizes the EPA to establish NAAQS (EPA 2016a). The EPA has set time-averaged standards for six air pollutants considered to be key indicators of air quality: carbon monoxide, nitrogen dioxide, ozone, sulfur dioxide, lead, and two categories of particulate matter (particulate matter with an aerodynamic diameter of 10 microns or less [PM_{10}] and particulate matter with an aerodynamic diameter of 2.5 microns or less [$PM_{2.5}$]).

The CAA requires each state to identify areas with ambient air quality that violates federal standards using monitoring data collected through state monitoring networks, as follows:

- Areas that violate air quality standards are designated as nonattainment for the relevant criteria air pollutants.
- Areas that comply with air quality standards are designated as attainment for the relevant criteria air pollutants.
- Areas that have been redesignated from nonattainment to attainment are considered maintenance areas.
- Areas of uncertain status are generally designated as unclassifiable but are treated as attainment areas for regulatory purposes.

The general project area is in attainment or is unclassified for all NAAQS (EPA 2016b).

EPA's Air Data website provides air quality information for Santa Fe County. The current information for Santa Fe County is available for 2015 and shows that the air quality is good in the general project area (see Figures 2 through 6 in **Appendix H**; EPA 2016c).

There are no permitted stationary sources within 6 miles of the general project area.

3.9 Climate Change

In 2009, the U.S. Department of the Interior issued Secretarial Order 3289, *Addressing the Impacts of Climate Change on America's Water, Land, and Other Natural and Cultural Resources*. The order directed U.S. Department of the Interior agencies to include potential climate change in long-range planning processes.

Reclamation revised the Reclamation Manual of Directives and Standards for Water and Related Resources Feasibility Studies Comprehensive Policy 09-02 (Reclamation 2014b). This manual provides guidelines for incorporating potential climate change in project alternatives impacts, including future conditions without a plan.

Reclamation Comprehensive Policy 09-02 provides for the following approaches to climate change impact assessment:

- Option A—No analysis
- Option B—Literature review and qualitative analysis
- Option C—Quantitative effects analysis

Option C was adopted for the RWS feasibility studies based on Rio Grande Basin quantitative assessments performed through the WaterSMART program (Reclamation 2013b) and alternatives described in **Chapter 2**.

This section describes how climate change is influencing the Pojoaque Basin watershed and the GHG emissions within the basin that contribute to climate change.

3.9.1 Methods

The Pojoaque Basin, including the general project area, is the area of analysis for climate change.

Climate change data were compiled based on literature resources describing historic trends in climate and water resource measurements and future condition projections driven by future GHG emission scenarios and general circulation models.

Downscaled climate model predictions for northern New Mexico were obtained for three emissions scenarios modeled with 15 general circulation models (Maurer et al. 2007). The three emissions scenarios were B1 (low emission), A1B (moderate emission), and A2 (high emission). A range of these climate scenario impacts was evaluated using the Upper Rio Grande Water Operations Model to analyze changes to supply and water uses (Reclamation 2015c). Each scenario was categorized into consensus groupings representing warmer and drier conditions, warmer and wetter conditions, hotter and drier conditions, hotter and wetter conditions, and a central tendency group. Time frames used in evaluating climate changes are generally stated as the period from 2070 to 2100.

3.9.2 Historic Climate Trends

Within the upper Rio Grande Basin, average temperatures have increased 2 degrees Fahrenheit in the Santa Fe watershed since 1900 (Lewis et al. 2013) and 2.5 degrees Fahrenheit in the overall Upper Rio Grande region since 1971 (Reclamation 2013b). The minimum daily temperatures have tended to increase more than the maximum daily temperatures. The temperature increases have also tended to be greater at elevations

above 7,500 feet. Valleys tended to experience more atmospheric inversions affecting the average temperatures. The warming temperatures have been associated with decreases in snowpack and increases in snowline elevation (New Mexico Office of the State Engineer 2006; USGS and Scripps Institution of Oceanography 2007). River flows in the area have trended lower over the recent timeline, as noted in **Section 3.3.2.2**, Rio Grande Watershed**,** Historical Stream Flows. The Rio Grande at Embudo had average flows of 860,000 to 1 million afy in the early 1900s, while flows averaged 586,630 afy during water years 1971 to 2012.

One driving mechanism strongly associated with winter precipitation and summer monsoons is the El Niño-Southern Oscillation (Reclamation 2013b; Grantz et al. 2007). Higher winter precipitation and reduced monsoonal precipitation tends to be driven by El Niño conditions, while La Niña conditions tend to be warmer, with below-average snowpack and higher amounts of monsoonal rains. The frequency of El Niño to La Niña conditions has increased since 1970.

Regional studies have compiled changes in temperature and precipitation in the southwestern states. Melillo et al. (2014) provides additional information on regional climatic trends.

3.9.3 Future Climate Projections

Future climate projections have been evaluated to the end of the twenty-first century for potential changes in water supply and operations in the Upper Rio Grande Basin (Reclamation 2013b). These projections are based on simulated climate scenarios from a set of global circulation models. These global circulation model climate estimates are not specific to localized areas. This is because these results are downscaled or used for input into other climate models to obtain watershed-level information. There is a wide range of potential climate change inferences produced from these climate models, with varying degrees of certainty in the likelihood of the results (Melillo et al. 2014).

Climate change predictions presented here are based on evaluating a range of emissions scenarios and global circulation models. Statements about predicted climate changes are generally representative of a median change, which could be considered a consensus condition suggested by the range of model predictions. The range of the predictions could mean that the stated climate change or impact could be less than stated or more than stated.

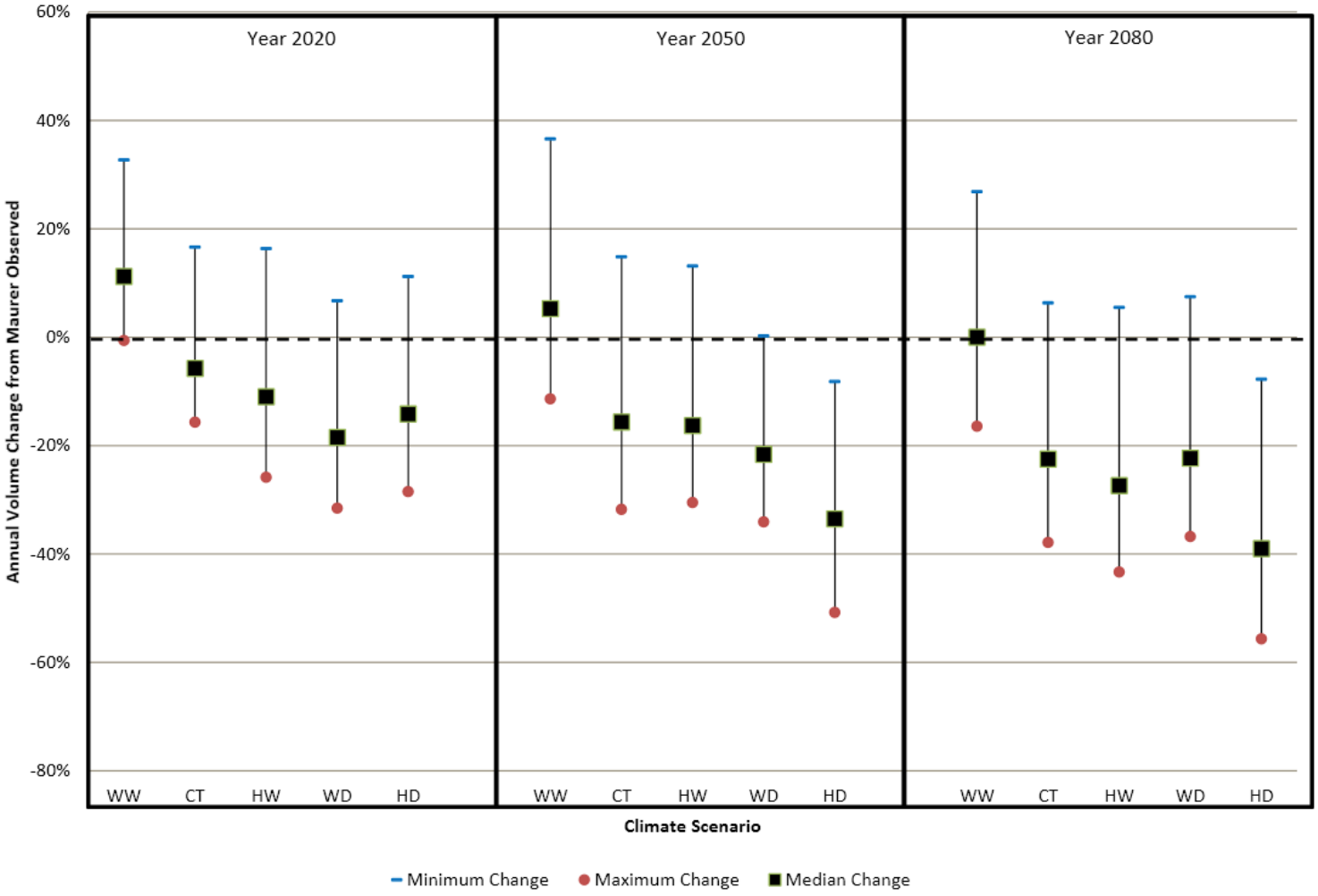
These climate change predictions and impacts are not necessarily the same as impact analyses discussed in **Chapter 4**. For example, the evaluation of the Upper Rio Grande climate changes uses a base scenario that assumes current population, water uses, and water operations remain the same with the altered future climate (Reclamation 2013b). Additionally, time frames used in evaluating climate change are generally stated as the period from 2070 to 2100, which could differ from the time frame used in evaluating project impacts in **Chapter 4**.

Regional future climate change impacts on the Upper Rio Grande Basin and the Santa Fe watershed within this basin were evaluated by Reclamation (2013b) and Lewis et al. (2013), respectively. The consensus global circulation model predictions indicate an increase in average temperature by 5 to 7 degrees Fahrenheit and a reduction in annual precipitation (Reclamation 2013b).

The Upper Rio Grande and local tributary impacts from the predicted climate change are the following:

- Higher proportions of rainfall versus snowfall (New Mexico Office of the State Engineer 2006)
- Reductions in Rio Grande and Rio Chama native runoff by one-third by the end of the twenty-first century (Reclamation 2013b)
- Tributary runoff reductions over time. The Santa Fe River runoff above McClure Reservoir is projected to decline by 11 to 18 percent by the mid-twenty-first century (Lewis et al. 2013). Runoff of Rio Grande tributaries, such as the Rio Nambé, could decrease by one-third by the end of the twenty-first century (Reclamation 2013b). Peak flow timing of the minor tributaries is not anticipated to change significantly.
- San Juan tributaries supplying the San Juan-Chama Project are projected to decline by one-fourth, with less flow in the summer (Reclamation 2013b). Corresponding Azotea Tunnel flows are projected to decline by a similar amount. Allocation of San Juan-Chama water to contractors is projected to decline from a nearly full supply on average to an average allocation of 81 percent of contracted amounts. Years in which all accounts receive full allocation are projected to decline from 98 percent to 36 percent.
- Reduced groundwater recharge and increased reliance on pumping to supplement the lower surface water supply could affect aquifers and reduce evapotranspiration from phreatophyte and riparian vegetation. While the predicted evaporation rates from reservoirs would increase from 10 to 12 percent, a reduction in runoff and reservoir storages could mean less total evaporation losses. Predicted agricultural water needs could increase by 5 percent. Municipal water needs in the summer could increase by 10 percent.
- **Figure 3-5**, Change in Annual Volume at Otowi for Various Climate Scenarios, provides the range of changes in annual flow at the Otowi gage for various climate scenarios, compared to current climate conditions. For 2020, the warmer-wetter climate scenario was simulated as higher runoff than the current conditions; the median change was an increase of 11 percent. The other climate scenarios have varying amounts of decreases in the median runoff, from 6 percent to 18 percent. Wetter years have increases in runoff, while drought years have greater decreases in runoff.

Figure 3-5. Change in Annual Volume at Otowi for Various Climate Scenarios



Source: Maurer et al. 2007
WW = warmer and wetter conditions; WD = warmer and drier conditions; HD = hotter and drier conditions; HW = hotter and wetter conditions; CT = central tendency

- The climate scenario runoffs have generally decreasing runoff in year 2050 and year 2080 outlooks. The median and drought year runoff changes have greater decreases in runoff compared to wetter years. With the exception of the hotter-drier scenario, the other scenarios by year 2080 have increases in runoff during wet years. Drought years in the year 2080 outlook are simulated as having 0 to 39 percent decreases in runoff, compared to current conditions (Reclamation 2015c).
- Low-flow and high-flow events on the Rio Grande at Otowi Bridge were projected to be more frequent under various climate change scenarios. **Figure 3-6**, Change in 7Q10 Flows at Otowi for Various Climate Scenarios, shows the lowest sustained flow over a given week occurring once every 110 years for various climate scenarios. For the year 2020 outlook, the climate scenarios generally show decreases of 21 percent (for the central tendency) to 47 percent (warmer and drier scenario). The wet and warmer scenario had a 9 percent increase in low flow. The year 2080 outlook shows that all climate scenarios considered had decreases in the low flow, ranging from 17 to 65 percent.
- The 1 percent annual chance peak flow (a high flow and flood event) had increases influenced by more rapid snowpack melt as provided in **Figure 3-7**, Change in Peak Flows at Otowi for Various Climate Scenarios. The year 2020 outlook had increases in peak flow of 6 to 33 percent, driven by the extent of temperature and snow pack increases. By the year 2080 outlook, peak flow increases range from 27 to 61 percent.

3.9.4 Greenhouse Gases

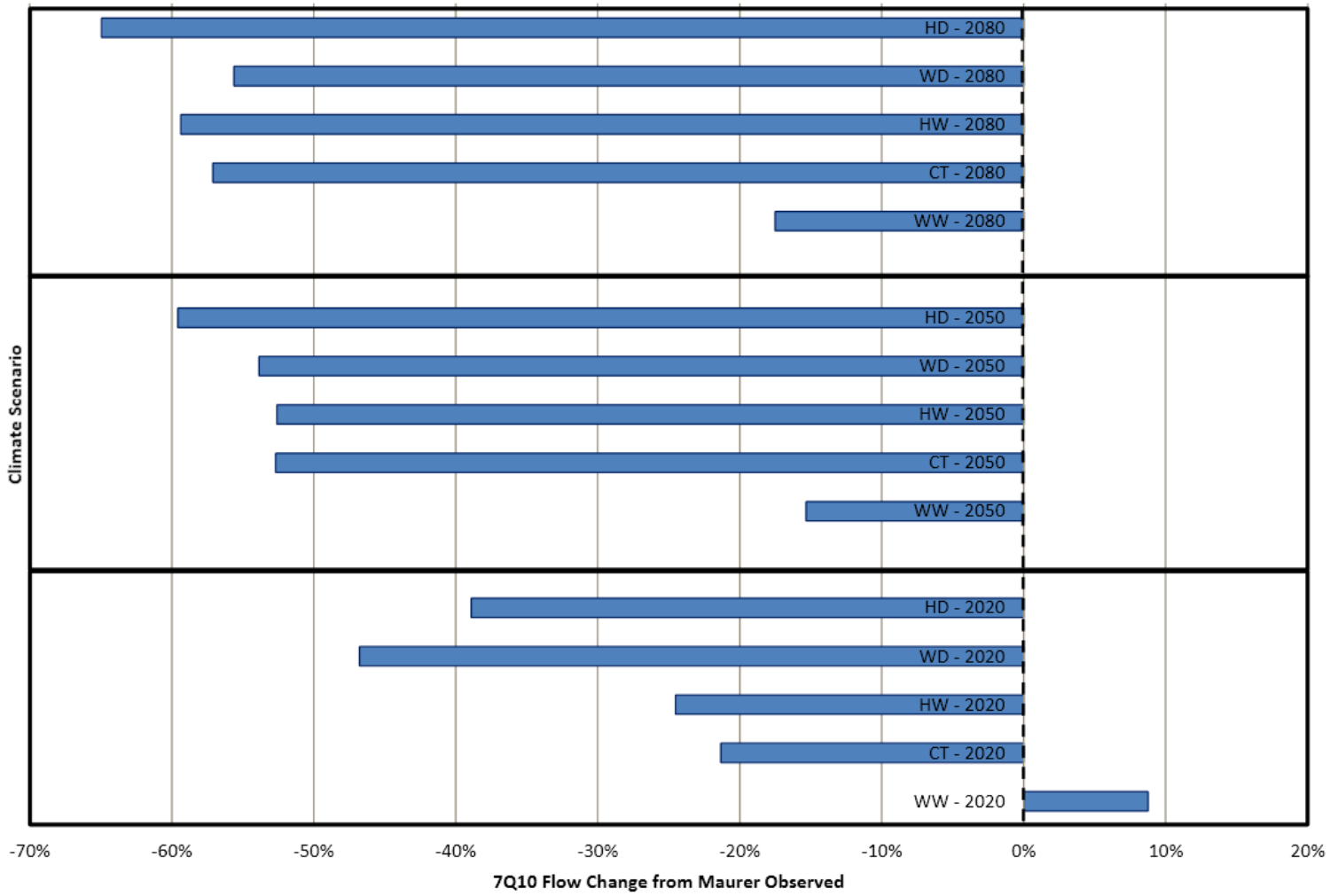
GHGs are compounds that contribute to climate change by trapping heat in the atmosphere. They absorb infrared radiation and radiate a portion of it back to the Earth's surface, thus trapping heat and warming the atmosphere. The most important naturally occurring GHG compounds are carbon dioxide (CO_2), methane, nitrous oxide, ozone, and water vapor.

Although naturally present in the atmosphere, concentrations of CO_2, methane, and nitrous oxide are also produced by industrial processes, transportation, urban development, agriculture, and other human activity. Globally, atmospheric CO_2 concentrations have increased from an estimated 277 parts per million before 1750 to approximately 395 parts per million in 2013 (Global Carbon Project 2014).

In the U.S., GHG emissions come mostly from energy use. Such emissions result from combustion of fossil fuels used for electricity generation, transportation, industry, heating, and other needs. In 2009, the electric power sector was the largest source, accounting for 40 percent of all energy-related CO_2 emissions; the transportation sector was the second largest source, at 34 percent of total emissions (EIA 2011).

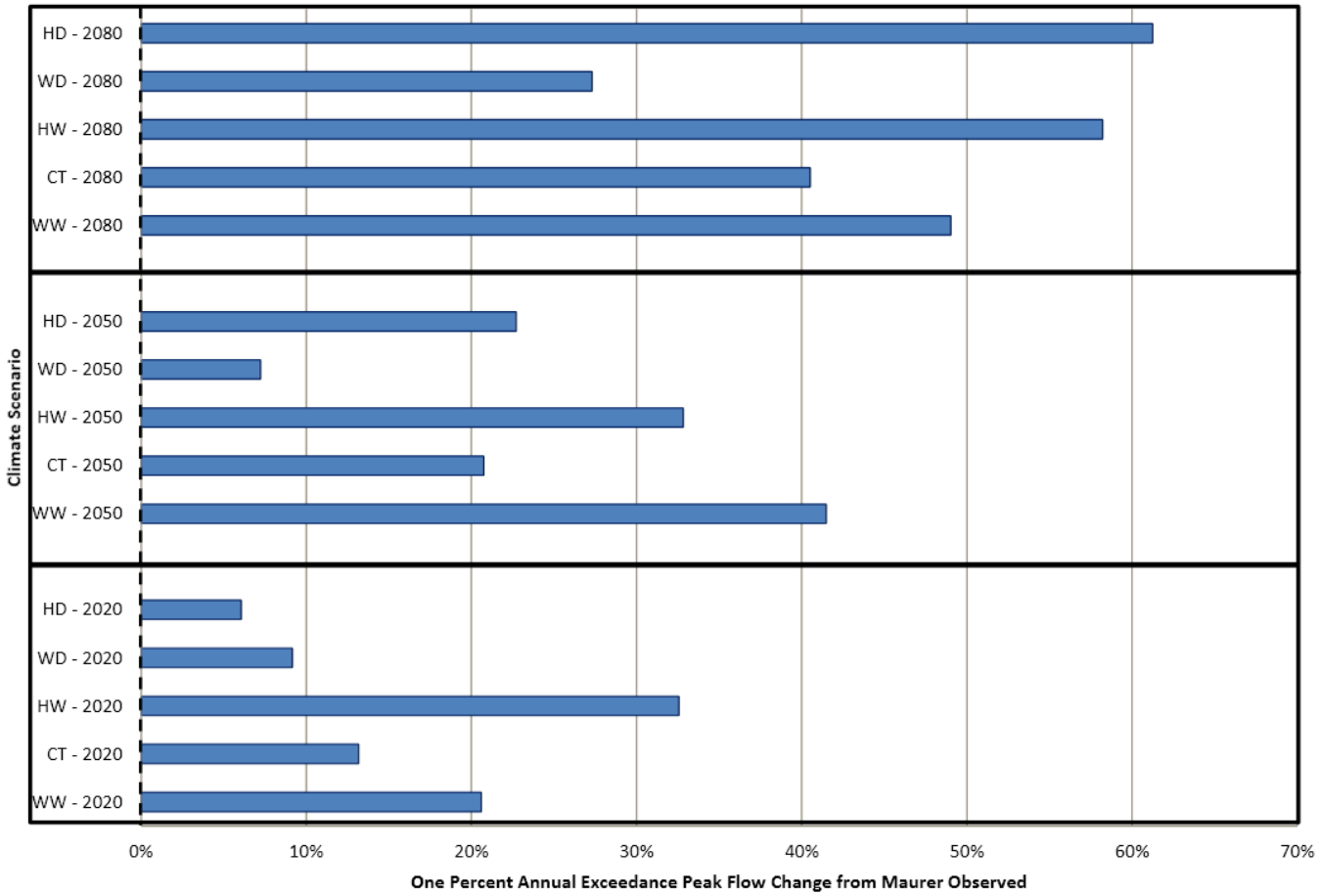
The EPA estimated that national GHG emissions in 2014 totaled 6,873 million metric tons of CO_2 equivalents (CO_2e; EPA 2015).

Figure 3-6. Change in 7Q10 Flows at Otowi for Various Climate Scenarios



Source: Maurer et al. 2007

Figure 3-7. Change in Peak Flows at Otowi for Various Climate Scenarios



Source: Maurer et al. 2007

The most recent available comprehensive inventory of statewide GHG emissions for New Mexico was in 2007. It showed gross GHG emissions of 76.2 million metric tons of CO_2e (NMED 2010). This state-wide inventory was 1.02 percent of total U.S. emissions for that same year (7,480 million metric tons of CO_2e).

3.10 Vegetation

Sections 3.10 through **3.14** provide information on the following biological resources within the general project area: vegetation; wetlands, non-wetland waters, and floodplains; wildlife, aquatic resources, and federally listed threatened and endangered species. Sources used for these resources are as follows:

- Aerial images and GIS layers provided by Reclamation, BIA, and other agencies
- e-Bird online database of compiled locations of avian species in New Mexico (eBird.org)
- Biota Information System of New Mexico online database (BISON-M 2016a) for species-specific information and state-listed species
- The Migratory Bird Treaty Act of 1918 (MBTA), 16 USC, as amended in 1989
- New Mexico Ornithological Society (NMOS) database of bird sightings throughout the state (NMOS 2014-2016)
- Project-related reports and technical memos containing data obtained during field reconnaissance of the general project area
- Service Information for Planning and Conservation (IPaC) online database (Service 2016a) for federally listed species in Santa Fe County, New Mexico

3.10.1 Methods

A literature review of existing biological resources in the 30,400-acre general project area was completed in 2013 (Reclamation 2013d). In 2015 and 2016, biological surveys were conducted to determine potential impacts on biological resources within a more narrowly defined 5,900-acre area along the proposed project infrastructure. This area, referred to herein as the biological resources area of analysis (**Figure 3-8**), represents the portion of the general project area where these resources may be disturbed by the project alternatives. Observed plant species, including special status species, were inventoried and recorded within this area of analysis. In addition, any noxious weeds designated as Class A, B, and C species observed during field surveys were also recorded (NMDA 2009 and 2016). Species lists are included in the Pojoaque Basin Regional Water System Biological Assessment (**Appendix J**, Pojoaque Basin Regional Water System Biological Assessment and U.S. Fish and Wildlife Service Concurrence Letter).

3.10.2 Vegetation Communities

The 2013 biological literature review for the 30,400-acre general project area (Reclamation 2013d) identified a variety of vegetation communities (Dick-Peddie 1993).

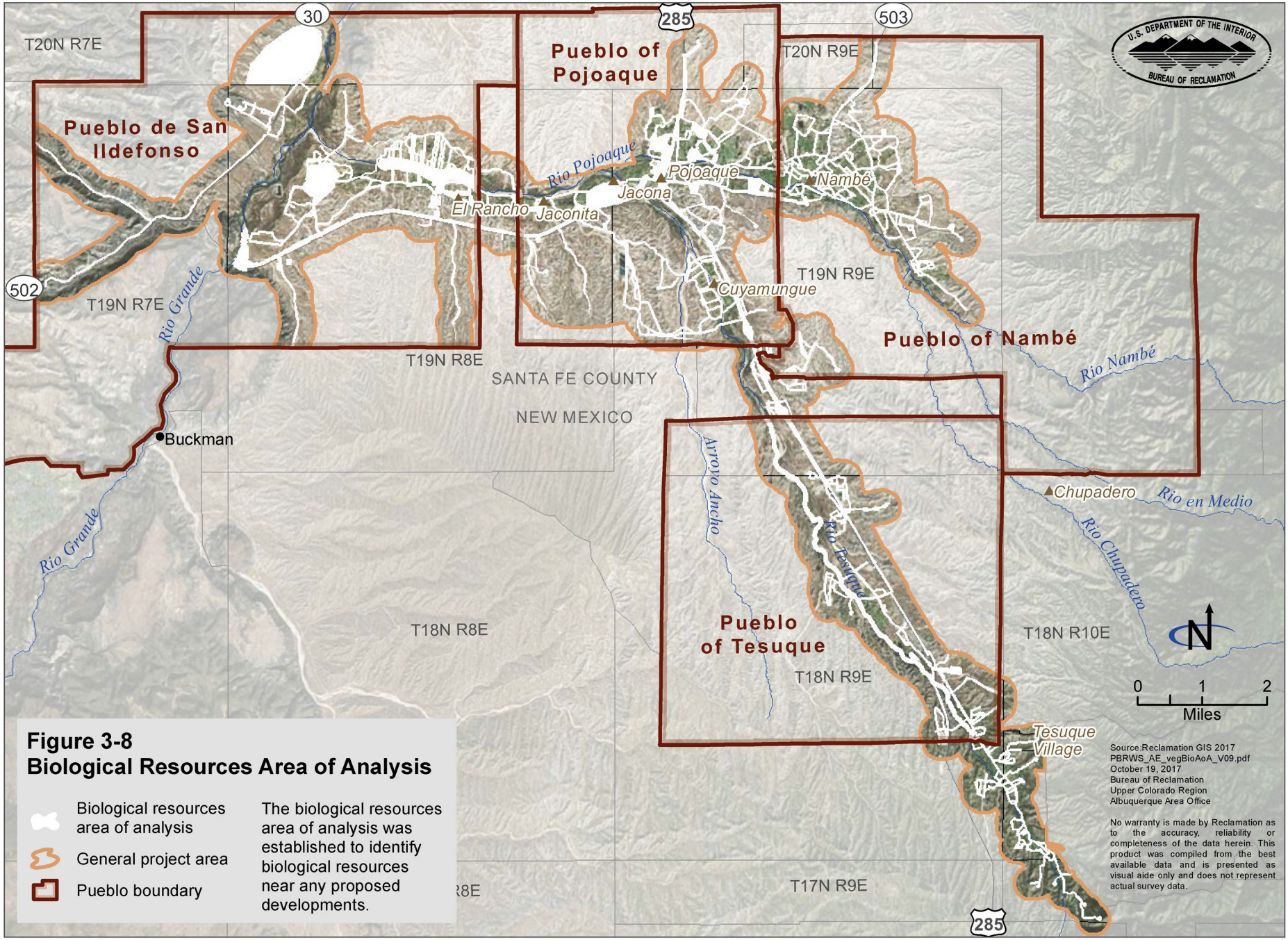


Figure 3-8
Biological Resources Area of Analysis

Biological resources area of analysis
General project area
Pueblo boundary

The biological resources area of analysis was established to identify biological resources near any proposed developments.

These consist of approximately 65 percent Urban, Farmland, or Open Water (19,700 acres), 12 percent Desert Grassland (3,720 acres), 8 percent Coniferous and Mixed Woodland (2,580 acres), and 15 percent Juniper Savanna (4,430) acres.

For a refined review of the vegetation within the general project area, a land cover map was created from aerial imagery to characterize the vegetation distribution by density and elevation within the general project area. **Figure 3-9**, Vegetation and Land Cover, shows land-cover categories of residential/agricultural, uplands and slopes, developed land, wetlands, open water, and three densities of riparian vegetation. The majority of land cover in the general project area consists of uplands and slopes (63 percent or 19,060 acres).

Vegetation spatial data from the Southwest Regional Gap Analysis Project (SWReGAP 2014) was accessed in 2014. It provided a more detailed description of the vegetation communities in the general project area (**Figure 3-10**, SWReGAP Vegetation Communities). **Table 3-13**, Vegetation Communities in the Pojoaque Basin **General Project Area**, presents SWReGAP (2014) land cover of ecological systems by acreage.

3.10.3 Special Status Plant Species

Although there are 11 rare plant species listed for Santa Fe County (NMRPTC 1999; NMEMNRD 2015), there is potential habitat for only two state listed endangered species and three state sensitive species in the biological resources area of analysis, as summarized in **Table 3-14**, Special Status Plant Species with Habitat in the Biological Resources Area of Analysis (NMEMNRD 2015). During surveys in 2015 and 2016, the locations of any special status species within the 5,900-acre biological resources area of analysis (**Figure 3-8**) were documented.

3.10.4 New Mexico State Sensitive and Endangered Plant Species With the Potential to Occur in the Biological Resources Area of Analysis

Cyanic milkvetch (*Astragalus cyaneus*). This rare milkvetch is a state sensitive species native to the north-central New Mexico counties of Rio Arriba, Santa Fe, and Taos. It is widely scattered in small populations on hills and ridges between 6,200 to 7,300 feet above msl where it is usually associated with Southern Rocky Mountain Piñon-Juniper Woodland and Juniper Savanna. It blooms in late April to early June and its leaves and pods are identifiable during most of the summer. To date, no populations of cyanic milkvetch have been identified within the biological resources area of analysis.

Santa Fe milkvetch (*A. feensis*). This rare milkvetch is a state sensitive species that ranges mostly from the vicinity of Santa Fe south to the Albuquerque foothills. Santa Fe milkvetch has been documented on Ohkay Owingeh Pueblo north of Española (SEINet 2014). Typical habitat for this species is found in the Southern Rocky Mountain Juniper Savanna or Semi-Desert Grassland between 5,100 to 6,200 feet above msl. It blooms in April to May and its leaves and pods are identifiable during most of the summer. No populations of Santa Fe milkvetch were identified within the biological resources area of analysis.

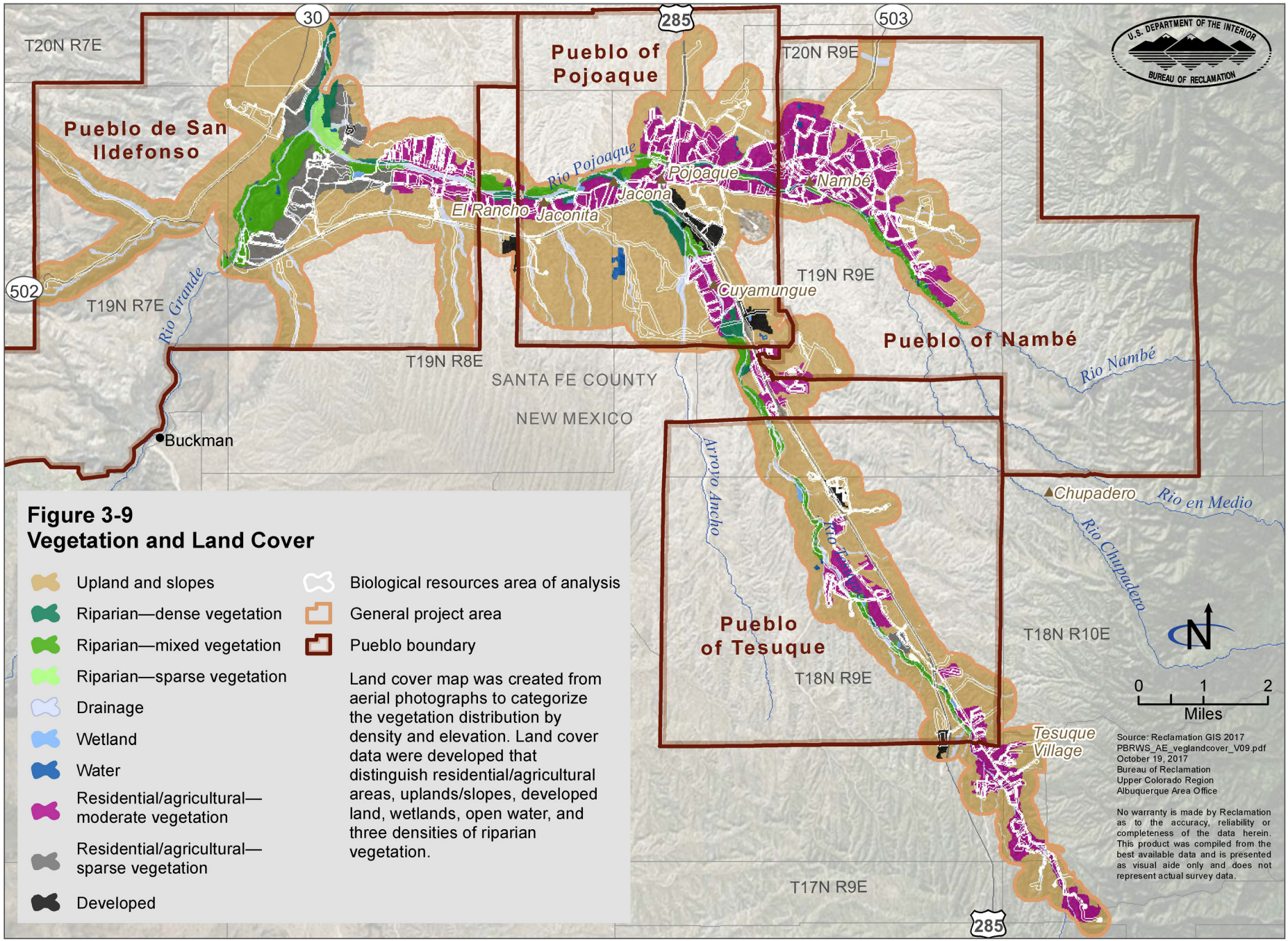


Figure 3-9
Vegetation and Land Cover

- Upland and slopes
- Riparian—dense vegetation
- Riparian—mixed vegetation
- Riparian—sparse vegetation
- Drainage
- Wetland
- Water
- Residential/agricultural—moderate vegetation
- Residential/agricultural—sparse vegetation
- Developed
- Biological resources area of analysis
- General project area
- Pueblo boundary

Land cover map was created from aerial photographs to categorize the vegetation distribution by density and elevation. Land cover data were developed that distinguish residential/agricultural areas, uplands/slopes, developed land, wetlands, open water, and three densities of riparian vegetation.

Source: Reclamation GIS 2017
PBRWS_AE_veglandcover_V09.pdf
October 19, 2017
Bureau of Reclamation
Upper Colorado Region
Albuquerque Area Office

No warranty is made by Reclamation as to the accuracy, reliability or completeness of the data herein. This product was compiled from the best available data and is presented as visual aide only and does not represent actual survey data.

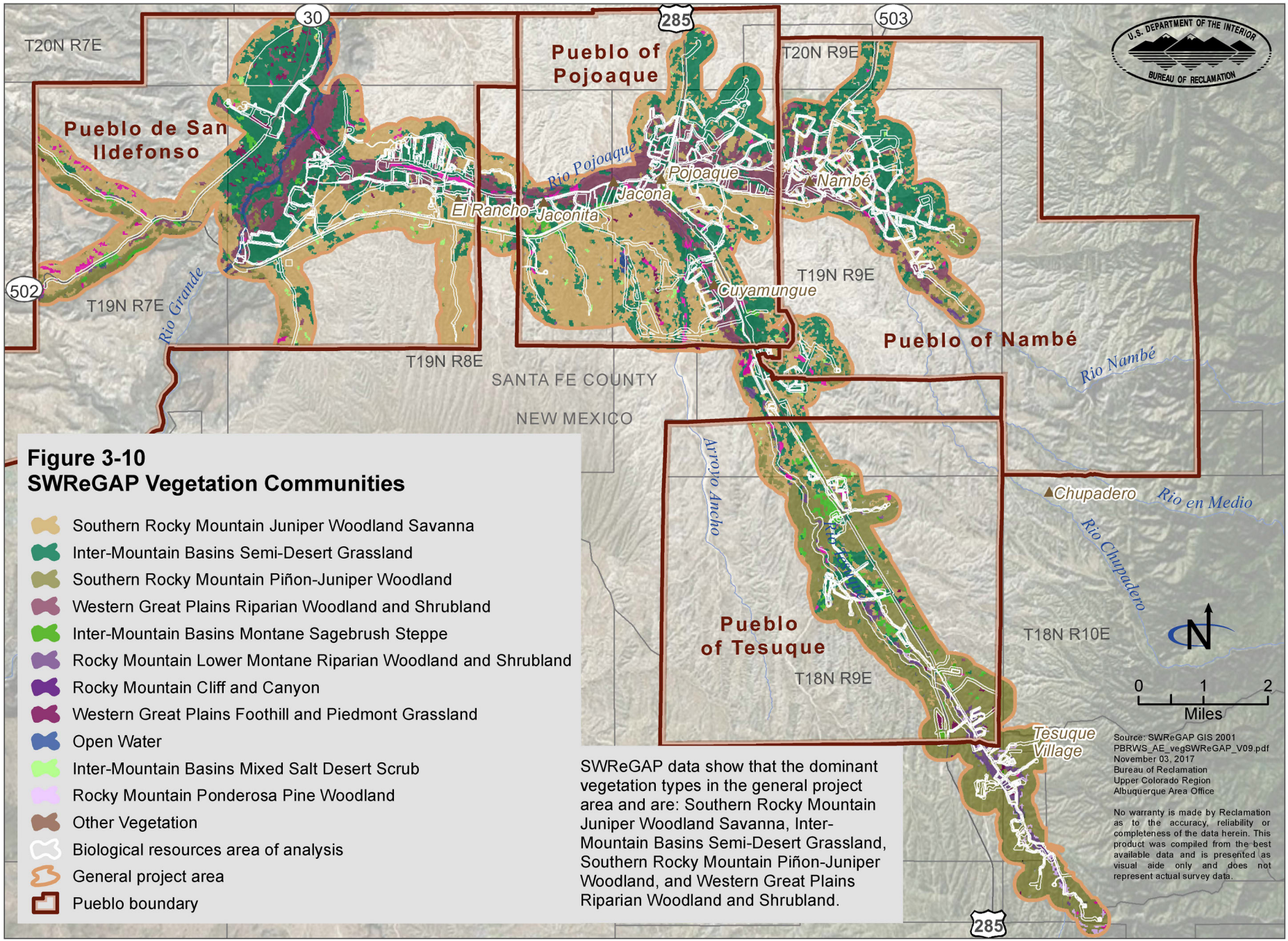


Figure 3-10
SWReGAP Vegetation Communities

- Southern Rocky Mountain Juniper Woodland Savanna
- Inter-Mountain Basins Semi-Desert Grassland
- Southern Rocky Mountain Piñon-Juniper Woodland
- Western Great Plains Riparian Woodland and Shrubland
- Inter-Mountain Basins Montane Sagebrush Steppe
- Rocky Mountain Lower Montane Riparian Woodland and Shrubland
- Rocky Mountain Cliff and Canyon
- Western Great Plains Foothill and Piedmont Grassland
- Open Water
- Inter-Mountain Basins Mixed Salt Desert Scrub
- Rocky Mountain Ponderosa Pine Woodland
- Other Vegetation
- Biological resources area of analysis
- General project area
- Pueblo boundary

SWReGAP data show that the dominant vegetation types in the general project area and are: Southern Rocky Mountain Juniper Woodland Savanna, Inter-Mountain Basins Semi-Desert Grassland, Southern Rocky Mountain Piñon-Juniper Woodland, and Western Great Plains Riparian Woodland and Shrubland.

Source: SWReGAP GIS 2001
PBRWS_AE_vegSWReGAP_V09.pdf
November 03, 2017
Bureau of Reclamation
Upper Colorado Region
Albuquerque Area Office

No warranty is made by Reclamation as to the accuracy, reliability or completeness of the data herein. This product was compiled from the best available data and is presented as visual aide only and does not represent actual survey data.

Table 3-13. Vegetation Communities in the Pojoaque Basin General Project Area

Vegetation Community	Acres in the General Project Area
Southern Rocky Mountain Juniper Woodland and Savanna	10,520
Intermountain Basins Semi-Desert Grassland	8,800
Southern Rocky Mountain Piñon-Juniper Woodland	5,550
Western Great Plains Riparian Woodland and Shrubland	3,390
Intermountain Basins Montane Sagebrush Steppe	540
Rocky Mountain Lower Montane Riparian Woodland and Shrubland	450
Rocky Mountain Cliff and Canyon	420
Western Great Plains Foothill and Piedmont Grassland	230
Intermountain Basins Mixed Salt Desert Scrub	160
Open Water	140
Rocky Mountain Ponderosa Pine Woodland	120
Intermountain Basins Semi-Desert Shrub Steppe	40
Colorado Plateau Mixed Bedrock Canyon and Tableland	20
Rocky Mountain Alpine-Montane Wet Meadow	<10
Rocky Mountain Gambel Oak-Mixed Montane Shrubland	<10
Rocky Mountain Montane Dry-Mesic Mixed Conifer Forest and Woodland	<10
Rocky Mountain Montane Mesic Mixed Conifer Forest and Woodland	<10

Source: SWReGAP 2014

Table 3-14. Special Status Plant Species with Habitat in the Biological Resources Area of Analysis

Scientific Name	Common Name	Status
Astragalus cyaneus	Cyanic milkvetch	New Mexico Sensitive
A. feensis	Santa Fe milkvetch	New Mexico Sensitive
Cylindropuntia viridiflora	Santa Fe cholla	New Mexico Endangered
Mentzelia springeri	Springer's blazing star	New Mexico Sensitive
Spiranthes magnicamporum	Great Plains lady tresses orchid	New Mexico Endangered

Sources: NMRPTC 1999; NMEMNRD 2015; Robert Sivinski, former New Mexico Endangered Plants Coordinator, and Parametrix Botanist, who conducted biological surveys from 2015 through 2016.

Santa Fe cholla (*Cylindropuntia viridiflora*). This state-listed endangered cactus occurs primarily in the Southern Rocky Mountains Juniper Woodland/Savanna ecotone. This ecotone is interspersed with patches of Western Great Plains Foothill and Piedmont Grassland and Intermountain Basins Semi-Desert Grassland (SWReGAP 2014) at elevations of 5,800 to 7,200 feet above msl. Santa Fe cholla is typically found in gravelly soils on rolling hills, often in association with tree cholla (*Cylindropuntia imbricata*; NMRPTC 1999). This species blooms in late June, and although its distinctive slender stem joints and patchy growth form make it somewhat identifiable year-round, we noted in the field that some Santa Fe cholla hybridize with tree cholla, and recommend that future surveys for this species be conducted in June when the flower is present for greater verification of the species.

One population of Santa Fe cholla observed during field survey occurs on the Pueblo of Pojoaque near the Cities of Gold Casino. In May 2016, approximately three Santa Fe chollas were observed at this location, but the cacti appeared to be dead or dying from disease. In addition to the population located near the Cities of Gold Casino, one individual, healthy Santa Fe cholla was identified within the biological resources area of analysis. This cholla was located in the southern section of the Pueblo of Pojoaque within an existing population of tree cholla.

In October 2017, Reclamation personnel identified a potential Santa Fe cholla during a survey conducted on the Pueblo of Pojoaque. This site is at a newly proposed tank location within the general project area. It is outside of the biological resources area of analysis, in an area that had not been previously surveyed. The potential Santa Fe cholla is east of the Cities of Gold, in habitat that has been previously recognized as potential Santa Fe cholla habitat. It is near the boundary of the project area and should be avoided during future construction activities.

Springer's blazingstar (*Mentzelia springeri*). This state sensitive species is endemic to volcanic soils in the Jemez Mountains, where it occurs from 7,000 to 8,000 feet above msl in Southern Rocky Mountain Juniper Woodland and Savanna, and Rocky Mountain Ponderosa Pine Woodland. Springer's blazingstar differs from other New Mexico blazingstars by its slender leaves and perennial habit. The flowers open only in late afternoon and evening from mid-to-late summer. It can be locally abundant like a population located in May 2016 next to SH 502 at the extreme western edge of the biological resources area of analysis, on the Pueblo de San Ildefonso. Numerous *M. springeri* grow at this location on the upper cut slope of the highway ROW, on pumice soil with basalt cobbles.

Great Plains lady tresses orchid (*Spiranthes magnicamporum*). This orchid is listed as state endangered in New Mexico because it has only a few small populations that are separated by more than 500 miles from its normal range in the tall-grass prairies of the Midwestern states. The New Mexico populations occur only in riparian/wet meadow habitats, which are threatened ecosystems. A few historic observations of this rare orchid have been made on the Rio Santa Cruz at Sombrillo (SEINet 2014), so it could potentially occur in riparian wetlands in the biological resources area of analysis. It is only detectible when blooming in September. No Great Plains lady tresses orchids were identified within the biological resources area of analysis.

3.10.5 Cottonwood Galleries

The banks and floodplains of the Rio Grande, Rio Pojoaque, and Rio Tesuque support riparian vegetation, including cottonwoods (*Populus* spp.), willows (*Salix* spp.), grasses, rushes (*Juncus* spp.) and sedges (*Carex* spp.). In addition to the special status plant species discussed above, mature cottonwood trees are an important biological resource in the general project area. Cottonwood trees provide important habitat and forage for wildlife, including nesting and roosting sites for numerous avian species. The associated floodplains in these areas provide reliable water sources that support these large trees. Within the biological resources area of analysis, cottonwood galleries comprise approximately 1 acre within the Pueblo of Tesuque, 0.6 acres within the Pueblo of Nambé, and 25 acres within the Pueblo de San Ildefonso. **Figure 3-11** is an example of a cottonwood gallery in the biological resources area of analysis.

Figure 3-11. Cottonwood Gallery in the Biological Resources Area of Analysis



Photo credit: Parametrix

To determine the average number of mature cottonwood trees per acre, biologists examined a representative cottonwood gallery within the biological resources area of analysis. Biologists determined that a standard acre of mature cottonwood galleries contain an average of 45 mature cottonwood trees. Mature trees are defined as individuals with a diameter at breast height greater than 26.5 inches (Andersen 2016). Mature cottonwoods destroyed during construction will be replaced at a ratio of 10 young trees for every healthy, mature tree and 5 young trees for every young or diseased cottonwood removed.

3.10.6 Noxious Weed Species

The general project area contains multiple vegetation zones and has experienced many forms of historic and ongoing disturbances including settlement, agriculture, ranching, and commercial and transportation development—all of which are conducive to the

spread of noxious weed species. Noxious weeds occur, to varying degrees, across the biological resources area of analysis (NMDA 2009, 2016). Reconnaissance surveys in 2014 at the proposed diversion site on the Rio Grande found the area contained approximately 50 percent exotic species, primarily Russian olive. Surveys conducted in 2015 and 2016 identified 18 noxious weed species within the biological resources area of analysis, as listed in **Table 3-15**, below.

Table 3-15. Noxious Weeds in the Biological Resources Area of Analysis

Common Name	Scientific Name	Noxious Weed Class
Canada thistle	*Cirsium arvense*	A
Dalmatian toadflax	*Linaria dalmatica*	A
Diffuse knapweed	*Centaurea diffusa*	A
Dyer's woad	*Isatis tinctoria*	A
Hoary cress	*Cardaria* spp.	A
Scotch thistle	*Onopordum acanthium*	A
Bull thistle	*Cirsium vulgare*	B
Chicory	*Cichorium intybus*	B
Perennial pepperweed	*Lepidium latifolium*	B
Russian knapweed	*Acroptilon repens*	B
Teasel	*Dipsacus fullonum*	B
Cheatgrass	*Bromus tectorum*	C
Jointed goatgrass	*Aegilops cylindrica*	C
Musk thistle	*Carduus nutans*	C
Russian olive	*Elaeagnus angustifolia*	C
Siberian elm	*Ulmus pumila*	C
Tree of heaven	*Ailanthus altissima*	C
Saltcedar	*Tamarix* spp.	C

Source: NMDA 2016

3.11 Wetlands, Non-wetland Waters, and Floodplains

Aquatic resources regulated under Section 404 the Clean Water Act include wetlands, non-wetland waters, and floodplains. Wetlands are transitional lands between terrestrial and aquatic systems 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" (40 CFR, Subpart 230.3, and 33 CFR, Subpart 328.3). Wetlands provide habitat for many organisms and provide essential functions, such as improving water quality and minimizing the impacts of floodwater.

Delineated wetlands may be subject to regulatory standards under Section 404 of the CWA (33 USC 1344). Identifying wetlands is based on three essential indicators: dominance of hydrophytic vegetation, hydric soils, and wetland hydrology. Hydrophytic vegetation consists of species that require the presence of permanent or semi-permanent water during the growing season. Hydric soils are flooded during the growing season long enough to develop anaerobic (absence of oxygen) conditions. Wetland hydrology refers to the frequency and duration of the presence of water that creates the wetland environment.

Non-wetland waters, regulated by Section 404 of the CWA (33 USC 1344), are described as waters in the absence of wetlands, defined by the lateral extent of an OHWM, the line established by the fluctuations of water levels (Curtis and Lichvar 2010). The OHWM is indicated by an impression on the bank, shelving, changes in the soil sediment, and changes in vegetation (Curtis and Lichvar 2010). This is discussed in greater detail in the Pojoaque Basin Regional Water System Wetland and Non-wetland Waters Delineation Report (Parametrix 2017).

Floodplains consist of low, flat areas next to rivers and streams that are subject to inundation from precipitation or high flows from adjacent fluvial systems. Most floodplains in New Mexico are associated with large, perennial waterways. Floodplains are valuable resources that provide critical functions, including floodwater reduction, erosion control, wildlife habitat, groundwater recharge, and water-quality maintenance.

Executive Order 11988, Floodplain Management (May 24, 1977), established federal policy "to avoid to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development wherever there is a practicable alternative." Two phrases that are used in floodplain regulatory guidance are the 100-year flood and the 100-year floodplain. Floods are usually described in terms of their statistical frequency. A 100-year flood is an event subject to a 1 percent probability of occurrence in any given year. A 100-year floodplain is the area around a waterway or water body that would be inundated by a 100-year flood. Since floodplains can be mapped, the boundary of the 100-year flood is commonly used in floodplain mitigation programs to identify areas where the risk of flooding is significant.

The following sections provide the methods used to analyze the existing wetland conditions within the biological resources area of analysis, and a description of existing wetland conditions. **Section 3.3**, Surface Water, provides a detailed discussion of existing waterways within the general project area.

3.11.1 Methods

The area of analysis for wetlands is the 5,900-acre biological resources area of analysis (**Figure 3-8**). Wetlands and non-wetland waters in this area that may be affected by project construction were delineated and mapped to determine their boundaries, relative to the project alternatives. Field data compiled from surveys of all wetlands and non-wetland waters in the biological resources action area were incorporated into the Pojoaque Basin Regional Water System Wetland and Non-wetland Waters Delineation Report (Parametrix 2017), which the USACE will review. Following this review, the USACE will determine what types of nationwide permits will be required. Reclamation will also consult with the Pueblos regarding regulatory permits and other determinations made by the USACE.

Field reconnaissance surveys of the general project area were conducted in 2014 (Parametrix 2014a). In addition, potential wetland locations were identified by reviewing aerial photographs, topographic maps, National Wetlands Inventory (NWI) maps (Service 2017), and the NRCS Soil Survey Geographic Database (NRCS 2013 and 2016).

Wetland delineations were conducted in 2015 and 2016. Reclamation engineers mapped each waterway that could be affected by the project before visiting it in 2016. All

OHWMs in these waterways were delineated for submeter accuracy and photographed to determine the short- and long-term impacts of each RWS-related project. The methods used to delineate wetlands and non-wetland waterways are in accordance with the USACE Arid West Regional Supplements (Lichvar and McColley 2008; USACE 2008; Curtis and Lichvar 2010). These impacts are included in the Pojoaque Basin Regional Water System Wetland and Non-wetland Waters Delineation Report (Parametrix 2017) to be reviewed by the USACE.

The boundaries of all 100-year floodplains in the general project area were identified and mapped using National Flood Hazard Layer data. These data are derived from flood insurance studies, previously published FEMA Flood Insurance Rate Maps (FIRMs), flood hazard analyses performed in support of the flood insurance studies and FIRMs, and new mapping data, where available (FEMA 2012, 2013, 2014).

3.11.2 Wetland Descriptions

In the Arid West Region, wetlands generally include springs, seeps, small marshes referred to as cienegas and desert playas (USACE 2008). Wetlands in the general project area and biological resources area of analysis are generally associated with the Rio Grande, Rio Tesuque, and Rio Pojoaque. Wetlands were identified on all four Settlement Pueblos and on non-Pueblo lands within the biological resources area of analysis (**Figure 3-8**). Based on data collected from the NWI dataset, the biological resources area of analysis contains approximately 204 acres of wetlands. The Pueblo of Pojoaque has 112 acres of wetlands, the Pueblo de San Ildefonso has 54 acres of wetlands, the Pueblo of Nambé has 16 acres of wetlands, the Pueblo of Tesuque has 10 acres of wetlands, and areas that are on non-Pueblo lands contain 12 acres of wetlands. Wetland locations and acreages, compiled from the NWI dataset, were refined in the Pojoaque Basin Regional Water System Wetland and Non-wetland Waters Delineation Report (Parametrix 2017), based on field delineations.

3.11.3 Non-wetland Waters Descriptions

Initially non-wetland waters in the 5,900-acre biological resources area of analysis (**Figure 3-8**) were compiled from the National Hydrography Dataset (NHD; USGS 2017). Based on the NHD dataset and lidar (light detection and ranging) data compiled by Reclamation, 474 waterways were identified in the RWS general project area. Waterways were identified on all four Settlement Pueblos and on non-Pueblo lands as appropriate. The results of these surveys are detailed in the Pojoaque Basin Regional Water System Wetland and Non-wetland Waters Delineation Report (Parametrix 2017).

3.11.4 Floodplains

Executive Order 13690, Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input (January 30, 2015), amended Executive Order 11988. The amendment pertains to potential change in flood risks due to future climate change. Flood risks and impacts can be evaluated based on one of the following: flood risks associated with climate change science; assuming future flood risks of 2 to 3 feet above the 100-year floodplain; or assuming future flood risks using the 500-year (that is, a 0.2 percent annual chance) floodplain.

In response to escalating taxpayer costs for flood disaster relief, Congress established the National Flood Insurance Program in 1968. This program is a voluntary mitigation program administered by FEMA. Under this program, the federal government makes flood insurance available in those communities that practice prescribed floodplain management. The National Flood Insurance Program requires participating communities to enact ordinances that protect the natural floodplain environment, prevent damage to property, and protect public safety. This incentive encourages state and local governments to develop and implement floodplain-management programs. The floodplains within the general project area includes parts of the Settlement Pueblos in Santa Fe County as well as unincorporated areas of the county. All of these communities participate in FEMA's National Flood Insurance Program. The identification numbers for the participating communities are listed in **Table 3-16**, below.

Table 3-16. FEMA Participating National Flood Insurance Program Communities in the General Project Area

Community Name	Community Number
Pueblo of Nambé	350124
Pueblo of Pojoaque	350153
Pueblo de San Ildefonso	350092
Santa Fe County (unincorporated areas)	350069
Pueblo of Tesuque	350137

Source: FEMA 2013

Special flood hazard areas are given a zone designation based on the level of detail of the FEMA flood insurance study and the anticipated type of flooding (FEMA 2014). There are several types of zones, but the following special flood hazard area zones are located within the general project area:

- Zone A—Areas subject to inundation by a base flood; identified by approximate studies, with no base flood elevations established
- Zone AE—Areas subject to inundation by a base flood, as determined by detailed methods; base flood elevations established
- Zone X—Areas outside of the base flood zones (Zones A and AE) and the 0.2 percent annual chance flood hazard (or 500-year flood)
- 0.2 percent annual chance flood hazard zone—Areas subject to the 0.2 percent annual chance (or 500-year) flood

Floodplains occur along the Rio Pojoaque, the Rio Tesuque, the Rio Nambé, the Rio Grande, and their smaller tributaries. All of the floodplains are in special flood hazard zones A and AE. Zone A floodplains, those for which base flood elevations have not been established, are extensive in the basin, whereas zone AE floodplains, those for which base flood elevations have been determined by detailed methods, are limited.

Zone AE floodplains are confined to the Rio Pojoaque and the Rio Tesuque within the general project area. The largest AE floodplain extends from the confluence of Pojoaque Creek and the Rio Tesuque downstream to the Rio Grande. Another zone AE floodplain is located on a reach of the Rio Tesuque through Bishop's Lodge and on an unnamed

arroyo contributing to the Rio Tesuque. The floodplain starts at the extreme southern end of the Pueblo of Tesuque and proceeds south onto private land in Santa Fe County. The remainder of the waterways in the general project area have floodplains designated as zone A as listed below (see **Figure 3-12**, Hydrology and Floodplains):

- Rio Grande, from about 0.25 miles downstream of the Otowi Bridge to about 1.5 miles upstream of the confluence with the Rio Pojoaque
- Downstream segments of the Rio Nambé and Rio Chupadero
- Pojoaque Creek and its tributaries
- Rio Tesuque and its tributaries

3.12 Wildlife

The following sections provide the methods used to analyze existing conditions of non-aquatic wildlife, followed by a description of existing wildlife conditions. Species listed as federally threatened or endangered are discussed separately in **Section 3.14**, Federally Listed Threatened and Endangered Species.

3.12.1 Methods

Reconnaissance habitat surveys and relevant species-specific surveys were conducted within the biological resources area of analysis (**Figure 3-8**), to assess site conditions near any proposed infrastructure (Parametrix 2014a, 2014b). A land-cover map was created to broadly categorize the distribution of habitat in the general project area by vegetation density and elevation (see **Figure 3-9,** Vegetation and Land Cover). Habitat was further defined using SWReGAP maps (**Figure 3-10**, SWReGAP Vegetation Communities). Habitat areas were verified through biological field surveys conducted in 2015 and 2016 within the biological resources area of analysis (**Figure 3-8**). Survey results were compiled in a comprehensive GIS database to geographically record the locations of known rare, threatened, endangered, and special status wildlife populations. The Pojoaque Basin Regional Water System Biological Assessment provides detailed information regarding all flora and fauna identified during field surveys (**Appendix J**).

3.12.2 General Wildlife Species

The biological resources area of analysis consists of sandy, semiarid, flat to moderately sloping hillsides covered in mixed brush. Many of the upland areas are highly disturbed or developed, with residential and agricultural land uses most prevalent. Wildlife species that potentially occur in these areas are upland bird species and small mammals, such as ringtails (*Bassariscus astutus*), jackrabbits (*Lepus californicus*), cottontails (*Sylvilagus auduboni*), gophers (*Thomomys* spp.), ground squirrels (*Spermophilus* spp.), prairie dogs (*Cynomys* spp.), and various species of mice and woodrats. Large mammals include coyote (*Canis latrans*), mule deer (*Odocoileus hemionus*), and occasionally Rocky Mountain elk (*Cervus canadensis*).

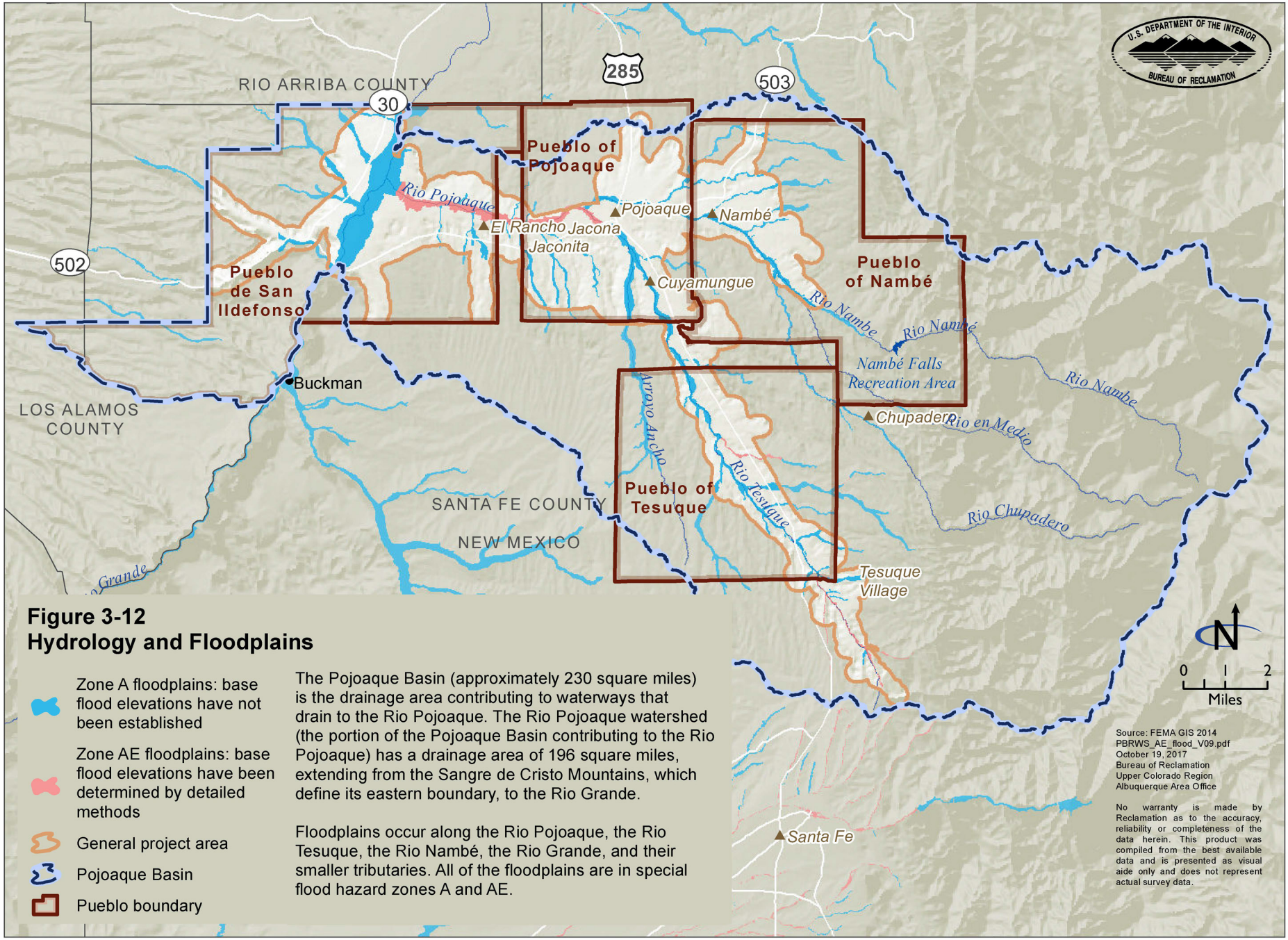


Figure 3-12
Hydrology and Floodplains

- Zone A floodplains: base flood elevations have not been established
- Zone AE floodplains: base flood elevations have been determined by detailed methods
- General project area
- Pojoaque Basin
- Pueblo boundary

The Pojoaque Basin (approximately 230 square miles) is the drainage area contributing to waterways that drain to the Rio Pojoaque. The Rio Pojoaque watershed (the portion of the Pojoaque Basin contributing to the Rio Pojoaque) has a drainage area of 196 square miles, extending from the Sangre de Cristo Mountains, which define its eastern boundary, to the Rio Grande.

Floodplains occur along the Rio Pojoaque, the Rio Tesuque, the Rio Nambé, the Rio Grande, and their smaller tributaries. All of the floodplains are in special flood hazard zones A and AE.

Many birds use areas along the Rio Grande, Rio Tesuque, and Rio Pojoaque, where riparian vegetation is present. Riparian vegetation along these areas includes native cottonwoods, willows, grasses, and sedges, along with nonnative vegetation such as Russian olive, tamarisk, and Siberian elm. Many songbirds use the riparian corridors of the Rio Grande and its tributaries during spring and fall migrations. In the Pojoaque Basin, wildlife diversity is generally greater in the desert riparian systems, compared with upland areas lacking cover and water. Desert riparian systems provide increased habitat for nesting and migrant songbirds, and downed trees provide shelter for small mammals, as well as reptiles and amphibians.

3.12.3 Special Status Wildlife Species

Reconnaissance surveys conducted in 2013 and 2014 identified habitat for the special status species listed in **Table 3-17**, below. This table also includes bald and golden eagles, protected by the amended Bald and Golden Eagle Protection Act and the MBTA. Although the MBTA protects all migratory birds, only migratory bird focal species (MBFS) for Santa Fe County that could occur in the general project area are included in this report (Service 2011).

Table 3-17. Special Status Species in Santa Fe County that Potentially Occur in the Biological Resources Area of Analysis

Common Name (Scientific Name)	Legal Status		Habitat Associations	Potential for Species to Occur in Biological Resources Area of Analysis
	Federal	State		
Bird				
Bald eagle (*Haliaeetus leucocephalus*)	Bald and Golden Eagle Act and MBTA	T	Breeding habitat most commonly includes areas close to large bodies of water, as the species feeds primarily on fish and waterfowl. In winter, bald eagles may congregate near waterfowl concentrations or areas with abundant fish, though they tend to avoid areas with high levels of human activity and development (BISON-M 2015a).	In Santa Fe County the bald eagle is primarily associated with the Rio Grande (eBird 2016). Bald eagles may forage along the rivers associated with the biological resources area of analysis.
Baird's sparrow (*Ammodramus bairdii*)	MBTA	T	Baird's sparrow is a small, ground-nesting, neotropical migrant songbird. Nesting habitat includes ungrazed or lightly grazed mixed-grass prairie. It feeds on various types of seeds (BISON-M 2016b).	Although nesting habitat does not exist within the biological resources area of analysis, foraging habitat does exist for this species. The closest documented Baird's sparrow was observed in the Las Vegas, New Mexico area in 1991 (eBird 2016).
Golden eagle (*Aquila chrysaetos*)	MBTA MBFS		In New Mexico, typical habitats utilized by this species include grassland, shrub-steppe, and piñon-juniper woodland. Golden eagles are highly sensitive to human disturbance. During the breeding season, they typically use mountain cliffs or canyons, often near open desert or grasslands (BISON-M 2015b).	Golden eagles could forage in areas in the biological resources area of analysis. Golden eagles have been documented near Nambé, New Mexico in 2013 (eBird 2016).

Table 3-17. Special Status Species in Santa Fe County that Potentially Occur in the Biological Resources Area of Analysis (cont.)

Common Name (Scientific Name)	Legal Status		Habitat Associations	Potential for Species to Occur in Biological Resources Area of Analysis
	Federal	State		
Bird				
Black tern (*Chlidonias niger*)	MBTA MBFS		The black tern is a semi-colonial, gull-like bird that inhabits coastlines, marshes, sloughs, rivers, lakeshores, and impoundments, often with cattails and bulrushes. It typically nests low in marsh vegetation, on floating vegetation mats, or on the ground next to shallow water. It prefers to be close to open water and feeds on fish (BISON-M 2013).	Foraging and nesting habitat for this species occurs in the biological resources area of analysis. Nine records for this species from 1962-2009 occur (NMOS 2016), including locations on the Pueblo de San Ildefonso. A black tern was documented on the Ohkay Owingeh Fishing Lakes in Rio Arriba County in 2014 (eBird 2016).
Least tern (*Sternula antillarum*)	MBTA MBFS E[1]	E	The least tern is a small, gull-like bird that inhabits mostly marine and other aquatic environments. Interior populations of this species nest mainly on riverside sandbars or salt flats that become exposed during periods of low water. In New Mexico, the only successful documented breeding population of the species is at Bitter Lake National Wildlife Refuge, although least terns have successfully nested at Brantley Lake in the past. The NMOS database lists four records for least terns in Santa Fe County (BISON-M 2016c).	There may be limited migratory or feeding habitat in the biological resources area of analysis. One least tern was previously recorded by the NMOS in 1995 on the Pueblo de San Ildefonso pond. Least terns have been documented in Rio Arriba County on Ohkay Owingeh Fishing lake in 2014 (eBird 2016).

Table 3-17. Special Status Species in Santa Fe County that Potentially Occur in the Biological Resources Area of Analysis (cont.)

Common Name (Scientific Name)	Legal Status		Habitat Associations	Potential for Species to Occur in Biological Resources Area of Analysis
	Federal	State		
Bird				
Gray vireo (*Vireo vicinior*)	MBTA	T	The gray vireo is a small, neotropical migrant songbird that breeds in the woodlands of the Southwest. In New Mexico, the species' primary habitat is rocky hills, covered with sparse brush and scrub in piñon-juniper, juniper and oak (BISON-M 2016d).	The biological resources area of analysis may include habitat for the gray vireo. This species was documented in 2014 in Santa Fe County, north and south of the biological resources area of analysis, near the Rio Grande (eBird 2016)
Mammal				
Spotted bat (*Euderma maculatum*)		T	The spotted bat prefers arid to semiarid western habitats, with rough and rocky terrain. This species is generally located in the western half of New Mexico, westward into Arizona, and southward into Mexico. The spotted bat uses a variety of habitats, from desert shrub to coniferous forest; and roosts in inaccessible cliffs and crevices, foraging mainly over water. In New Mexico, this species is a resident of the ponderosa pine zone in June and July and migrates to lower elevations in fall (BISON-M 2014).	The spotted bat could potentially use the waterways in the biological resources area of analysis.

Sources: Cartron 2010; eBird 2016; BISON-M 2013, 2014, 2015a, 2015b, 2016b, 2016c, 2016d; NMOS 2016; Service 2011, 2012, 2016a, 2016b, 2016c.
E = Endangered; species is in danger of extinction throughout all or a significant portion of its range
T = Threatened; species is likely to become endangered within the foreseeable future
MBTA = Migratory Bird Treaty Act
MBFS = Migratory bird focal species
E[1] = Least tern is not listed under the IPaC data for the project area (Service 2016a), although it is listed in BISON-M as a federal endangered species; therefore, this species is discussed only under state-listed species, using the BISON-M data set for this project. Federally listed species for this project area are based on the IPaC list only.

3.13 Aquatic Resources

The following sections provide the methods used to analyze the existing conditions of aquatic resources, including special status fish, followed by a description of existing aquatic resource conditions. The affected environment for federally threatened and endangered species is discussed in **Section 3.14**, Federally Listed Threatened and Endangered Species.

3.13.1 Methods

The area of analysis for aquatic resources is the following:

- Main stem of the Rio Grande, from its confluence with the Red River, downstream to Cochiti Dam (hydrologic considerations)
- A subset of this area of analysis involves project-related construction, from approximately RM 258 to a reach 1 mile downstream of the Otowi Bridge
- Rio Pojoaque, from its confluence with the Rio Grande, upstream to the confluence with the Rio Tesuque
- Rio Tesuque, from its confluence with Rio Pojoaque, upstream to a reach approximately 3 miles south of Tesuque
- Pojoaque Creek/Nambé River, from its confluence with Rio Pojoaque and Rio Tesuque, upstream to the confluence with Rio Nambé, Rio en Medio, and Rio Chupadero tributaries
- Ephemeral washes or arroyos that may be affected by future water-related infrastructure projects on Pueblo de San Ildefonso

Baseline data for aquatic resources were collected through an extensive review of numerous documents completed for similar projects in the vicinity; a review of county, state, and federal databases; and interviews with state, federal, and Pueblo biologists familiar with the area of analysis.

After they collected baseline data, project biologists conducted a site visit in February 2014 to the following locations in the aquatic resources area of analysis:

- Rio Grande potential surface water withdrawal location and horizontal radial well collector locations
- Rio Grande main stem, from Otowi Bridge, downstream approximately 1 mile
- Crossings of the proposed RWS pipeline of the Rio Pojoaque, Rio Tesuque, and Pojoaque Creek/Nambé River within Pueblo jurisdictions
- Rio Pojoaque barrier dam location
- Rio Tesuque channel modification location

3.13.2 Overview of Aquatic Resources in the Pojoaque Basin

Fish assemblages in the lower portion of the Pojoaque Basin, including the main stem of the Rio Grande, are similar to that of the general project area (described in detail below).

Habitat for aquatic species is generally absent for most of the year in the middle portions of the basin, where wide dry reaches of the Rio Pojoaque and Rio Tesuque dominate the landscape. Pueblo biologists have historically observed fish in the Rio Tesuque near RM 11; however, these fish (including warm water species such as common carp [*Cyprinus carpio*], dace [*Rhinichthys* spp.], and goldfish [*Carassius* spp.]) were washed down from upstream reservoirs. The fish-occupied waters of the Rio Tesuque are well upstream of the general project area, near the headwaters on U.S. Department of Agriculture, Forest Service (Forest Service) lands.[1]

3.13.3 Aquatic Habitat

3.13.3.1 Rio Grande

The Rio Grande reach of the general project area is defined as the reach from the confluence with the Red River (RM 329) downstream to Cochiti Dam (RM 233). This reach could be affected by water gains and losses associated with the RWS and fish communities transition throughout the reach. Upper sections of the reach typically have swift flow, course substrate, and substantial riffle and pool habitat. Colder water species, including trout, occupy the upper reaches. Below Ancho Canyon the river transitions to slower velocity and finer substrate. As the river approaches Cochiti Dam, it becomes wide, shallow, and sandy, and an increase in warmer water fish species (e.g., channel catfish and sunfish) reflect this transition (Castell et al. 2012).

A portion of the Rio Grande project reach from the upstream-most subsurface collection system proposed under any alternative (RM 258), to about 1 mile downstream of the Otowi Bridge could be affected by project-related construction. This reach flows through Pueblo lands and is not managed as a recreational fishery. The reach is perennial, with increased summer and fall flows due to reservoir releases, including those from the San Juan-Chama Project. Extensive gravel mining in the 1980s lowered the riverbed (Reclamation 2012). In general, the channel in this reach averages 310 feet wide. It is a single thread with low sinuosity (few bends), though there are sections of migrating bends and split channels. The river is channelized through this reach, with sections containing low bank scour.

Aquatic habitat at the potential surface water diversion location just upstream of the Otowi Bridge and SH 502 Bridge crossings (RM 257.6) consists of a swiftly flowing stream reach, with low gradient, uniform flow, little-to-no turbulence, and limited pools. Along the eastern bank riparian corridor proposed for potential construction of the horizontal radial well collectors (RM 257.7 through 258.1), run habitat is also predominant, with scattered vegetated gravel bars.

From the horizontal radial well collector location downstream to the potential diversion site, the substrate is primarily sand and silt on the stream margins, while gravels and small cobbles dominate the deeper, higher velocity portions of the channel. In general, the banks are relatively stable, with some areas of low-to-moderate scour. Banks are typically vegetated with a mix of native and invasive species; for example, salt cedar (*Tamarix* spp.), willow (*Salix* spp.), cottonwood (*Populus wislizeni*), and Russian olive

[1]R. Swazo-Hinds, Tesuque Pueblo Biologist, personal communication with Becky Holloway, HDR, February 12, 2014.

(*Elaeagnus angustifolia*). Rooted macroalgae is generally absent from the Rio Grande project area.

Downstream of the Otowi Bridge, the Rio Grande is a mix of deeper water runs and broad, shallow riffles, with gravel and cobble substrate. Vegetated gravel bars are common in the channel, and silt point bar deposits are common along the inside bends of the river.

Several large, unnamed arroyos are present along the north bank of the Rio Grande, some of which are hydraulically connected to the river during heavy rains. These arroyos carry significant amounts of water during monsoons. Similar to the Rio Tesuque and Rio Pojoaque, the unnamed arroyos are composed of sandy washes, with a thin band of riparian vegetation along their banks. An unpaved road and SH 30 cross one large arroyo in the northwest corner of the Pueblo de San Ildefonso. The banks of this arroyo are armored in some places to protect road infrastructure; aquatic habitat is limited.

Banks are predominantly vegetated with shrub species, though scattered assemblages of cottonwoods are present in some locations. Substrates are typically silt and sand along the margins and relatively clean gravel/cobble within roughly 20 feet of the river banks. Very little large, woody debris is present in the reach within a mile downstream of the Otowi Bridge. Off-channel habitat and high-velocity refugia are absent in this reach, with the exception of some small areas along the river margins. These conditions result in a paucity of pools and pool-forming features. Gravel-dominated substrate is plentiful in this reach, in numerous riffle complexes.

While no rooted macroalgae was observed during the site visit, aquatic macroinvertebrate habitat is likely of moderate-to-high quality, due to the presence of oxygenated water from shallow riffles, overhanging riparian vegetation along the stream margins, and numerous boulder complexes that provide cover.

Background underwater noise levels have not been measured. Laughlin (2005; as cited in WSDOT 2015) found that in shallow (1 foot deep or less), fast-moving rivers, the ambient sound levels are about 140 decibels (dB) root mean square (the average noise levels over time). This is relatively loud, compared to deep-water lakes, which have background noise of about 120 dB root mean square. Noise levels in shallow rivers are louder, due to the water moving over rocks and boulders and the wave action at the surface. Based on this information, background levels are estimated to be about 135 dB root mean square in the vicinity of the proposed intake.

3.13.3.2 Rio Pojoaque

The Rio Pojoaque is an ephemeral tributary of the Rio Grande, formed by the combined flows of the Rio Tesuque and Pojoaque Creek. From the confluence of the Rio Tesuque and Pojoaque Creek, it is approximately 5 miles long. It is often dry, or nearly so, except for periods of runoff and during monsoons. The channel bottom is dominated by sand, with scattered gravels in some areas. The broad channel is 180 to 300 feet wide and is typically composed of a single thread, with little slope and low sinuosity. Vegetated gravel bars are common, and banks are typically sparsely vegetated with herbaceous and shrub species, including coyote willow (*Salix exigua*), with Fremont cottonwoods established further landward from the bank. During aquatic habitat surveys conducted for the project (HDR 2014a), biologists observed no macroalgae and limited suitable habitat for aquatic macroinvertebrates.

Near the Pojoaque barrier dam, a vegetated island divides the channel, which spans the southern, or left half (facing downstream), of the channel for about 60 feet. The island splits the river channel for roughly 600 feet downstream. At the barrier dam, the northern, or right half, of the streambed is higher than the southern half. At the time of the site visit, the northern half of the channel was dry and there was flow only on the southern half. Shallow water flow continues in the southern channel past the barrier dam. The southern channel upstream of the dam is dominated by sandy substrate; the streambed remains sandy downstream of the dam, but it also contains gravels and cobbles.

During a site visit in February 2014, the channel was dry and the substrate was dominated by sand, with scattered gravels. The northern (right) bank was sparsely vegetated with herbaceous and shrub species, with coyote willow (*Salix exigua*) along the fringe and cottonwoods (*Populus* spp.) landward of the bank. There was no evidence of macroalgae or aquatic macroinvertebrate habitat on the north side of the channel.

Upstream of the barrier dam to the eastern boundary of the Pueblo de San Ildefonso, the Rio Pojoaque widens when its banks are full to an average width of 200 to 300 feet. The channel bottom is dominated by sand, with scattered gravels in some areas. The channel is typically a single thread, with little slope and low sinuosity.

3.13.3.3 Rio Tesuque

The Rio Tesuque is an ephemeral water body with gaining and losing reaches. Aquatic habitat surveys were conducted at proposed pipeline crossing locations in the lower 8 RMs of the Rio Tesuque (HDR 2014a). At that time, the river channel was dry and wide (100 to 300 feet), with sand substrate. Large woody debris, typically composed of cottonwood logs and branches, was sparsely scattered on the dry riverbed in some locations. The banks are often sparsely vegetated with herbaceous and shrub species. Macroalgae is absent from the lower Rio Tesuque and there is limited suitable habitat for aquatic macroinvertebrates.

Approximately 8 miles upstream of its confluence with the Rio Pojoaque, the Rio Tesuque's channel narrows to about 80 feet. It is braided with remnant dry side channels along the west (left) bank (looking downstream), and the substrate is dominated by coarse sand with some gravel. The banks are sparsely vegetated with herbaceous and shrub species. There is no evidence of macroalgae and aquatic macroinvertebrate habitat is limited and of poor quality.

Upstream of about RM 8.5, groundwater provides water to the Rio Tesuque. Near RM 10 (one possible site for proposed channel modification), the Rio Tesuque is a single thread, approximately 20 feet wide, when its banks are full. During a project site visit to this area in February 2014 (HDR 2014a), the channel contained 1 to 3 inches of flow concentrated on the eastern (right) bank, across a wetted width of about 10 feet. This hydrology was reported to be typical for this location and season.[2]

The substrate is dominated by a mix of sand and small-to-medium-size gravel. The banks are vegetated with an understory of grasses, with willow and cottonwood overstory. This site has been subject to riparian restoration and invasive vegetation removal for the past

[2]R. Swazo-Hinds, Pueblo of Tesuque Biologist, personal communication with Becky Holloway, Senior Environmental Scientist, HDR, February 12, 2014.

10 years.[3] Macroalgae is lacking, though rust-colored algae was observed in the channel. Macroinvertebrate habitat (e.g., stream margins with overhanging vegetation) is present but is limited in quantity and complexity.

Just downstream of the Rio Tesuque reach of the general project area, approximately 11.5 miles upstream of its confluence with the Rio Pojoaque, a large arroyo enters on the western (left) bank. This arroyo is just upstream of an existing unpaved crossing, which is several hundred feet upstream of a concrete diversion structure. A perforated infiltration pipe runs under the streambed in this reach of the river.[4] At the time of the site visit, the channel was dry.

The western bank is relatively undefined at the crossing location, but it becomes more defined as the channel narrows downstream. The eastern (right) bank is stable and vegetated, and there is some scattered large wood in the channel and on the banks. Cottonwood and willow are present along both banks, and the channel is about 40 feet wide.

3.13.3.4 Pojoaque Creek/Nambé River

According to Pueblo personnel, Pojoaque Creek is called the Nambé River on the Pueblo of Nambé, and it is called Pojoaque Creek on the Pueblo of Pojoaque.[5] This water body combines with the Rio Tesuque to form the Rio Pojoaque on the Pueblo of Pojoaque.

The Nambé River/Pojoaque Creek is considered perennial, but the wetted channel typically consists of narrow meandering threads a few inches deep, except during spring runoff and monsoons.[6]

RWS pipeline crossings are proposed on Pojoaque Creek on the Pueblo of Pojoaque, approximately 1.1 RMs upstream of the confluence of Pojoaque Creek and the Rio Tesuque. At these locations, the river channel is generally a single thread. When the banks are full, the widths vary from 30 to 50 feet and substrates are a mix of sand and gravel. The banks are vegetated with an herbaceous understory of grasses; shrub species are dominated by salt cedar and Russian olive, with some willow. No macroalgae was observed, and habitat for macroinvertebrates is limited.

The Nambé River varies in width from 45 to 100 feet at potential RWS pipeline crossings. Near one crossing site, the reach contains a concrete channel-spanning weir and several paved river fords. In general, the substrate is dominated by coarse sand with some gravel. The banks are sparsely vegetated with herbaceous and shrub species. Aquatic macroinvertebrate habitat is limited and of poor quality and amphibian habitat is lacking.

Some narrow reaches of the river contain patches of green algae on larger gravels and small cobbles. The cause of the algae is unknown, but it could be due to nutrient loading (nitrogen or phosphate). The source for these nutrients could be adjacent residential septic systems, cattle grazing, agricultural activities, or wastewater discharge, among

[3]R. Swazo-Hinds, Pueblo of Tesuque Biologist, personal communication with Becky Holloway, Senior Environmental Scientist, HDR, February 12, 2014.
[4]Ibid.
[5]S. Rydeen, Pueblo of Nambé, personal communication with Becky Holloway, Senior Environmental Scientist, HDR, February 13, 2014.
[6]Ibid.

other sources. Wastewater treatment has been recently centralized into three sewage and wastewater treatment facilities.[7]

3.13.4 Aquatic Biota

3.13.4.1 Rio Grande

Upstream of Cochiti Lake, the Rio Grande fish community is largely composed of cool and cold water species that use gravel and cobble for spawning (Buntjer and Remshardt 2005). The relatively fast-flowing single channel in the general project area provides suitable habitat for some Rio Grande species (e.g., Rio Grande chub); however, it does not provide ample amounts of foraging or rearing habitat for many fish species in the Rio Grande, such as white sucker, which prefers pools with cover. The swift-moving water and lack of macroalgae make this stretch of the Rio Grande unsuitable for amphibian spawning or rearing.

Reclamation did not conduct project-specific fish sampling for the RWS project; however, it did collect data from state, federal, and Pueblo biologists to develop a species list for the project reach (RM 258 downstream to the BDD, RM 254.3). Based on discussions with resource agencies and a review of sampling data, Reclamation anticipates that the fish community in the general project area is similar to that near the BDD.

In 2010, the NMDGF (Castell et al. 2012) conducted a raft electrofishing survey of the Rio Grande in White Rock Canyon, between Buckman Landing and Cochiti Lake. The intent of the survey was to collect baseline data for the presence, distribution, and relative abundance of species. Fish collected at the Buckman Landing site, near the downstream terminus of the general project area (**Table 3-18**, Fish Species Sampled by NMDGF at the Buckman Wash (RM 254.3)), are representative of the fish community.

The species presented in **Table 3-18** are representative of those that Reclamation commonly collects during its annual fish surveys. These surveys have been conducted with the Santa Clara Pueblo (north of the Pueblo de San Ildefonso) since 2001. In addition, **Table 3-18** lists seven fish species—brown trout, white sucker, common carp, flathead chub, longnose dace, channel catfish, and smallmouth bass—that were captured during 2002 sampling in eddy, shoreline run, and main stem run habitats next to the BDD location (Forest Service and BLM 2006). During the 2002 surveys, the white sucker and flathead chub were the most abundant fish collected. Similar sampling results were obtained from a fisheries inventory at the Pueblo de San Ildefonso that identified white sucker, common carp, brown trout, longnose dace, flathead chub, and channel catfish (BIA 2000).

In addition to the species presented in **Table 3-18**, the following species may be present: Rio Grande chub (*Gila pandora*, native), fathead minnow (*Pimephales promelas*, native), River carpsucker (*Carpiodes carpio*, native), and western mosquitofish (*Gambusia affinis*, invasive).[8] This determination is based on sampling that the Service conducted upstream (near Española) and downstream (at Buckman Wash) of the general project area.

[7]Lt. Gov. Garcia, Pueblo of Nambé, personal communication with Becky Holloway, Senior Environmental Scientist, HDR, May 22, 2014.
[8]D. C. Kitcheyan, Tribal and Native Trout Biologist, Service, personal communication with Becky Holloway, HDR, December 12, 2013; LANL 2015.

Table 3-18. Fish Species Sampled by NMDGF at the Buckman Wash (RM 254.3)

Common Name	Scientific Name	Native (N) or Invasive (I)
Brown trout	*Salmo trutta*	I
Longnose dace	*Rhinichthys cataractae*	N
Flathead chub	*Platygobio gracilis*	N
Common carp	*Cyprinus carpio*	I
Red shiner	*Cyprinella lutrensis*	N
White sucker	*Catostomus commersoni*	I
Northern pike	*Esox lucius*	I
Walleye	*Sander vitreus*	I
Channel catfish	*Ictalurus punctatus*	I
Black bullhead	*Ameiurus melas*	I
Yellow bullhead	*A. natalis*	I
White bass	*Morone chrysops*	I
Green sunfish	*Lepomis cyanellus*	I
Bluegill	*L. macrochirus*	N
Smallmouth bass	*Micropterus dolomieui*	I
Largemouth bass	*M. salmoides*	I
White crappie	*Pomoxis annularis*	I

Source: Castell et al. 2012

A review of available literature also indicates two additional species have the potential to occur in the general project area: the Rio Grande cutthroat trout (*Oncorhynchus clarkii virginalis*) and the Rio Grande sucker (*Catostomus plebeius*; NMDGF and Natural Heritage New Mexico 2013). The Rio Grande sucker is rarely found in waters with heavy loads of silt and organic debris (Sublette et al. 1990). For this reason, it is unlikely that it occurs with great frequency in the general project area.

No amphibians, including tadpoles, were observed during site visits for the RWS project. Field survey locations were the bank, pool habitat, and main channel of the Rio Grande at the potential water diversion site, horizontal radial well collector location, and habitat within a mile downstream of the Otowi Bridge.

In general, water velocities in the Rio Grande reach of the general project area are too high to meet habitat requirements for tadpoles, which are relatively poor swimmers.

3.13.4.2 Rio Pojoaque

During periods of high flow, when the Rio Pojoaque is hydraulically connected to the Rio Grande, the following species may occupy the lower reaches in limited numbers: flathead chub, Rio Grande chub, white sucker, fathead minnow, red shiner, green sunfish, and

black bass.[9] A Pueblo fisheries biologist stated that fish have not been observed in the Rio Pojoaque in recent years.[10]

The dam on the southern (left) bank does not likely present a significant migratory fish barrier because of the general lack of fish in this reach of the river during most of the year. The Rio Pojoaque does not likely provide significant spawning habitat. This is because most fish in the lower reaches, when present, tend to spawn in the watered main channel and backwater habitats, both of which are lacking in this river.[11]

3.13.4.3 Rio Tesuque

Fish survey data are not available for the section of the Rio Tesuque in the general project area. The Service has attempted to survey the Rio Tesuque with Tribal staff, but the lack of water has prohibited such surveys.[12] Pueblo of Tesuque biologists have not observed fish in this section of the Rio Tesuque since about 2007. The likelihood is remote that fish are present in any of the water bodies in the Rio Tesuque reach of the general project area.[13]

The nearest fish-occupied waters of the Rio Tesuque are well upstream of the general project area, near the headwaters, on Forest Service lands.[14] Aquatic habitat has been severely degraded over the past decade by numerous fires in the upstream headwaters. These fires destroyed riparian vegetation, leading to increased instream temperatures, bank erosion, and the introduction of large amounts of sediment into the channel. Pueblo of Tesuque biologists have not observed fish in the Rio Tesuque reach of the general project area since 2007.[15] Fish observed in the past in the Rio Tesuque have included species that have been washed down from upstream reservoirs. Examples are warm water species, such as common carp (*Cyprinus carpio*), dace (*Rhinichthys* spp.), and goldfish (*Carassius* spp.). Rainbow trout (*Oncorhynchus mykiss*) were historically present but have not been observed for over a decade.

3.13.4.4 Pojoaque Creek/Nambé River

The Pueblo of Nambé has not conducted any fish surveys in the general project area, and previous macroinvertebrate data could not be located.[16] The Pueblo of Pojoaque has not conducted fish or macroinvertebrate surveys in Pojoaque Creek. Its biologists have not observed fish in Pojoaque Creek for over seven years, when flathead chub were observed

[9]R. Hansen, Fish Biologist, NMDGF, personal communication with Becky Holloway, Senior Environmental Scientist, HDR, February 20, 2013.
[10]A. Duran, Pueblo of Pojoaque, personal communication with Becky Holloway, Senior Environmental Scientist, HDR, February 12, 2014; S. Rydeen, Pueblo of Nambé, personal communication with Becky Holloway, Senior Environmental Scientist, HDR, February 13, 2014.
[11]R. Hansen, Fish Biologist, NMDGF, personal communication with Becky Holloway, Senior Environmental Scientist, HDR, February 20, 2013.
[12]D. C. Kitcheyan, Tribal and Native Trout Biologist, Service, personal communication with Becky Holloway, Senior Environmental Scientist, HDR, February 13, 2013.
[13]R. Swazo-Hinds, Tesuque Pueblo Biologist, personal communication with Becky Holloway, Senior Environmental Scientist, HDR, February 12, 2014.
[14]Ibid.
[15]Ibid.
[16]S. Rydeen, Pueblo of Nambé, personal communication with Becky Holloway, Senior Environmental Scientist, HDR, February 13, 2014.

in the creek.[17] Biologists with the Pueblo speculate that the Nambé fires in the Sangre de Cristo Mountains and subsequent aquatic and riparian habitat degradation in mountain tributaries has led to the loss of fish species.

3.13.5 Special Status Fish Species

Special status fish are defined as those that are protected under the New Mexico Conservation Act and species on lists maintained by the Forest Service, the BLM, and the Service. Species that are federally listed as threatened or endangered under the ESA are discussed in **Section 3.14**, Federally Listed Threatened and Endangered Species.

Previous fish sampling were considered for determining suitable habitat for special status species in the Rio Grande portion of the general project area. This is in addition to aquatic habitat surveys conducted at potential water diversion sites and downstream habitat on the Rio Grande. Based on these efforts, four special status species, or suitable habitat for those species, are potentially present in the Rio Grande reach of the general project area. Of the species listed in **Table 3-19**, Special Status Fish Species with Suitable Habitat in the Rio Grande Reach of the General Project Area, only the flathead chub and the Rio Grande chub have been collected during sampling in or near the Rio Grande reach of the general project area (see **Section 3.13.1**, Methods). Biologists from the NMDGF confirm that these two species may be present in the Rio Grande reach of the general project area.[18]

Flathead Chub

The flathead chub is a BLM sensitive species that is often found in fast, shallow waters (less than 3 feet deep) with small substrates, such as sand and gravel (Tibbs 1998). As stated under **Section 3.13.4**, Aquatic Biota, along with the white sucker, flathead chub are typically the most abundant species collected in the Rio Grande reach of the general project area and reaches immediately upstream and downstream.

Rio Grande Chub

The Service lists the Rio Grande chub as sensitive. Rees et al. (2005) noted that the Rio Grande chub has likely been extirpated from the main stem Rio Grande and is currently found only in tributaries; however, the species was previously collected in the main stem, between the Rio Chama confluence and Otowi Bridge (Platania 1993; Service 2004). It may still be present in low numbers. Due to a general lack of pools and instream vegetation in the general project area, the occurrence of this species is likely low.

Rio Grande Cutthroat Trout

In 2008, the Service added the Rio Grande cutthroat trout to its list of candidate species for listing under the ESA (73 *Federal Register* 27900). In numerous surveys conducted in or near the general project area over the past decade, no Rio Grande cutthroat trout have been found in the samples (see **Table 3-19** and subsequent discussion). The nearest

[17]A. Duran, Pueblo of Pojoaque, personal communication with Becky Holloway, Senior Environmental Scientist, HDR, February 12, 2014.
[18]K. Patten, Assistant Chief of Fisheries at NMDGF, personal communication with Becky Holloway, HDR, February 19, 2013.

Table 3-19. Special Status Fish Species with Suitable Habitat in the Rio Grande Reach of the General Project Area

Common Name	Scientific Name	Status				Habitat Requirements
		Service	Forest Service	BLM	New Mexico	
Flathead chub	*Platygobio gracilis*			S		Occurs in turbid, alkaline waters with shifting substrate.
Rio Grande chub	*Gila pandora*		S		S	Occurs in impoundments of small-to-moderate streams. Though uncommon, the species may occur in the Rio Grande portion of the general project area, likely in low densities.
Rio Grande cutthroat trout	*Oncorhynchus clarkii virginalis*	C	S	S	S	Occurs in cool waters over clean gravel. May occur in low densities in the Rio Grande reaches of the general project area; however, current distributions are limited to headwater tributaries of the Rio Grande.

Sources: NMDGF and Natural Heritage New Mexico 2013; Forest Service and BLM 2006; K. Patten, Assistant Chief of Fisheries, NMDGF, personal communication with Becky Holloway, Senior Environmental Scientist, HDR, February 19, 2013.
C= Candidate
S = Sensitive

known main stem Rio Grande populations occur several miles upstream, in and near the confluence with the Rio Chama.[19] Several tributaries immediately upstream of the general project area could be occupied by an occasional Rio Grande cutthroat trout, but it is highly unlikely.[20] Based on this information, the Rio Grande cutthroat trout is not likely present in the general project area.

3.13.5.1 Rio Pojoaque

Due to the lack of flow, no special status fish species are known to reside or spawn in the Rio Pojoaque. However, during periods of high flow, the flathead chub and Rio Grande chub may move into the lower reaches of the river, near its confluence with the Rio Grande.

[19]K. Patten, Assistant Chief of Fisheries at NMDGF, personal communication with Becky Holloway, Senior Environmental Scientist, HDR, December 19, 2013.
[20]K. Patten, Assistant Chief of Fisheries at NMDGF, personal communication with Becky Holloway, Senior Environmental Scientist, HDR, December 19, 2013.

chub may move into the lower reaches of the river, near its confluence with the Rio Grande.

3.13.5.2 Rio Tesuque

No special status fish species are known to occur in the Rio Tesuque.

3.13.5.3 Pojoaque Creek/Nambé River

No special status fish species are known to occur in Pojoaque Creek or the Nambé River.

3.14 Federally Listed Threatened and Endangered Species

The following sections provide the methods used to analyze the existing conditions of federally listed threatened and endangered species, followed by a description of existing conditions in the general project area and the biological resources area of analysis, (**Figure 3-8**). For more detailed information regarding federally listed threatened and endangered species see the Pojoaque Basin Regional Water System Biological Assessment (**Appendix J**).

The area of analysis for federally listed threatened and endangered avian and mammal species encompasses the general project area and the 5,900-acre biological resources area of analysis (**Figure 3-8**) where field and species-specific protocol surveys were completed.

The 5,900-acre biological resources area of analysis falls within the 30,400-acre general project area. The project area is also referred to as the action area in the Pojoaque Basin Regional Water System Biological Assessment (**Appendix J**). This happens in cases where federally listed threatened and endangered species could be directly or indirectly affected by federal actions (50 CFR, Subpart 402.2) related to this project. The RWS action area is delineated by an approximately quarter-mile-wide buffer surrounding all proposed project features: the RWS infrastructure, the Rio Pojoaque irrigation improvement project, the Rio Tesuque channel modification project, and the Pueblo de San Ildefonso future projects. The action area for federally listed threatened and endangered aquatic species is the Rio Grande, from its confluence with the Rio Chama to Cochiti Reservoir, including tributaries in the general project area.

Currently, the Service's IPaC System database lists four threatened and endangered species for Santa Fe County (Service 2016a):

- Southwestern willow flycatcher (SWFL), *Empidonax traillii extimus*, federally endangered
- Yellow-billed cuckoo (YBCU), *Coccyzus americanus*, federally threatened
- Mexican spotted owl (MSO), *Strix occidentalis lucida*, federally threatened
- New Mexico meadow jumping mouse (NMMJM), *Zapus hudsonius luteus*, federally endangered

Avian species discussed in this section are protected under the MBTA. Although the Rio Grande silvery minnow (*Hybognathus amarus*, federally endangered), is not listed as being present in Santa Fe County, the Service's IPaC database states this species is located in Sandoval County, downstream from the general project area. Therefore, it is also included

in this analysis and discussed further in **Section 3.14.2**, Federally Listed Threatened and Endangered Species Descriptions.

3.14.1 Methods

Reconnaissance surveys were conducted in May 2014, in areas identified through a desktop analysis of potential habitat for SWFL, YBCU, and NMMJM (Parametrix 2014b). During the field reconnaissance, biologists noted the habitat condition, the presence of water, the proximity to roads or dwellings, and the potential need for protocol wildlife surveys (Parametrix 2014b; see **Table 3-20**, below). Based on this information, protocol surveys were conducted in 2015 for YBCU, and in 2016 for SWFL, to determine the presence or absence of these species in the biological resource area of analysis.

3.14.2 Federally Listed Threatened and Endangered Species Descriptions

Table 3-20, below, shows federally listed threatened and endangered species in the biological resources area.

3.14.2.1 Avian Species

Southwestern Willow Flycatcher

Habitat for this species in the biological resources area (**Figure 3-8**) consists of riparian and wetland areas. It includes overstory vegetation of cottonwood and Goodding's willow, or Russian olive or tamarisk (or both) and an understory of willow. During reconnaissance surveys, biologists identified areas with moderate-to-dense riparian vegetation and a mix of overstory and understory species, and at least some surface water in proximity to those sites. These characteristics are considered minimal requirements for SWFL and YBCU (Sechrist et al. 2009; Parametrix and Southern Sierra Research Station 2016). Sites visited during biological and protocol surveys were fairly narrow and linear and due to the size of available habitat were better suited for SWFLs (**Figure 3-13**, Southwestern Willow Flycatcher and Yellow-billed Cuckoo Habitat).

While conducting the general biological surveys and protocol surveys for the YBCU in 2015, biologists audibly detected willow flycatchers within the biological resources area, along the Rio Grande and the Rio Pojoaque. Protocol surveys for SWFL were conducted in 2016, and two willow flycatchers were audibly and visually detected during the first protocol survey in May along the Rio Pojoaque, but none were detected during additional protocol surveys. This behavior is consistent with migrating birds.

Western Yellow-Billed Cuckoo

Federally listed SWFLs and YBCUs use riparian habitat and are often documented using the same areas or those next to one another (**Figure 3-13**, Southwestern Willow Flycatcher and Yellow-billed Cuckoo Habitat).

Table 3-20. Federally Listed Threatened and Endangered Species With the Potential to Occur in the Biological Resources Area of Analysis

Common Name (Scientific name)	Legal Status	Habitat Associations	Potential for Species to Occur Within the Biological Resources Area of Analysis
Bird			
Southwestern willow flycatcher (*Empidonax traillii extimus*)	E MBTA	The SWFL is a small, neotropical migrant songbird. The southwestern (*extimus*) subspecies, which is the only listed subspecies, breeds in the southwestern U.S. and winters in northern Latin America, nesting in dense, multistoried, riparian vegetation along river courses (BISON-M 2015c)	Habitat for this species is present in the biological resources area of analysis, in the bosque vegetation along the Rio Grande and the Rio Pojoaque. In 2015, biologists heard willow flycatchers along the Rio Grande and the Rio Pojoaque, during biological surveys and while conducting YBCU protocol surveys. During SWFL protocol surveys in 2016, two willow flycatchers were detected on the Rio Pojoaque.
Yellow-billed cuckoo (*Coccyzus americanus*)	E MBTA	The YBCU is a large, secretive, riparian-obligate, migratory songbird, native to nearly the entire U.S. In western North America, YBCUs breed intermittently, from southern Canada to Mexico, typically nesting in dense, multistoried riparian forests, especially cottonwood-willow, but also occasionally in areas where salt cedar or other species are dominant (Sechrist et al. 2009).	Minimal habitat was determined to be present during 2014 reconnaissance surveys in the biological resources area of analysis, in the bosque vegetation along the Rio Grande, and along the Rio Pojoaque. Protocol surveys for the YBCU were conducted in 2015. No YBCUs were detected during protocol surveys.

Table 3-20. Federally Listed Threatened and Endangered Species With the Potential to Occur in the Biological Resources Area of Analysis (cont.)

Common Name (Scientific name)	Legal Status	Habitat Associations	Potential for Species to Occur Within the Biological Resources Area of Analysis
Mexican spotted owl (*Strix occidentalis lucida*)	T MBTA	The MSO is a medium-sized nocturnal forest raptor. This species generally does not migrate. In New Mexico, MSOs inhabit mixed conifer and riparian canyon areas and nest in tree cavities or on rock ledges where they consume a variety of small mammals and birds (BISON-M 2015d).	The highest elevation within the general project area is located north of Santa Fe in the mixed conifer areas. Sites along the Rio Grande may be considered foraging habitat for this species. In 2015, MSOs nested on LANL property west of the Pueblo de San Ildefonso (LANL 2015); however, due to the lack of habitat in the action area, no protocol species surveys were conducted for MSO.
Mammal			
New Mexico meadow jumping mouse[1] (*Zapus hudsonius luteus*)	E	The NMMJM is a small rodent of primarily riparian habitats. In New Mexico and Colorado, the historic range encompassed the San Juan, Sangre de Cristo, Jemez, and Sacramento Mountains, with several localities in the Rio Grande Valley. This species utilizes moist grasslands and meadows, often along the edges of marshes and near free-flowing water. In New Mexico, it is restricted to complex riparian habitats, especially those with tall, dense sedges. NMMJM also uses waterways associated with irrigation systems (Service 2014).	There is no adequate tall, dense sedge habitat near water in the biological resources area of analysis; therefore, based on coordination with the Service, no protocol surveys for this species were conducted.

Table 3-20. Federally Listed Threatened and Endangered Species With the Potential to Occur in the Biological Resources Area of Analysis (cont.)

Common Name (Scientific name)	Legal Status	Habitat Associations	Potential for Species to Occur Within the Biological Resources Area of Analysis
Fish			
Rio Grande silvery minnow[2] (*Hybognathus amarus*)	E	Occurs in silt and sand substrate in slow backwaters or eddies.	The Rio Grande silvery minnow has been extirpated from the action area and does not occur in any water bodies associated with the in-water work related to this project; therefore, no surveys for this species were conducted.

Sources: Cartron 2010; BISON-M 2015a, 2015b; NMOS 2016; Service 2011, 2012, 2014, 2016a, 2016b, 2016c; Forest Service and BLM 2006
[1] E. Hein, Service NMMJM specialist, personal communication with Jenny Lisignoli, Senior Natural Resources Scientist, Parametrix, April 6, 2015.
[2] K. Patten, Assistant Chief of Fisheries, NMDGF, personal communication with Becky Holloway, Senior Environmental Scientist, HDR, February 19, 2013
E = Federally listed as endangered; species is in danger of extinction throughout all or a significant portion of its range.
T = Federally listed as threatened; this species is likely to become endangered within the foreseeable future.

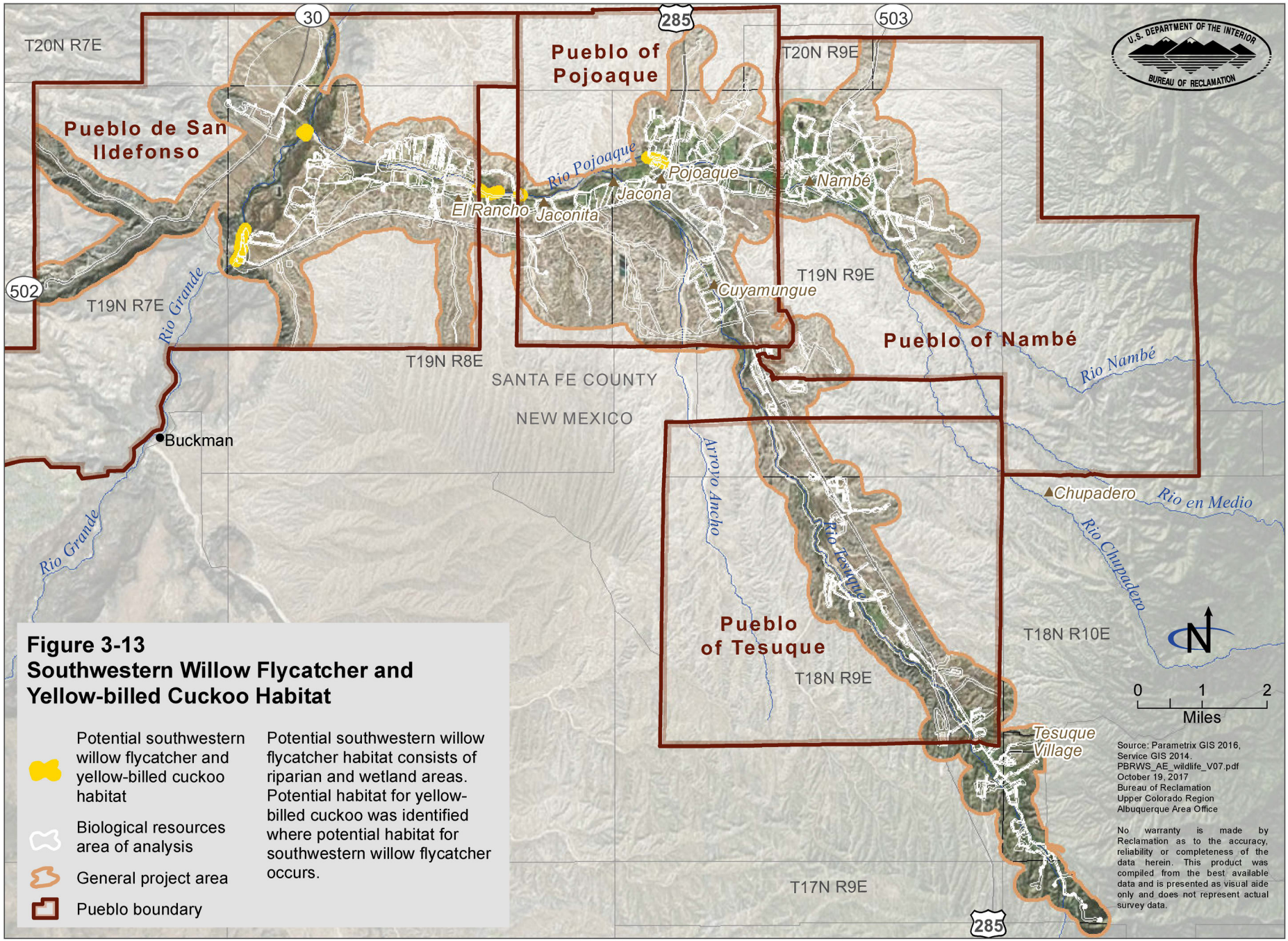


Figure 3-13
Southwestern Willow Flycatcher and Yellow-billed Cuckoo Habitat

Populations of YBCUs along the Colorado River have been documented in contiguous riparian vegetation, containing cottonwood and willow, with an average overstory height of 15 feet (Anderson and Ohmart 1984). YBCUs generally nest in patches of habitat up to 200 acres (Halterman et al. 2015); however, they also have been documented in narrow bands of riparian habitat, as small as 1 to 2 acres and as narrow as 33 feet to 66 feet wide, for foraging, breeding, and nesting (Halterman et al. 2015; Parametrix and Southern Sierra Research Station 2016).

In New Mexico, YBCU home ranges along the Rio Grande are estimated to be an average of 153-acre patches (Sechrist et al. 2013). The average width of breeding habitat varies between 1,312 feet and 3,937 feet of riparian habitat (Sechrist et al. 2013). This indicates that the home ranges and their widths are larger along the Rio Grande in New Mexico than in similar habitat along the lower Colorado River in Arizona, California, and Nevada. Although no large riparian patches of habitat are in the biological resources area, to verify presence or absence of this species, protocol surveys for the YBCU were conducted where marginal habitat is present along the Rio Grande and the Rio Pojoaque. No YBCUs were detected during the 2015 protocol surveys for the species, and existing habitat appears to be too narrow and linear for this species.

Mexican Spotted Owl

The highest-elevation portions of the general project area located north of Santa Fe in the mixed conifer areas, and in areas along the Rio Grande, may be considered marginal foraging habitat for the MSO; however, due to the lack of mature trees, closed canopies, and old-growth forests, MSOs would most likely not nest in the action area, although they could forage there. MSOs were documented nesting on LANL property in 2015 (LANL 2015). No protocol surveys were conducted for this species, and no MSOs have been documented in the action area; therefore, no protocol surveys were conducted for this species.

3.14.2.2 Mammal Species

New Mexico Meadow Jumping Mouse

Biologists evaluated habitat for NMMJM during reconnaissance surveys in 2014. Emergent wetlands and riparian areas that appeared to contain abundant native grasses or sedges were evaluated. Coordination in 2015 with NMMJM biologist, Eric Hein, of the Service included discussions regarding habitat for this species based on field observations from reconnaissance surveys in 2014 and biological surveys in 2015.[21] Following discussions and a review of photographs taken of the potential NMMJM habitat in the biological resources area of analysis (**Figure 3-8**), Mr. Hein concluded that no NMMJM protocol surveys would need to be conducted for this species.

[21]Eric Hein, Service New Mexico meadow jumping mouse biologist, personal communication with Jenny Lisignoli, Senior Natural Resources Scientist, Parametrix, April 5, 2015.

3.14.2.3 Fish

Rio Grande Silvery Minnow

Due to habitat degradation and fragmentation, the Rio Grande silvery minnow was federally listed as endangered in 1994 (59 *Federal Register* 36988), and critical habitat was designated in 2003 (66 *Federal Register* 8088). In the Rio Grande, designated critical habitat is downstream of Cochiti Dam, 25 miles south of the proposed primary source water collection site; therefore, this habitat is not found in the action area. The Rio Grande silvery minnow historically occupied main stem habitats of the Rio Grande, from its confluence with the Rio Chama to the Gulf of Mexico (Sublette et al. 1990; Bestgen and Platania 1991).

Habitat for juvenile and adult Rio Grande silvery minnow may be present in the action area (Parametrix 2014b); however, the ability for the species to successfully sustain its life cycle is limited by two factors in the Rio Grande in the action area: the lack of low velocity habitat for larvae and young-of-the-year and the seasonal lack of flow areas for retaining drifting eggs from Rio Chama to Otowi Bridge, RM 272 to RM 257.6 (Service 2005).

Rio Grande silvery minnow have not been collected upstream of the Cochiti Dam since 1994 (Platania 1995). They are likely completely gone from the upper portion of the Middle Rio Grande (Bestgen and Platania 1991), upstream of Cochiti Dam (Service 1999). Based on this information, it is highly unlikely that the Rio Grande silvery minnow is present in the general project area.

Adults spawn in the water column, typically over 1 month in the late spring to early summer (May to June) during spring runoff. Rio Grande silvery minnow do not typically occupy straight, incised channels with rapid flows (Sublette et al. 1990; Bestgen and Platania 1991). Spawning adults release eggs that passively drift while developing (Platania 1995; Platania and Altenbach 1998). Young silvery minnows occupy shallow, low-velocity backwaters with silt substrates (Dudley et al. 2014). Because the minnow has been extirpated from the Rio Grande upstream of Cochiti Dam, no protocol surveys were conducted for this species.

3.14.3 Critical Habitat

Federal critical habitat has been designated for the MSO, SWFL, and the NMMJM (Service 2016b). However, there is no designated critical habitat for these species in the action area (Service 2016b). Proposed critical habitat for the YBCU is found along the Rio Grande within the biological resources area of analysis.

Designated critical habitat for the Rio Grande silvery minnow does not occur in the general project area. In the Rio Grande, designated critical habitat is downstream of Cochiti Dam, 25 miles south of the proposed primary source water collection site.

3.15 Cultural Resources

Cultural resources is a broad term that encompasses numerous categories of historic properties, sacred American Indian sites, and resources of Tribal concern. Under the National Historic Preservation Act of 1966 (NHPA), “historic properties” are defined

specifically as sites, buildings, structures, objects, and districts that are included in or eligible for inclusion in, the National Register of Historic Places (NRHP). The term "cultural resources" is not defined in the NEPA, rather the Act requires agencies to consider the effects of their actions on all aspects of the human environment, including the cultural environment.

Examples of cultural resources are prehistoric and historic archaeological sites, residential and commercial buildings, structures (e.g., bridges, roads, railroads, irrigation ditches, and historic trails), objects (e.g., roadside markers, monuments, signs, and sculptures), and historic districts, which may encompass one of more of these resource types in a concentrated, geographically definable area. Cultural resources can be significant in the context of national, regional, or local history, architecture, archaeology, engineering, or culture. They may also include sacred sites and natural features significant to extant communities or peoples.

In general, prehistoric resources are those that predate written records and therefore are associated with cultural activities that occurred before Euro-American contact and settlement in the New World. Historic resources are those that date to the period of written records. This period began with the establishment of Euro-American settlement and thus varies in origination date by specific region. Ethnographic resources are those that are directly associated with the cultural practices and beliefs of living cultures.

3.15.1 Methods

3.15.1.1 Literature Review

The approximately 30,400-acre general project area encompasses a physically and temporally extensive cultural landscape. To better understand the types and extent of resources within the general project area, Reclamation prepared a Class I cultural resources literature review (Okun et al. 2014). The literature review presented a detailed cultural and historical overview of the general project area based on available records, and provided information on known cultural resources and previous investigations that have occurred within this area.

The literature review also included consulting with the following agencies, entities, and institutions:

- Reclamation, NMDOT, and BIA
- The Settlement Pueblos
- New Mexico Cultural Resource Information System of the New Mexico Historic Preservation Division
- NRHP
- New Mexico State Register of Cultural Properties

Reclamation conducted intensive government-to-government consultation with each of the Settlement Pueblos to identify Tribal resources of religious and cultural importance. This information, combined with results of the Class I literature review, was used to determine the location of known cultural resources, to develop a context for identifying and assessing cultural resources, to identify key data gaps in the existing record, and to derive expectations for the types and frequencies of cultural resources in the general

project area. Results of the Class I literature review are summarized in **Section 3.15.3**, Previous Research. These data help to provide a context for interpreting the results of the intensive pedestrian (Class III) survey of the proposed RWS project area and the connected actions.

3.15.1.2 Cultural Resources Area of Analysis (Area of Potential Effects)

A Class III pedestrian inventory of cultural resources occurred across a more narrowly defined, 5,900-acre area of analysis. This intensive survey identified and documented cultural resources within areas anticipated to be disturbed by the project alternatives. This is the project's area of analysis for cultural resources (**Figure 3-14**, Cultural Resources Area of Analysis), which was determined by Reclamation in consultation with the governments and Tribal Historic Preservation Officers (THPOs) of the Settlement Pueblos, the BIA, and the New Mexico State Historic Preservation Officer (SHPO).

The area of analysis was defined as follows:

- In open undeveloped terrain or lightly developed areas, the area of analysis was defined as a 200-foot-wide corridor (100 feet on each side of the centerline of project alignments).
- In heavily developed areas containing historic built environment resources (buildings, structures, and objects over 50 years old), the area of analysis was defined as a 500-foot-wide corridor (250 feet from each side of the centerline) to provide maximum flexibility for siting distribution lines.
- Along major highways (U.S. Highway 84/285 and SH 502), the area of analysis was defined as the entire highway easement (where defined), the entire area between ROW fence lines (where they exist), or a width similar to nearby portions of the same highway containing defined rights-of-way. In addition, the area of analysis was expanded outside the existing easement or fence lines to ensure a 100-foot-wide buffer on each side of the alignment (for example, when the proposed alignment is on one side of the highway, this 100-foot-wide buffer often extends outside the fence line on this side of the highway).
- For additional infrastructure, including wells, treatment plants, irrigation improvements, channel modifications, and other facilities, the area of analysis was defined as the entire area of potential disturbance, plus a 100-foot-wide buffer on all sides.

3.15.1.3 Archaeological Survey

The Class III cultural resources survey of the proposed undertaking began in spring 2014. Before fieldwork began, GIS maps were produced showing the boundaries of the area of analysis and all previously recorded sites in the analysis area. Field crews typically conducted surveys by walking transects no more than 50 feet apart.

The definitions for cultural resource types follow generally accepted state and federal practices.

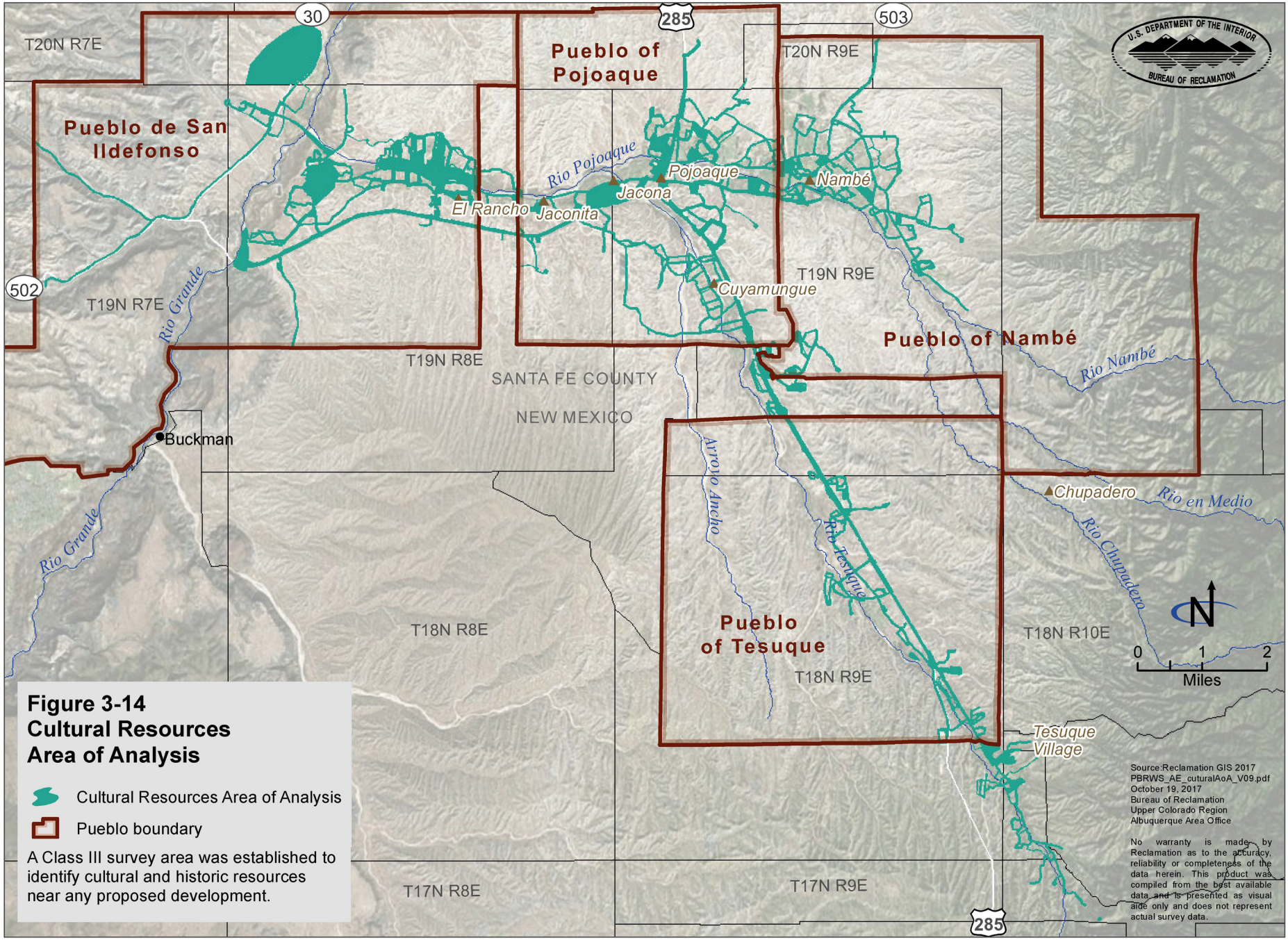


Figure 3-14
Cultural Resources
Area of Analysis

Cultural Resources Area of Analysis

Pueblo boundary

A Class III survey area was established to identify cultural and historic resources near any proposed development.

Cultural manifestations that are at least 50 years old but that do not meet the above site definitions were recorded as isolated occurrences. They usually consist of locations with fewer than 10 artifacts or with an isolated feature that lacks integrity or does not contain associated artifacts.

3.15.1.4 Historic Built Environment Survey

The historic built environment includes buildings, structures, objects, districts, and linear features (e.g., acequias and roads) that are at least 50 years old. The methods for documenting the historic built environment are detailed in the Methods of Analysis Plan (EMPSi 2013). Based on the large number of architectural resources and the narrow width of many of the roadways in the area of analysis, proposed water transmission and distribution pipelines are located in proximity to historic buildings.

The standard 50-foot-wide buffer used by the New Mexico SHPO for avoiding potential vibrations from utility line construction cannot be used for all areas of this project. Because of this, the data collection method was devised in a way that would help inform future mitigation strategies. Rather than cataloging all built-environment resources within the area of analysis, the field method was focused on gathering both broad and specific datasets to develop a regional architectural historic context for the Pojoaque Basin. A second focus was on individual contexts tailored to the specific histories of each Pueblo. These historic contexts may then be used to inform the development of appropriate mitigation measures.

A judgmental sample was then selected to include the best and most representative examples of these property types and styles. Resources considered to be potentially eligible for inclusion in the NRHP, as well as previously documented or listed properties, were included in this sample. Significant concentrations of resources that are united historically or aesthetically were considered during the field survey in order to identify potential historic districts and cultural landscapes.

This sampling strategy was necessary to properly evaluate the historic built environment of the general project area and to assess effects that are anticipated to occur at the district or landscape level, rather than solely on individual properties. The judgmental sample therefore included documentation of some built environment resources outside the project area of analysis.

3.15.1.5 American Indian Consultation

Reclamation has coordinated with the Settlement Pueblos and other American Indian Tribes who may claim religious or cultural significance to resources within the general project area. These resources have a direct association with living cultural groups and are of religious, cultural, or traditional significance to an American Indian Tribe or other group. They are referred to as properties of religious, cultural, or community significance. Such properties and other sacred sites may be considered eligible for listing on the NRHP, due to their “association with cultural practices or beliefs of a living community that are rooted in that community’s history, and are important in maintaining the continuing cultural identity of the community” (NPS 1990).

Examples of properties of religious, cultural, or community significance are locations for ceremonies or for gathering medicinal plants, agricultural areas, ancestral sites, trails, shrines, other sacred spaces, and natural features, such as springs. Such locations are

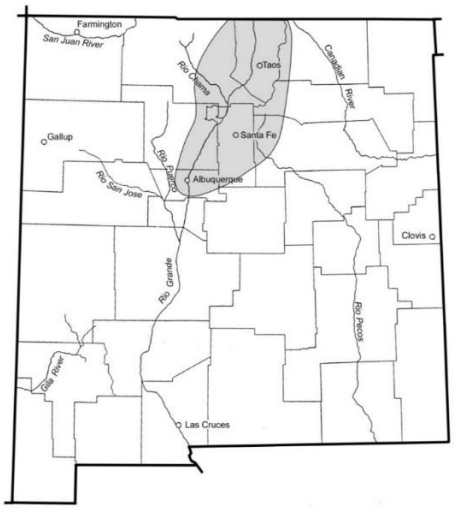
typically identified through government-to-government consultation or through the NEPA and Section 106 of the NHPA public involvement processes.

For the RWS and connected actions, consultation with the Settlement Pueblos was undertaken to identify sacred sites and potential properties of religious, cultural, or community significance on Pueblo lands. Reclamation has also initiated government-to-government consultation with other potentially interested Tribes for lands outside the general project area. Tribal consultation and identification of properties of religious, cultural, or community significance is ongoing.

3.15.2 Cultural History of the Pojoaque Basin

The Northern Rio Grande region is typically defined as extending north to south from the Taos area to La Bajada Mesa, and west to east from the Pajarito Plateau to the Upper Pecos Valley and Galisteo Basin (**Figure 3-15**, below).

Figure 3-15. The Northern Rio Grande Cultural Area



Source: Wendorf and Reed 1955

Within the Northern Rio Grande Region, the Pojoaque Basin encompasses a rich cultural landscape that has been witness to some of the most important events and processes in the history and prehistory of New Mexico. For example, the larger Tewa Basin (a cultural region that encompasses the Settlement Pueblos and other extant Pueblos, with shared language [Tewa] and cultural traditions) was the setting for periods of dramatic aggregation and village formation among Pueblo groups in the Coalition and Classic periods (A.D. 1200–1600). The resources in the Northern Rio Grande cultural area help demonstrate northern New Mexico's complex, multicultural history.

The major cultural periods and phases in the general project area represent widely accepted past and current research from a variety of different sources. Overall, the Northern Rio Grande contains evidence for the broad spectrum of prehistoric, Ancestral Puebloan, Spanish, and Euro-American histories. These manifest themselves as archaeological sites, prehistoric ruins with features and standing architecture, historic buildings, objects from antiquity, and sites of religious and spiritual significance to individual Pueblo and native cultures.

3.15.3 Previous Research

As detailed above, a Class I literature review and records search was conducted before initiation of the Class III pedestrian survey. This data review indicates that 325 previously documented archaeological sites have been recorded in the general project area. In total, 274 investigations have been conducted within the project area of analysis defined for the Class III survey (the cultural resources area of analysis), and 178 previously documented archaeological sites are depicted in the New Mexico Cultural Resources Information System database as intersecting the area of analysis. In addition to these resources, 12 NRHP-listed and/or New Mexico State Register of Cultural Properties-listed properties, and two National Historic Trails (El Camino Real de Tierra Adentro and the Old Spanish Trail) intersect the area of analysis. For additional data on previous research in the general project area, refer to the Class I literature review (Okun et al. 2014).

3.15.4 Summary of Class III Survey Results

The affected environment pertaining to cultural resources is summarized below in **Table 3-21**, below.

Table 3-21. Summary of Historic Property Types in the Affected Environment

Historic Property Type	Number
Archaeological Sites	206
Listed Properties/Historic Districts	12
Historic Buildings	657
Acequia Segments	Over 50
Other Historic Structures (bridges, well houses, railroad and road alignments)	10
National Historic Trails	2

Source: Field survey, May 2014 to March 2016

3.15.4.1 Archaeological Resources

To date, 206 archaeological sites have been recorded during the Class III survey of the cultural resources area of analysis, including 87 previously identified sites and 119 newly identified sites. A total of 177 sites were identified and recorded during reconnaissance of for the RWS, while 29 were identified during survey for connected actions, specifically the Pueblo de San Ildefonso future projects alternatives and the Rio Tesuque channel modification project.

Several archaeological site types were encountered during the survey, dating to a variety of periods, and some notable spatial-temporal relationships have been identified. See **Table 3-22**, Major Cultural Periods and Phases in the Northern Rio Grande (NMHPD 2013), for specific dates pertaining to these time periods. Most of the identified Archaic period sites were in upland settings south of the Rio Pojoaque. These sites primarily consist of flaked-stone artifact scatters with thermal features (such as hearths), and sometimes they contained temporally diagnostic projectile points.

Table 3-22. Major Cultural Periods and Phases in the Northern Rio Grande

Period	Date Range
Paleo-Indian	10,000 B.C. to 5000 B.C.
Archaic	5500 B.C. to A.D. 400/600
Early Archaic	*5500 B.C. to 3500 B.C.*
Middle Archaic	*3500 B.C. to 1500 B.C.*
Late Archaic	*1500 B.C. to A.D. 400/600*
Ancestral Puebloan	**A.D. 600 to 1600**
Developmental	*A.D. 600 to 1200*
Coalition	*A.D. 1200 to 1325*
Classic	*A.D. 1325 to 1600*
Historic	**A.D. 1540 to 1999**
Age of Exploration	*A.D. 1540 to 1598*
Early Spanish Colonial Period	*A.D. 1598 to 1680*
Pueblo Revolt	*A.D. 1680 to 1692*
Late Spanish Colonial Period	*A.D. 1692 to 1821*
Mexican/Santa Fe Trail	*A.D. 1821 to 1848*
U.S. Territorial	*A.D. 1848 to 1912*
Twentieth Century	*A.D. 1912 to 1999*

Source: NMHPD 2013

Ancestral Puebloan sites were found in nearly every portion of the area of analysis. These sites include flaked-stone and ceramic artifact scatters with and without features, small field house or agricultural sites, resource-procurement locations, and specialized activity areas. Also found were habitation areas, which ranged from small sites containing a single room block to large villages or communities containing multiple pithouses, house mounds, kivas, and middens.

Spanish Colonial/Historic Puebloan period sites frequently contained distinctive ceramics that greatly differ stylistically from earlier Ancestral Puebloan pottery. These sites were most typically found on riverine terraces, particularly along the Rio Pojoaque in the vicinity of extant Hispanic communities that have been occupied for hundreds of years. These sites include both habitations and villages and small artifact scatters representing agricultural activity areas. Many of the Spanish Colonial/Historic Puebloan habitation sites overlie earlier Ancestral Puebloan period habitations, and some exhibit continuous occupation from the A.D. 1300s through the 1800s.

Sites dating to the U.S. Territorial to Recent Historic periods often consist of refuse dumps containing hundreds to thousands of historic Euro-American artifacts, such as glass bottles, white-glazed earthenware, and rusted cans and other metal objects. Other sites are ranching or farming locations and contain such features as corrals, outhouses, windmills, stock tanks, sheds, and dugout storage structures. Several deteriorated adobe house ruins, dating to the early part of the twentieth century, were also documented as archaeological sites.

One battlefield site is in the vicinity of the project area, but outside the cultural resources area of analysis. The Battle of Puertecito de Pojoaque took place on January 27, 1838, in

Rio Arriba County. A marker commemorates that battle site, which is located east of U.S. Highway 84/285, between Pojoaque and Española.

3.15.4.2 Built Environment Resources

Historic built environment resources identified in the area of analysis include 12 historic properties listed on the state or national registers, seven historic districts (all of which are listed properties), and hundreds of historic buildings and structures—including acequias and a bridge. Additional historic districts may be defined pending ongoing documentation and historic analysis. A sample of these resources will be subject to full documentation and will include all of the resources located along NMDOT rights-of-way.

Listed Properties and Historic Districts

Twelve NRHP-listed or New Mexico State Register of Cultural Properties-listed were documented during the Class III cultural resources survey. These historic properties are the Pueblo of Tesuque, the Pueblo de San Ildefonso, the Pueblo of Nambé, the Nambé Archaeological District, Las Acequias, the Otowi Bridge Historic District, the Otowi Suspension Bridge, Bouquet Ranch, the Jean Bouquet Historic/Archaeological District, the Ignacio Roybal House, the Lujan-Ortiz House, and the Albert Schmidt Residence and Studio. Each of the three NRHP-listed Pueblos also was previously documented as an archaeological site. Several other previously documented sites fall within the boundaries of the Nambé Archaeological District and the Jean Boquet Historic/Archaeological District.

Two National Historic Trail alignments (El Camino Real de Tierra Adentro and the Old Spanish Trail) extend through the general project area. El Camino Real de Tierra Adentro ("Royal Road of the Interior Land") was a 1,600-mile trade route and transportation corridor between Mexico City and San Juan Pueblo north of the RWS project area. The trail is believed to have been used by American Indian groups as a trade route long before Oñate's arrival in New Mexico in 1598. It served as the primary route by which Spanish peoples emigrated to and colonized New Mexico, and also functioned as the economic artery connecting Pueblo and Spanish villages throughout New Mexico and areas farther south.

El Camino Real de Tierra Adentro enters the general project area along the eastern side of Buckman Mesa. It roughly follows a drainage and two-track road, crossing SH 502 and extending into Pueblo de San Ildefonso, following what are now paved roads. The trail crosses to the west side of the Rio Grande, in the vicinity of Pajarito, and parallels the western side of the river, extending northward to Santa Clara Pueblo and Española.

A different segment of El Camino Real de Tierra Adentro extends east, from Pueblo de San Ildefonso, roughly paralleling County Road 84, through the village of El Rancho. The segment turns north across the Rio Pojoaque, following County Road 84D, and then follows the course of a two-track road that eventually transitions into a drainage as it heads north toward Española.

The Old Spanish Trail is a historic trade route that connected the City of Santa Fe and other northern New Mexico settlements with Spanish settlements in southern California. It extends roughly east-west for 700 miles across high desert, mountains, and canyon lands. The trail was likely established by American Indians, and then more formally

developed by Spanish explorers and Euro-American fur trappers and traders. Its peak use occurred from the 1830s through 1850, when it was primarily used by mule-drawn pack trains transporting goods arriving to the City of Santa Fe via El Camino Real de Tierra Adentro and then on to Los Angeles and other Spanish settlements in southern California. From the City of Santa Fe, the Old Spanish Trail extends northward through the RWS project area between U.S. Highway 84/285 and Bishop's Lodge Road. It parallels the west side of the Rio Tesuque and crosses the Rio Pojoaque near the SH 503/U.S. Highway 84/285 interchange. The trail then parallels the eastern side of the highway as it continues north toward Española. Within the general project area, El Camino Real de Tierra Adentro and Old Spanish Trail are both believed to be approximately collocated with the U.S. Highway 84/285 corridor, which currently contains a two- to three-lane highway, frontage roads, and substantial commercial development.

Although updated documentation was not completed for all elements of all of these historic properties, as some of these contain numerous features that are outside of the project area of analysis, all will be assessed for potential project-related effects. Full updates to historic properties may be considered as part of potential mitigation measures.

Historic Structures

More than 50 individual acequia segments from at least eight different historic acequia systems have been documented in the area of analysis. These include the Jacona Larga Ditch, Las Joyas Ditch, Acequia de Los Indios, and other named acequia systems that have priority dates in the early 1800s. A sample of the acequia segments in the general project area has been recorded, and historic research and GIS mapping of the acequia systems is ongoing. Other historic structures identified include bridges, well houses, and railroad and road alignments.

Historic Buildings

Over 600 historic buildings have been inventoried during the Class III survey. These buildings date from the 1700s through the middle of the twentieth century and exhibit a variety of functions and architectural styles. A sample of these buildings will be subject to full documentation, including all of the buildings along NMDOT rights-of-way. **Table 3-23**, below, presents the number of buildings recorded by location.

National Historic Trails

Segments of El Camino Real de Tierra Adentro and the Old Spanish Trail extend through the general project area and the cultural resources area of analysis. No remnant segment of El Camino Real de Tierra Adentro was identified during the Class III survey of the area of analysis. It is now overlain by two-tracks or paved roads, such as County Road 84. A possible segment of the Old Spanish Trail was identified east of U.S. Highway 84/285 on Tesuque Pueblo and was recorded as a portion of an archaeological site.

Table 3-23. Historic Buildings by Location in the General Project Area

Location	Number of Buildings
Pueblo de San Ildefonso	68
Private inholdings on the Pueblo de San Ildefonso (El Rancho)	103
Pueblo of Pojoaque	25
Private inholdings on the Pueblo of Pojoaque (Jacona, Jaconita, Cuyamungue)	169
Pueblo of Tesuque	74
Tesuque Village area	66
Pueblo of Nambé	50
Private inholdings on Pueblo of Nambé	92
Non-Pueblo	10
Total	**657**

Source: Field survey, May 2014 to November 2015

3.15.4.3 American Indian Consultation

Government-to-government consultation between Reclamation, the Settlement Pueblos, and other interested Tribal entities is ongoing and will continue throughout project construction. This consultation involves identifying properties of religious, cultural, or community significance.

3.16 Indian Trust Assets

The federal Indian trust responsibility is a legally enforceable fiduciary obligation on the part of the U.S. to protect Tribal treaty rights, lands, assets, and resources and to carry out the mandates of federal law with respect to American Indians. ITAs are legal interests in property held in trust by the United States for federally recognized Indian Tribes or individual Indians. ITAs can include land, minerals, federally reserved hunting, fishing, and water rights, and in-stream flows associated with trust land.

Reclamation assesses the impact of its programs and projects on Tribal trust resources and federally recognized Tribal governments. Reclamation, along with all bureaus in the Department of the Interior, is responsible for, among other things, the following:

- Identifying any impact of its plans, projects, programs or activities on ITAs
- Ensuring that potential impacts are explicitly addressed in planning, decision, and operational documents
- Consulting with recognized Tribes who may be affected by proposed activities

Reclamation has continually engaged the four Settlement Pueblos and other relevant American Indian groups on a government-to-government basis. Discussions have taken place on a variety of topics and issues, including identifying Indian trust responsibilities. Additionally, research has been conducted on applicable treaties, statutes, and executive orders, and the findings of the Indian Claims Commission.

The area of analysis is Santa Fe County and encompasses the Pueblo de San Ildefonso, the Pueblo of Pojoaque, the Pueblo of Nambé, and the Pueblo of Tesuque. It also includes

the non-Pueblo communities of El Rancho, Jacona, Nambé Village, Cuyamungue, and Tesuque Village. To date the ITAs that have been identified as relevant to the analysis are water rights and the use of trust land for easements, rights-of-way, and facilities construction.

3.16.1 Pueblo Lands

Centuries before Spanish explorers and settlers arrived, the indigenous Pueblo cultures and other American Indian groups commonly used the lands and resources next to the Rio Grande and its tributaries in the Pojoaque Basin. Territories associated with different groups were fluid but were defined by natural features and mutual agreement. For the most part, the Pueblo settlements that were encountered by the Spanish beginning in the mid-sixteenth century were permanent communally owned villages.

The ownership of these lands and their resources by Pueblo inhabitants was recognized as a standard entitlement under Spanish law by 1700, but, in practice, it was not always respected. The recognition of these property and resource rights existed through Mexican rule and was guaranteed, at least on paper, under the Treaty of Guadalupe Hidalgo in 1849 when the U.S. acquired the New Mexico territory. In 1854, the Office of the Surveyor General of the U.S. for New Mexico was established. The Office recommended confirmation by Congress of the validity of the respective Spanish land grants for the Pueblo de San Ildefonso, the Pueblo of Pojoaque, and the Pueblo of Tesuque. Congress confirmed the grant lands for each of the four Pueblos on December 22, 1858. Patents were issued to each Pueblo on November 1864, thus confirming the property rights associated with each of these Pueblos (GAO 2001).

The U.S. recognizes that Pueblos have superior title to their lands, unlike Tribes that were removed to reservations created by the federal government. The U.S. has no ownership interest in the land grants. However, through subsequent federal actions and court decisions, the current land of the four sovereign Pueblos has been incorporated into the reservation system as restricted fee lands. These lands are subject to the federal trust relationship and protections; they are treated as trust lands for the beneficial interest of each Pueblo (GAO 2004). Lands purchased or re-acquired by a Pueblo within its grant boundary are treated as trust lands per the Pueblo Lands Act of 1924 and rulings in the Aamodt case.

3.16.2 Water Rights

Court decisions and the Settlement Agreement recognize that these Pueblos have first priority water rights associated with Pueblo grant lands, because they owned the land and used the water before Euro-American settlement. The priority of this right is “time immemorial.” These water rights are held in trust by the U.S. and are not subject to abandonment, forfeiture, or loss for non-use. Secondarily there are also Pueblo water rights that are associated with the status of reservation lands held by the U.S. for the benefit of Nambé Pueblo and Pueblo de San Ildefonso’s Eastern Reservation respectively under the Supreme Court’s Winters Doctrine decision. The court held that the establishment of an Indian reservation carries with it an implied volume of water necessary to satisfy the purposes of the reservation. A water right granted to a Tribe under the Winters Doctrine is given a priority date no later than the time when the

reservation was established. Unlike water rights permitted, licensed, or adjudicated under state statutes, such rights under the Winters Doctrine cannot be lost through non-use.

3.16.2.1 Pueblo de San Ildefonso

Under the Settlement Agreement, the first priority water right for the Pueblo de San Ildefonso has been quantified at 1,246 afy of consumptive use in the Pojoaque Basin. Consumptive use refers to water that is permanently withdrawn from its source and is no longer available for use. The Pueblo also has a reserved right under federal law for its Eastern Reservation to consumptively use 4.82 afy of the waters of the Pojoaque Basin for grazing livestock on the reservation. The priority of this right is 1939 (U.S. District Court 2016).

3.16.2.2 Pueblo of Pojoaque

Under the Settlement Agreement, the first priority water right for the Pueblo of Pojoaque has been quantified at 236 afy of consumptive use in the Pojoaque Basin. (U.S. District Court 2016).

3.16.2.3 Pueblo of Nambé

Under the Settlement Agreement, the first priority water right for the Pueblo of Nambé has been quantified at 1,459 afy of consumptive use in the Pojoaque Basin. The Pueblo has an additional reserved right under federal law to consumptively use 302 afy. The priority of this right is 1902 (U.S. District Court 2016).

3.16.2.4 Pueblo of Tesuque

Under the Settlement Agreement, the first priority water right for the Pueblo of Tesuque has been quantified at 1,459 afy of consumptive use in the Pojoaque Basin. (U.S. District Court 2016).

3.17 Land Use

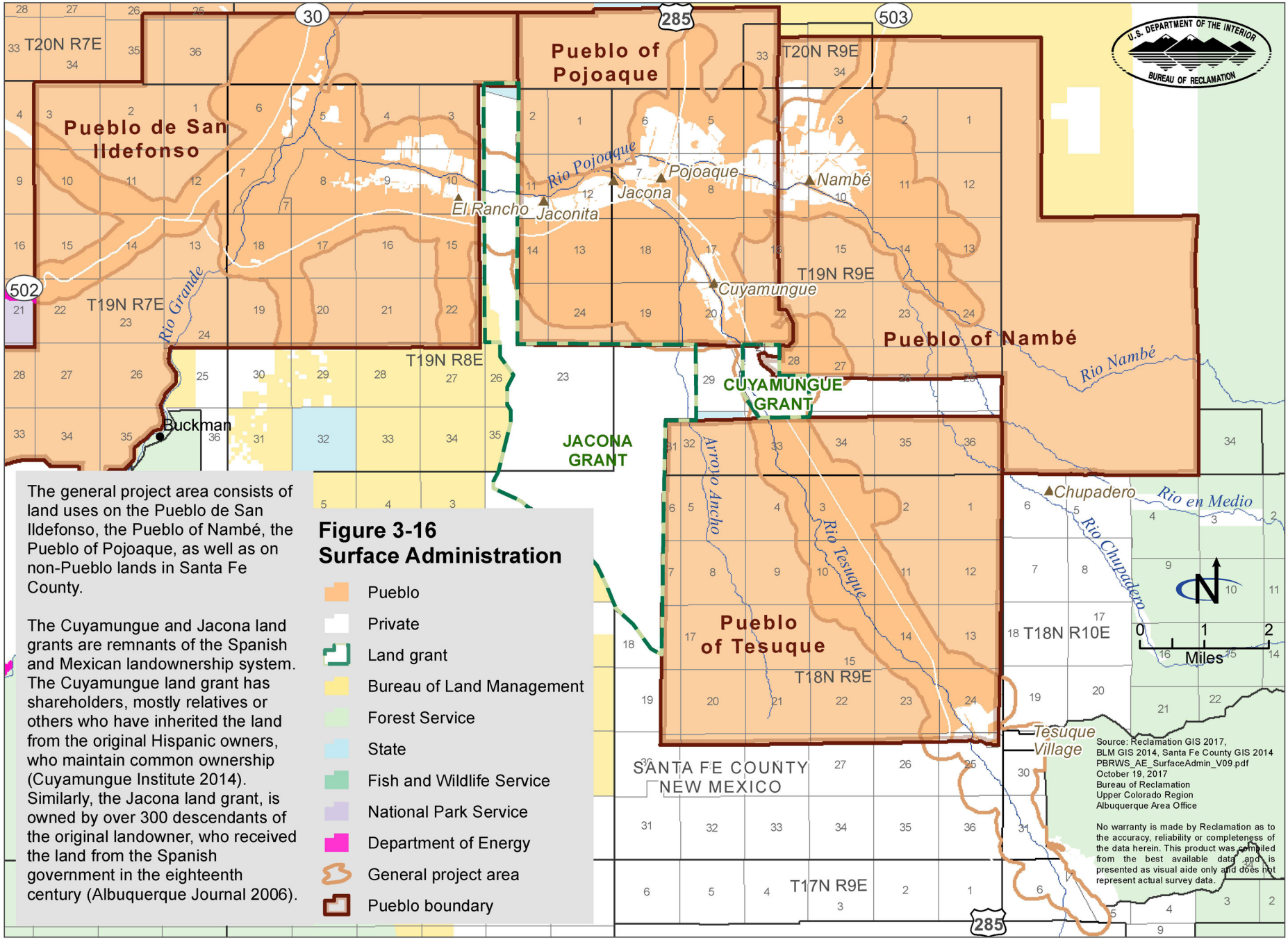
The following sections provide the methods used to analyze the existing conditions of land use, followed by a description of existing land use conditions.

3.17.1 Methods

The area of analysis for land use encompasses the general project area. A literature review of jurisdictional planning documents was conducted to determine current land use conditions and planning objectives in the general project area. Information on recreation in the general project area was gathered from commercial and local, state, federal, and Pueblo government sources.

3.17.2 Land Use

Eighty-nine percent of the lands in the general project area are on the Pueblo of Pojoaque, the Pueblo of Tesuque, the Pueblo of Nambé, and the Pueblo de San Ildefonso. The remaining 11 percent is privately owned, non-Pueblo areas of Santa Fe County (3,330 acres; see **Figure 3-16**, Surface Administration). There are no Forest Service, BLM, or other federal agency lands in the general project area.



The general project area consists of land uses on the Pueblo de San Ildefonso, the Pueblo of Nambé, the Pueblo of Pojoaque, as well as on non-Pueblo lands in Santa Fe County.

The Cuyamungue and Jacona land grants are remnants of the Spanish and Mexican landownership system. The Cuyamungue land grant has shareholders, mostly relatives or others who have inherited the land from the original Hispanic owners, who maintain common ownership (Cuyamungue Institute 2014). Similarly, the Jacona land grant, is owned by over 300 descendants of the original landowner, who received the land from the Spanish government in the eighteenth century (Albuquerque Journal 2006).

Figure 3-16
Surface Administration

- Pueblo
- Private
- Land grant
- Bureau of Land Management
- Forest Service
- State
- Fish and Wildlife Service
- National Park Service
- Department of Energy
- General project area
- Pueblo boundary

3.17.2.1 Santa Fe County

In the general project area, existing development in the non-Pueblo portions of Santa Fe County consists of low-density development (one dwelling per 2.5 acres or greater). In non-Pueblo areas of Santa Fe County, there are 871 acres of commercial-zoned parcels and another 989 acres of industrial-zoned lands. However, all of the industrial-zoned lands and 220 acres of commercial-zoned lands are in the annexation area, next to the City of Santa Fe. The remaining 650 acres are mainly concentrated along the U.S. Highway 84/285 corridor. The largest portion of the non-Pueblo Santa Fe County area is the area south of the Pueblo of Tesuque, which includes the Traditional Historic Community of Tesuque.

The Rio Tesuque Community Land Use Plan (Santa Fe County 2000a) is in place to preserve the community's rural character, to manage natural and cultural resources, and to guide future land use actions. Santa Fe County Ordinance 2000-13 further establishes the Rio Tesuque Land Use Plan and Tesuque Community Zoning District (Santa Fe County 2000b). The ordinance provides specific direction regarding land uses, terrain management, architecture, signage, visual quality, and roadway standards.

Santa Fe County is one of three counties in New Mexico that comprises the Northern Rio Grande National Heritage Area, administered by the National Park Service. Established by Congress in 2006 (PL 109-338), the designation is to assist local communities to preserve the unique cultural and historic resources in the area. Interpretive signs, national landmarks, and informational materials promote public awareness of the area's history, natural landscapes, land uses, and cultural resources. The National Heritage Area includes all of Santa Fe County, including the Pueblos of Nambé, Pojoaque, San Ildefonso, and Tesuque.

Nonresidential uses in the non-Pueblo Santa Fe County portion of the general project area are mainly in Tesuque Village and along U.S. Highway 84/285, between the Pueblo of Pojoaque and the Pueblo of Tesuque. This includes the Bishop's Lodge Resort, near the southern boundary of the general project area, east of County Road 590. Institutional land uses, such as the Santa Fe Opera near Tesuque Village and local schools, also account for a small amount of nonresidential land uses (Santa Fe County 2010). Agricultural lands in the non-Pueblo unincorporated Santa Fe County portion of the general project area tend to be fragmented and surrounded by nonagricultural uses.

Santa Fe County carries out land use planning and manages population growth according to its Sustainable Growth Management Plan (Santa Fe County 2010), other community plans, and Santa Fe County Ordinance No. 2002-3 (Santa Fe County 2002).

3.17.2.2 Pueblo of Pojoaque

The Pueblo of Pojoaque accounts for 8,390 acres (28 percent) of the general project area, and includes the communities of Pojoaque, Cuyamungue, Jacona, and Jaconita. Landownership on the Pueblo consists mainly of undeveloped lands with scattered holdings in the denser residential areas (see **Figure 3-16**, Surface Administration). Private land holdings are those associated with the Cuyamungue Land Grant in the community of Cuyamungue. There are other private land holdings along the Rio Nambé and Pojoaque Creek.

Land uses on the Pueblo include low density residential (0.2 to 0.5 dwellings per acre), small agricultural plots, and undeveloped open spaces. At the intersection of U.S. Highway

84/285 and SH 502 (Los Alamos Highway), there is a gaming establishment, a community center, and other commercial uses. Additional commercial uses, including another gaming establishment, are located along U.S. Highway 84/285, between Pojoaque and Cuyamungue. Agricultural land straddles the Rio Nambé and Pojoaque Creek, which run west to east through the Pueblo. There are also smaller agricultural land uses along the Rio Tesuque in Cuyamungue and a large gravel mine in the southwestern portion of the Pueblo.

Land use planning for Pueblo-owned lands is the responsibility of the Pueblo government, while authority on private lands is coordinated between Santa Fe County and the Pueblo. Private lands within the boundaries of Santa Fe County are subject to county jurisdiction. The Santa Fe County Sustainable Growth Management Plan (Santa Fe County 2010) contains the existing zoning and future land use planning objectives for private parcels on the Pueblo.

In 2007, the Pojoaque Valley Planning Committee and Santa Fe County Planning Division published the Pojoaque Valley Community Strategic Plan, which outlines specific community development objectives. Through its Vision 2025, the plan sets forth five broad goals. For each goal there are several strategic actions, including those for managing future growth, while preserving the unique rural, historical, and cultural characteristics of the Pojoaque Valley.

3.17.2.3 Pueblo of Tesuque

The Pueblo of Tesuque, which includes 4,370 acres (14 percent) of the general project area, is south of the Pueblo of Pojoaque and north of the Traditional Historic Community of Tesuque. The main population centers and commercial and agricultural areas are located along the Rio Tesuque and U.S. Highway 84/285, which bisect the Pueblo from northwest to the southeast. Areas in the northeast and southwest corners of the Pueblo are largely undeveloped open space. Outside the Pueblo of Tesuque, development is scattered along the Rio Tesuque, with a more concentrated cluster around the Pueblo proper. The most notable commercial land use on the Pueblo is the Camel Rock Casino, next to U.S. Highway 84/285, near the northern boundary of the Pueblo.

Land use planning for Pueblo-owned lands is the responsibility of the Pueblo government, while authority on private lands is coordinated between Santa Fe County and the Pueblo. Private lands within the boundaries of Santa Fe County are subject to county jurisdiction. The Santa Fe County Sustainable Growth Management Plan (Santa Fe County 2010) contains the existing zoning and future land use planning objectives for private parcels on the Pueblo.

The only privately owned parcels are in the southern part of the Pueblo of Tesuque, near Tesuque Village (see **Figure 3-16**, Surface Administration). For these privately owned properties, the Santa Fe County Sustainable Growth Management Plan assigns a land use designation of Tesuque Traditional Village, which allows for residential development at a maximum density of one dwelling unit per acre. The plan allows for commercial uses, so long as they are consistent with the Tesuque Community Plan Rural Character performance standards (Santa Fe County 2010).

3.17.2.4 Pueblo of Nambé

Areas in the northeastern portion of the general project area are on the Pueblo of Nambé and account for 4,580 acres (15 percent) of the total general project area. Land uses

consist mainly of low-density residential development, small-scale agriculture, and open space. The most intensive land uses—residential and agricultural—are in the northwestern portion of the Pueblo. There is also a gas station..

The Pueblo of Nambé has two primary population centers: the traditional communities of Nambé Village and Pueblo of Nambé itself, which form a low (2-acre lot size) to moderately dense (3/4-acre lot size) cluster of housing along the western boundary of the Pueblo, next to SH 503. Landownership in the Nambé Village area is primarily private, with the remaining areas, including the traditional Pueblo of Nambé community area, mostly owned by the Pueblo (see **Figure 3-16**, Surface Administration).

Land use planning for Pueblo-owned lands is the responsibility of the Pueblo government, while authority on private lands is coordinated between Santa Fe County and the Pueblo. Private lands within the boundaries of Santa Fe County are subject to county jurisdiction. The Santa Fe County Sustainable Growth Management Plan (Santa Fe County 2010) contains the existing zoning and future land use planning objectives for private parcels on the Pueblo. In accordance with the 2010 Santa Fe County Growth Management Plan, these private parcels are designated Residential Community, which allows for one dwelling unit per acre. A portion of private land north of the Nambé traditional communities, which is designated Residential Fringe, allows for one dwelling unit per 5 acres.

The Santa Fe County Sustainable Growth Management Plan assigns a residential land use designation only to privately owned lands; nevertheless, it provides for the continued mix of residential, nonresidential, agricultural, and institutional land uses. This is intended to preserve the unique land use on the Pueblo of Nambé and the other Pueblos (Santa Fe County 2010).

3.17.2.5 Pueblo de San Ildefonso

The Pueblo de San Ildefonso accounts for 9,760 acres (32 percent) of the general project area. Most of the land on the Pueblo de San Ildefonso portion of the general project area is undeveloped open space or riparian area associated with the Rio Grande and Rio Pojoaque. Overall, residential density is low: 0.1 to 0.5 dwellings per acre; there are low-density residential uses in the community of El Rancho and the Pueblo de San Ildefonso proper. There is a gas station with a convenience store located west of the Rio Grande, along SH 502.

Land use planning for Pueblo-owned lands is the responsibility of the Pueblo government, while authority on private lands is coordinated between Santa Fe County and the Pueblo. Private lands within the boundaries of Santa Fe County are subject to county jurisdiction. The Santa Fe County Sustainable Growth Management Plan (Santa Fe County 2010) contains the existing zoning and future land use planning objectives for private parcels on the Pueblo.

Agricultural uses are generally contiguous with the residential uses extending along the north and south banks of the Rio Pojoaque in the community of El Rancho. In this community, landownership is mostly private (see **Figure 3-16**, Surface Administration). Outside of El Rancho, including areas in the Pueblo proper and throughout the lesser developed portions of the Pueblo de San Ildefonso, lands are mostly under Pueblo ownership (AIWRMG 2001).

3.17.3 Land Grants

The Cuyamungue and Jacona land grants each overlap a portion of the general project area (see **Figure 3-16**, Surface Administration). The approximately 600-acre Cuyamungue land grant is located along the Rio Tesuque, south of the town of Cuyamungue. Shareholders, mostly relatives or others who have inherited the land from the original Hispanic owners, maintain common ownership (Cuyamungue Institute 2014). Similarly, the Jacona land grant, comprised of approximately 6,600 acres, east of the Pueblo de San Ildefonso, is owned by over 300 descendants of the original landowner, who received the land from the Spanish government in the eighteenth century (*Albuquerque Journal* 2006).

Land grants present unique land use challenges due to the extensive litigation surrounding their establishment and the multitude of landowners. Recently, both the Cuyamungue and Jacona land grantees have sold portions of their lands (Cuyamungue Institute 2014; *Albuquerque Journal* 2006). Future sales may occur as the regional population increases, prompting pressure for new residential and commercial development.

3.17.4 Access

There are numerous paved and unpaved public and private roadways that provide access to private properties throughout the general project area. In general, access to Pueblo land is restricted to Pueblo residents. See **Section 3.19**, Traffic, for a description of existing roadways in the general project area. Arterial roads provide access to the local street network, commercial uses, public facilities, open space, agricultural land, and private residences. Local collector roads mostly provide access to residential and agricultural uses and open space. There are few gates or fences preventing access onto private driveways or open lands in the general project area. In many areas, fences separate individual properties.

3.17.5 Recreation

Recreation opportunities in the general project area include gaming and a variety of other indoor and outdoor activities. Common dispersed outdoor recreation includes rafting, hiking, cross-country and distance running, camping (including at fee-based campgrounds), and fishing. Primary recreation providers in the Pojoaque Basin are the Pueblos and Santa Fe County. Outdoor recreation access on the Pueblos is allowed only with a permit or permission as specified by each Pueblo (NMDGF 2014); recreation on Santa Fe County lands is open to the public. Selected outdoor recreation amenities and destinations are shown in **Figure 3-17**, Recreation.

The NMDGF regulates fishing on public lands and on private lands that are not owned by Pueblos. Fishing on Pueblo lands is allowed once permission has been obtained from Pueblo officials; a New Mexico game-hunting license is not required. However, fish taken from Pueblo lands must be accompanied by official documentation, such as a Pueblo license or receipt, which demonstrates lawful possession.

Recreation on the Pueblo of Pojoaque includes golf, tennis, hiking, and mountain biking. In addition, a fitness and recreation trail can be accessed from the Pueblo of Pojoaque Wellness Center.

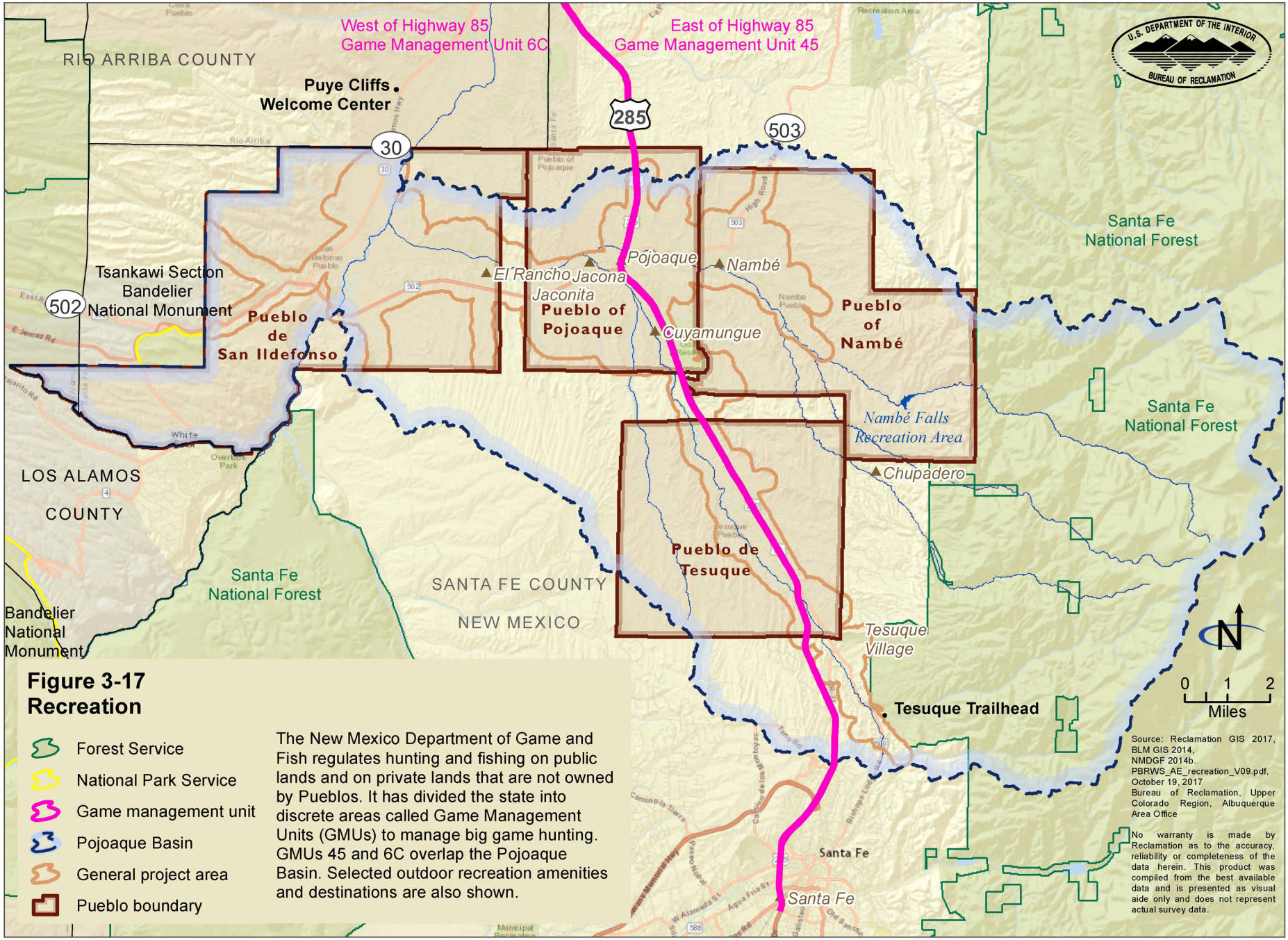


Figure 3-17
Recreation

- Forest Service
- National Park Service
- Game management unit
- Pojoaque Basin
- General project area
- Pueblo boundary

The New Mexico Department of Game and Fish regulates hunting and fishing on public lands and on private lands that are not owned by Pueblos. It has divided the state into discrete areas called Game Management Units (GMUs) to manage big game hunting. GMUs 45 and 6C overlap the Pojoaque Basin. Selected outdoor recreation amenities and destinations are also shown.

Source: Reclamation GIS 2017, BLM GIS 2014, NMDGF 2014b. PBRWS_AE_recreation_V09.pdf, October 19, 2017
Bureau of Reclamation, Upper Colorado Region, Albuquerque Area Office

No warranty is made by Reclamation as to the accuracy, reliability or completeness of the data herein. This product was compiled from the best available data and is presented as visual aide only and does not represent actual survey data.

Recreation amenities on the Pueblo of Tesuque include baseball fields, school playgrounds, hiking trails, and fishing spots. The Little Tesuque Creek trailhead to the east of the analysis area accesses a larger hiking trail system that extends into the Sangre de Cristo Mountains. The Pueblo of Tesuque is also an access point to the Santa Fe National Forest, which provides multiple outdoor recreation opportunities (Forest Service 2014).

Recreation on the Pueblo of Nambé is highlighted by the Nambé Falls Recreation Area, which features a picnic area, lake fishing, camping, hiking, and non-motorized boating.

Recreation amenities on the Pueblo de San Ildefonso are a community park, two baseball fields, and fishing ponds. The Pueblo de San Ildefonso maintains fishing ponds and picnic areas along the Rio Grande. Nonresidents must complete a fishing permit application, and the fishing ponds are open from April to October.

3.18 Visual Resources

Visual resources relate to the observable features on a landscape—land, water, vegetation, animals, and structures. These features contribute to the landscape's scenic or visual quality and appeal. A viewshed encompasses the land, vegetation, and other environmental elements that are visible from a fixed vantage point. Scenic resources, such as scenic byways, are considered to be lands that are managed for preservation and protection.

The following sections provide the methods used to analyze the existing conditions of visual resources, followed by a description of existing visual resource conditions.

3.18.1 Methods

The area of analysis for visual resources is viewsheds in and around the general project area. Key observation points (KOPs) were selected within the general project area as a sample of representative forms, lines, colors, and textures within the area and also areas from which the public could possibly be able to view some proposed RWS elements. A KOP is one of a series of points on a travel route or at a use area where the proposed project could be most revealing. KOPs are usually along commonly traveled routes or at other likely observation points, such as culturally or locally significant sites.

Technicians conducted site visits in the general project area, between September 28 and September 30, 2015, and on March 16, 2017. The purpose was to document the visual landscape of the Pojoaque Basin and to document conditions from KOPs.

3.18.2 Viewshed Characteristics

Major landforms that contribute to the visual landscape in the Pojoaque Basin are Buckman Mesa, Black Mesa, and the Sangre de Cristo and Jemez Mountains. These mountains form the edges of the basin and are visible from the Pueblos of Nambé and Tesuque.

Los Barrancos, a prominent ridge, is in the Pueblo of Pojoaque. The Jemez Mountains are west of the Rio Grande and the Pojoaque Basin. White Rock Overlook, southwest of the general project area, also contributes to the visual landscape of the area. The Rio Grande is also a significant visual resource in the Pojoaque Basin.

The colors in the general project area vary, with greener tones in the vegetated riparian areas and tan and gray tones in the sparsely vegetated areas beyond the rivers. The Rio Tesuque, Rio Pojoaque, and Rio Nambé, all significant visual resources in the area, meander through much of the general project area.

Human modifications impact the natural viewshed in the Pojoaque Basin. There are residences and other structures, paved and dirt roads, and agricultural land use throughout the region. All of these features impact the natural visual landscape of the area.

Significant visual resources in the area are the Santa Fe Opera, located less than a quarter-mile south of the Pueblo of Tesuque boundary and the Bishop's Lodge Ranch Resort and Spa, located three miles south of the Pueblo of Tesuque boundary. Additional landforms of visual significance are Camel Rock and Black Mesa.

Figure 3-18, Scenic Byways, shows scenic byways that pass through the general project area. El Camino Real National Scenic Byway, which overlaps the Old Spanish National Historic Trail in the Pojoaque Basin, passes through the Pueblo of Tesuque and the Pueblo of Pojoaque portions of the general project area (25.3 miles; New Mexico Tourism 2014a; Reclamation GIS 2017). The High Road to the Taos Scenic Byway also passes through a portion of the general project area on the Pueblos of Pojoaque and Nambé (4.8 miles; New Mexico Tourism 2014b; Reclamation GIS 2017).

The Santa Fe County Sustainable Growth Management Plan identifies scenic vistas and scenic quality priority features in the Pojoaque Basin in the general project area (Santa Fe County 2010). All of the Pueblos have areas that were determined to have scenic quality priority features. Their combined scenic quality, on a scale of low, moderate, medium, or high, was determined to be moderate to high (Santa Fe County 2010).

Figure 3-19, Key Observation Points, is a map of KOPs where visual surveys were conducted. **Table 3-24**, Key Observation Points, describes the KOPs, and **Appendix D**, Visual Simulations, includes photographs that show the current condition at these KOPs.

3.19 Traffic

The following sections provide the methods used to analyze the existing conditions of traffic, followed by a description of existing traffic conditions.

3.19.1 Methods

The Pojoaque Basin serves as the area for analysis for traffic since construction of the project would require supplies and workers from outside the general project area. The existing transportation network is describe using the following:

- Federal, state, Pueblo, and county roads in the general project area were identified using GIS
- Unnamed service roads on the Pueblos and private lands were identified using GIS
- Available traffic data were obtained from the NMDOT and Santa Fe County

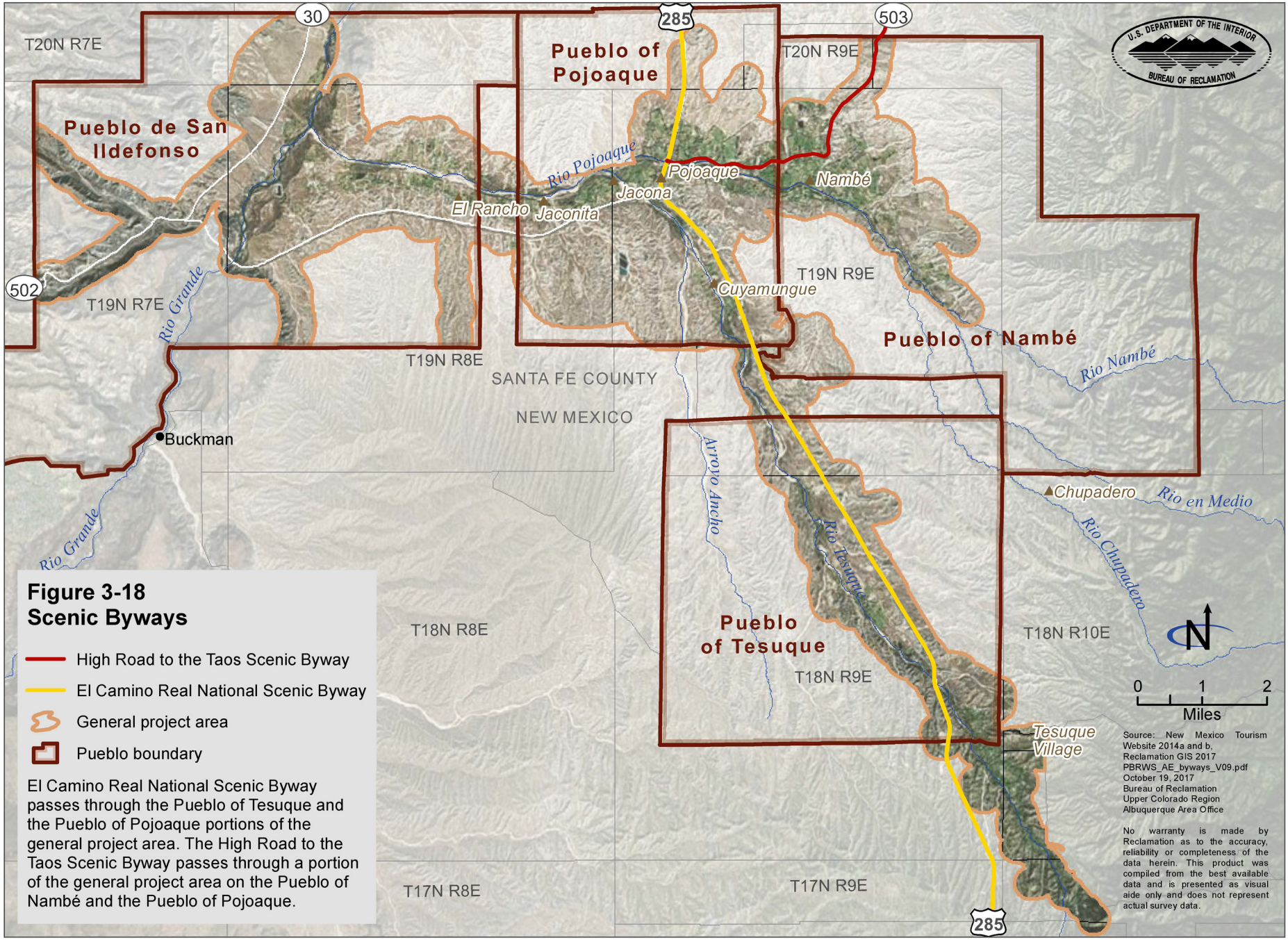


Figure 3-18
Scenic Byways

- High Road to the Taos Scenic Byway
- El Camino Real National Scenic Byway
- General project area
- Pueblo boundary

El Camino Real National Scenic Byway passes through the Pueblo of Tesuque and the Pueblo of Pojoaque portions of the general project area. The High Road to the Taos Scenic Byway passes through a portion of the general project area on the Pueblo of Nambé and the Pueblo of Pojoaque.

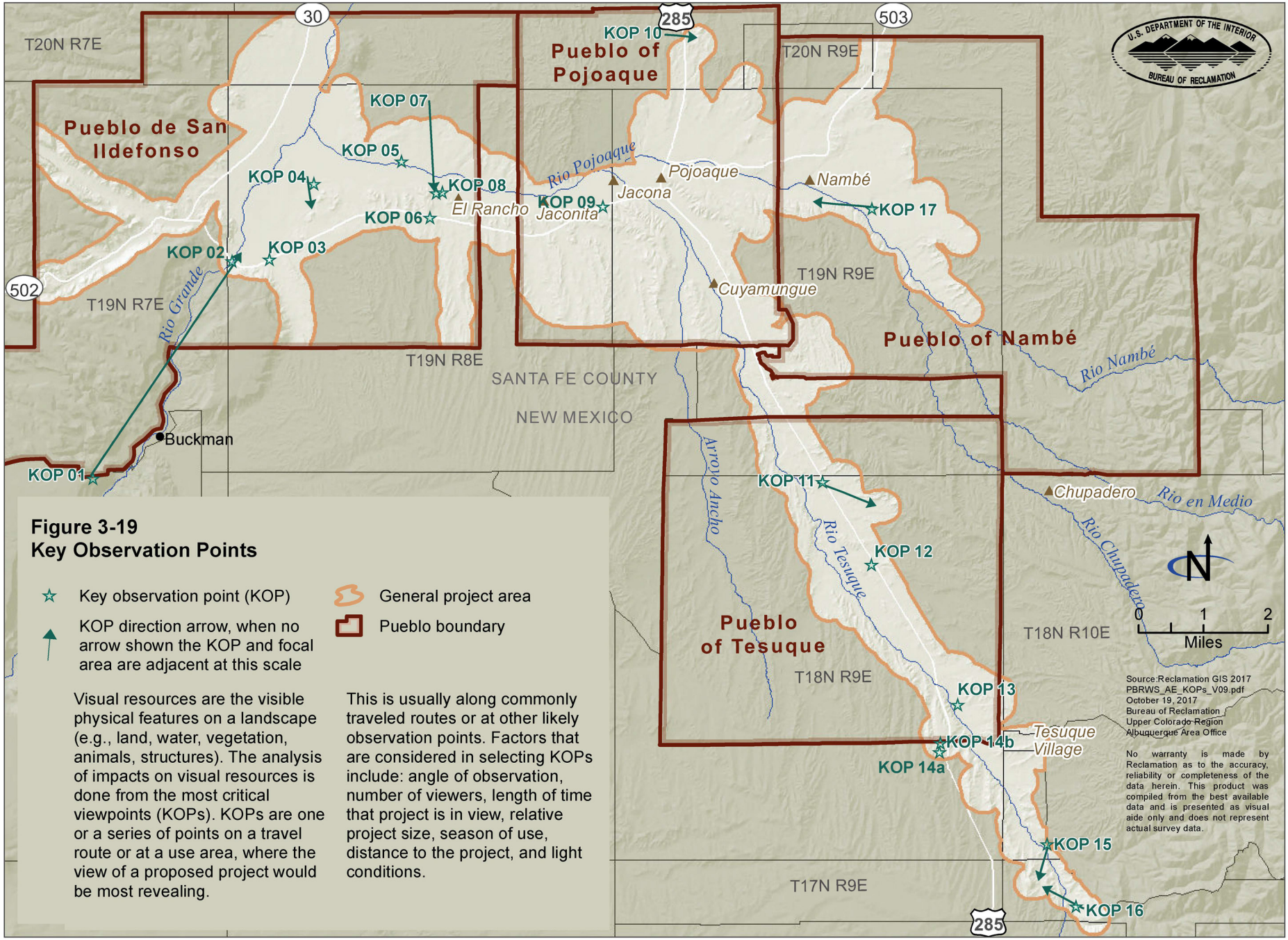


Figure 3-19
Key Observation Points

- Key observation point (KOP)
- KOP direction arrow, when no arrow shown the KOP and focal area are adjacent at this scale
- General project area
- Pueblo boundary

Visual resources are the visible physical features on a landscape (e.g., land, water, vegetation, animals, structures). The analysis of impacts on visual resources is done from the most critical viewpoints (KOPs). KOPs are one or a series of points on a travel route or at a use area, where the view of a proposed project would be most revealing.

This is usually along commonly traveled routes or at other likely observation points. Factors that are considered in selecting KOPs include: angle of observation, number of viewers, length of time that project is in view, relative project size, season of use, distance to the project, and light conditions.

Table 3-24. Key Observation Points

KOP Number	Direction of View	Reason(s) for the KOP	Current Condition Figure Number (Appendix D)
01	Northeast	Recreation views from White Rock Overlook	D-2 Key Observation Point 01—Existing Condition
02	East	Views from the Otowi Bridge over the Rio Grande	D-3 Key Observation Point 02—Existing Condition
03	Southeast	Views from the highway	D-6 Key Observation Point 03—Existing Condition
04	South	Views from the community	D-8 Key Observation Point 04—Existing Condition
05	West	Views from the Rio Pojoaque	D-9 Key Observation Point 05—Existing Condition
06	Northwest	Views from the highway	D-10 Key Observation Point 06—Existing Condition
07	South	Views from the community	D-13 Key Observation Point 07—Existing Condition
08	South	Views from the community	D-15 Key Observation Point 08—Existing Condition
09	South	Views from the community and highway	D-18 Key Observation Point 09—Existing Condition
10	Southeast	Views from El Camino Real National Scenic Byway	D-21 Key Observation Point 10—Existing Condition
11	Southeast	Views from El Camino Real National Scenic Byway and Camel Rock	D-22 Key Observation Point 11—Existing Condition
12	Southeast	Views from El Camino Real National Scenic Byway and recreation site	D-24 Key Observation Point 12—Existing Condition
13	South	Views from the County Road 73	D-26 Key Observation Point 13—Existing Condition
14a	North	Views from Crosby Theatre-Opera Club-Turner Family Lounge	D-28 Key Observation Point 14a—Existing Condition
14b	Northwest	Views from Opera Drive	D-31 Key Observation Point 14b—Existing Condition
15	Southwest	Views from the community	D-34 Key Observation Point 15—Existing Condition
16	Northwest	Views from The Bishop's Lodge Ranch Resort and Spa	D-35 Key Observation Point 16—Existing Condition
17	West	Views from the community	D-36 Key Observation Point 17—Existing Condition

3.19.2 Roadways

Smaller roads, generally maintained by the Pueblos, County, or private associations make up the majority of the mileage of roadways in the Pojoaque Basin. These roads, often narrow and unpaved, provide access to businesses, residences, government facilities, and service providers, and as such, are an important part of transportation network in this predominately rural area. These smaller roads tie into the state and federal highways that provide ingress and egress to the Pojoaque Basin.

U.S. Highway 84/285 traverses the Pojoaque Basin in a north-south direction, coming up from the City of Santa Fe, crossing the Pueblo of Tesuque and the Pueblo of Pojoaque as it continues north to Rio Arriba County. U.S. Highway 84/285 provides primary access from the City of Santa Fe and Albuquerque to the Pueblos. In the Pojoaque Basin, it is primarily a four-lane divided highway and is classified by NMDOT as a principal arterial road (NMDOT 2013).

NMDOT is upgrading U.S. Highway 84/285 at the Pojoaque interchange. Improvements include a new grade separation interchange on U.S. Highway 84/285, bridge construction and on- and off-ramps, roadway lighting, and reconstruction for a 0.72-mile segment just north of Pojoaque (NMDOT 2014).

New Mexico SH 502, a four-lane highway with no center divider, is one of two major east-west roads in the Pojoaque Basin. It enters the western end of the general project area in the Pueblo de San Ildefonso and terminates at its junction with U.S. Highway 84/285 in the Pueblo of Pojoaque. SH 502 also provides access to Los Alamos. The section of SH 502 in the Pueblo of Pojoaque includes a fifth center turning lane. NMDOT classifies SH 502 as a principal arterial road (NMDOT 2013).

SH 503 is the second major east-west road in the Pojoaque Basin. It originates in the Pueblo of Pojoaque at its junction with U.S. Highway 84/285 and travels east through the Pueblo of Nambé for approximately 8 miles before exiting the general project area and traveling north to its terminus at SH 76. It is a paved two-lane road with a yellow center line and is classified by NMDOT as a major collector road (NMDOT 2013).

SH 30 traverses the Pueblo de San Ildefonso in a primarily north-south direction. It originates at its junction with SH 502 and heads north-northeast through the Pueblo and into Rio Arriba County. SH 30 is a paved two-lane road with a yellow center line and wide, paved shoulders. It is classified by NMDOT as a minor arterial road (NMDOT 2013).

The NMDOT is conducting a corridor study for 8.5 miles of SH 30, including where it travels through the Pueblo de San Ildefonso. NMDOT will assess safety improvements and community, environmental, scenic, aesthetic, historic, and natural resources of the area (NMDOT 2014). An environmental assessment analyzing these improvements was released in February 2013 (NMDOT 2013).

3.19.3 Traffic

NMDOT is responsible for the state transportation system of roads, aviation, rail, and transit. In addition to constructing and maintaining state roads, NMDOT records annual average daily traffic (AADT), establishes functional classifications, and conducts long-range planning to determine the need for transportation network improvements. The AADT levels for the major roads in the Pojoaque Basin are presented in **Table 3-25**, below.

Table 3-25. Traffic Levels

Route	Mean 2014 AADT	Mean 2013 AADT	Mean 2012 AADT	Pueblo
U.S. Highway 84/285	14,930	14,476	14,164	Pueblo of Pojoaque, Pueblo of Tesuque
SH 502	6,064	5,918	5,867	Pueblo of Pojoaque, Pueblo de San Ildefonso
SH 503	4,947	5,090	5,151	Pueblo of Pojoaque, Pueblo of Nambé
SH 30	7,690	7,609	7,643	Pueblo de San Ildefonso

Source: NMDOT 2015a and 2015b

3.20 Noise

Noise is defined as unwanted sound and can be intermittent or continuous, steady or impulsive. Human response to noise is extremely diverse and varies according to the type of noise source, the sensitivity and expectations of the receptor, the time of day, and the distance between the noise source and the receptor. This section provides the methods used to analyze the existing conditions of noise, followed by a description of existing noise sources, sensitive receptors, and ambient noise levels.

3.20.1 Methods

The area of analysis for noise encompasses the general project area. Aerial imagery, GIS map layers showing facilities, zoning maps, and Census Bureau information were used to describe existing noise sources and sensitive receptors. The general project area was also based on an on-site tour of the general project area and ambient noise surveys. Ambient noise readings were taken at noise inventory sites (NISs). Readings were taken from September 28 to September 30, 2015, between 9:00 a.m. and 3:30 p.m. Mountain Standard Time. Technicians used the Sound Pressure Level Meter by Studio 6, shown to be an accurate sound level meter application (Fawver and Britten 2012), to take the readings.

3.20.2 Existing Noise Sources

Major sources of noise found in the general project area are the major roads passing through the area: U.S. Highway 84/285, SH 73, SH 502, SH 30, and SH 503. Additionally, there are two-track dirt roads in the area. Noises and vibrations are most prominent during times of high traffic volumes (see **Section 3.19**, Traffic, for a

discussion on traffic conditions). Agricultural machinery also contributes to the soundscape.

3.20.3 Existing Sensitive Receptors

Residences, schools, churches, and senior services facilities are found throughout the general project area, including New Beginnings Assembly of God, El Rancho Senior Care, El Rancho School, Pueblo of Tesuque Head Start, and Tesuque Day School. There are residences on the Pueblos as well as non-Pueblo lands along U.S. Highway 84/285 and SH 502.

Schools for various age groups are along the highways and in neighborhoods of all the Pueblos in the area; schools are also found on non-Pueblo lands between the Pueblo of Pojoaque and the Pueblo de San Ildefonso. Senior services facilities are on the Pueblo de San Ildefonso, the Pueblo of Pojoaque, and the Pueblo of Nambé. Additionally, the Santa Fe Opera is less than a quarter-mile south of the Pueblo of Tesuque boundary, and the Bishop's Lodge Ranch Resort and Spa is approximately three miles south of the Pueblo of Tesuque boundary.

Individuals at residences, senior care facilities, and Bishop's Lodge Ranch Resort and Spa would perceive noises at any time of day; individuals at schools, churches, Camel Rock, and the Santa Fe Opera would perceive noise during typical hours of operation or visitation.

People who visit cultural sites and properties of religious, cultural, or community significance would also perceive noises in the area and therefore would be considered sensitive noise receptors. Cultural resources in the area, according to literature reviews and field surveys, are discussed in detail in **Section 3.15**, Cultural Resources.

3.20.4 Ambient Noise Conditions

The decibel (dB) is the accepted unit of measurement for noise. Because human hearing is not equally sensitive to all sound frequencies, depending on the amplitude of the sound, various frequency weighting schemes have been developed to approximate the way people hear sound. Loudness (the subjective perception of sound by humans) is generally considered to double for approximately every 6 to 10 dB increase in sound level. There is a decrease in loudness at greater distances from the noise source (Hedge 2011). The A-weighted decibel scale (dBA) is normally used to approximate human hearing response to sound. Examples of sound noise levels are shown in **Table 3-26**, Common Sound Levels in Air.

There are no known noise monitoring stations within the general project area. To assess the general ambient noise levels, 14 NISs were established (**Figure 3-20**, Noise Inventory Sites). These sites were selected based on their proximity to sensitive noise receptors and where development could occur under the different alternatives. The sites also represent different type of noise environments found within the general project area. Noise levels ranged from about 30dB in rural areas to about 66dB near roadways and developed areas. Results and descriptions of the NISs are provided in **Table 3-27**, Noise Inventory Sites in the Noise Areas of Analysis.

Table 3-26. Common Sound Levels in Air

Characterization	dBA	Example Noise Condition Or Event
Painful	140	Jet engine
	130	Jackhammer
	120	Jet plane takeoff, siren
Extremely Loud	110	Maximum output of some MP3 players, model airplane, chain saw
	106	Gas lawn mower, snowblower
	100	Hand drill, pneumatic drill
	90	Subway, passing motorcycle
Very Loud	80-90	Blow-dryer, kitchen blender, food processor
Loud	70	Busy traffic, vacuum cleaner, alarm clock
Moderate	60	Typical conversation, dishwasher, clothes dryer
	50	Moderate rainfall
	40	Quiet room
Faint	30	Whisper, quiet library

Source: American Speech-Language-Hearing Association 2017

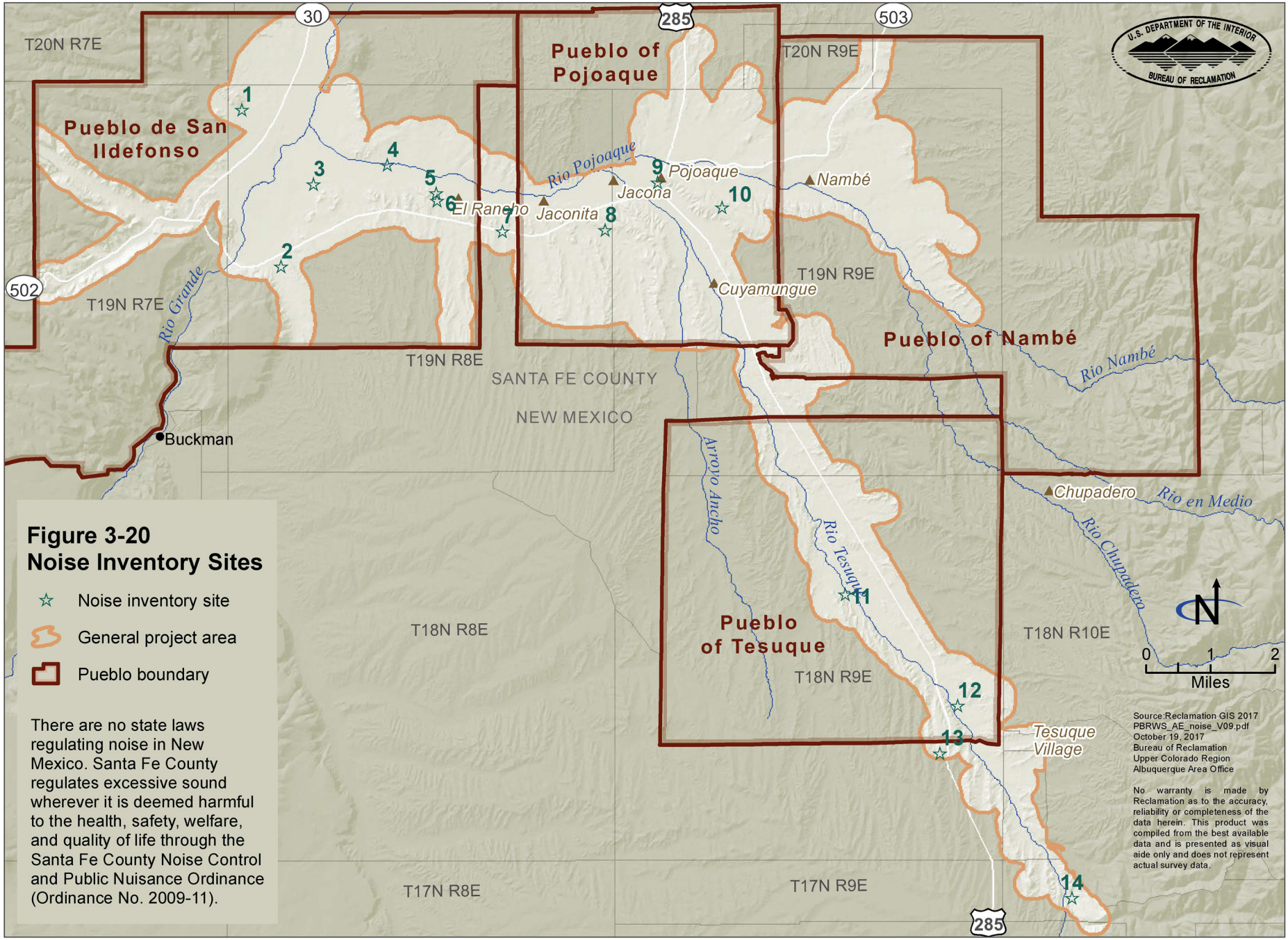


Figure 3-20
Noise Inventory Sites

☆ Noise inventory site

General project area

Pueblo boundary

There are no state laws regulating noise in New Mexico. Santa Fe County regulates excessive sound wherever it is deemed harmful to the health, safety, welfare, and quality of life through the Santa Fe County Noise Control and Public Nuisance Ordinance (Ordinance No. 2009-11).

Table 3-27. Noise Inventory Sites in the Noise Areas of Analysis

NIS Number	Description	Ambient Noise Reading (dB)
NIS 1	Ambient noise readings in undeveloped area outside of the Pueblo de San Ildefonso community. Sensitive receptors in this area would be the surrounding community members.	40.5
NIS 2	Ambient noise readings in undeveloped area off SH 502 in Pueblo de San Ildefonso.	53.8
NIS 3	Ambient noise readings from Pueblo de San Ildefonso kiva: Sensitive receptors at this NIS are visitors to the Pueblo de San Ildefonso Museum and the surrounding community members.	55.1
NIS 4	Ambient noise readings off of the Rio Pojoaque near Pueblo de San Ildefonso community: Sensitive receptors in this area would be the surrounding community members.	53.9
NIS 5	Ambient noise readings from Pueblo de San Ildefonso community: Sensitive receptors are the faculty and students of El Rancho School, the faculty and patrons of El Rancho Senior Center, and the surrounding community members. Ambient noise measurements at this location would be representative of the perceptions of receptors elsewhere in the area, including patrons of the New Beginnings Assembly of God Church and community members.	52.9
NIS 6	Ambient noise readings off of Entrada el Rancho (road) in undeveloped area in Pueblo de San Ildefonso: Although somewhat removed from occupied areas, sensitive receptors represented by this NIS are Pueblo de San Ildefonso community members and faculty and patrons of El Rancho Senior Center.	66.3
NIS 7	Ambient noise readings near Pojoaque Valley High school; Sensitive receptors represented at this NIS are students and faculty of the Pojoaque Valley High School, Pojoaque Valley Intermediate School, the Pablo Roybal Elementary School, and surrounding community members.	50.2
NIS 8	Ambient noise readings in undeveloped area in the Pueblo of Pojoaque: Ambient noise measurements would be representative of other undeveloped sites in the area.	29.8
NIS 9	Ambient noise readings near the Pojoaque Valley Middle School: Sensitive receptors represented by this NIS are the students and faculty of the Pojoaque Valley Middle School and Sixth Grade Academy, Pojoaque Elementary School, San Ildefonso Day School, Pojoaque Intermediate School, Pojoaque High School, Pojoaque Middle High School, and the surrounding community members.	44.8

Table 3-27. Noise Inventory Sites in the Noise Areas of Analysis (cont.)

NIS Number	Description	Ambient Noise Reading (dB)
NIS 10	Ambient noise readings near the Pojoaque Pueblo Senior Center and next to a walking/running trail: The sensitive receptors represented by this NIS are the employees and patrons of the Pojoaque Pueblo Senior Center and users of the trail.	33.2
NIS 11	Ambient noise readings next to the Tesuque Pueblo Day School: The sensitive receptors represented by this NIS are the faculty and students of the Tesuque Pueblo Day School and surrounding community members. Ambient noise measurements at this location would be representative of the perceptions of receptors elsewhere in the area, patrons of churches, and community members.	42.3
NIS 12	Ambient noise readings taken between a dirt road and SH 73: Although somewhat removed from occupied areas, sensitive receptors represented by this NIS are Tesuque Pueblo community members.	39.0
NIS 13	Ambient noise readings taken at the Santa Fe Opera: The sensitive receptors represented by this NIS are the patrons of the Santa Fe Opera.	64.9[1]
NIS 14	Ambient noise readings taken from Bishop's Lodge Ranch Resort and Spa: The sensitive receptors represented by this NIS are the patrons of the Bishop's Lodge Ranch Resort and Spa.	42.2

Source: Field inventory, September 28 to September 30, 2015 (see **Section 3.20.1**, Methods)
[1] Construction was occurring during this reading. Reading is likely not representative of typical noise level when construction would not be occurring.

3.21 Solid and Hazardous Materials

The following sections provide the methods used to analyze the existing conditions of solid and hazardous materials, followed by a description of existing health and safety conditions.

3.21.1 Methods

The area of analysis for health and safety encompasses the general project area.

Existing threats on public health and safety from hazardous materials were identified in the Pojoaque Basin and general project area using data from the IHS, NMED, and EPA. Additionally, JG Management Systems, Inc. (JGMS) and Environmental Data Resources, Inc. (EDR) were consulted as data sources.

In September 2014, JGMS published an environmental investigation report to assist Reclamation with the project planning and design of the RWS (JGMS 2014; **Appendix E**). This report identified areas of potential environmental concern, including IHS open

dump sites, EDR sites identified from a culmination of geo-referenced federal, state, and local GIS data, and JGMS-identified sites of environmental concern, based on site visits. JGMS ranked each site's relative hazard, based on their evaluation of available data. Not included in the data relayed in this section are sites that occur in various EDR databases, but that do not include location information.

Sites of concern were ranked using a relative hazard rating, based on anticipated environmental concerns during the construction phases for the RWS and the other proposed actions. JGMS took into consideration specifically the likelihood that waterline piping or the excavation process would come in contact with potentially contaminated soil or groundwater. The relative hazard rankings used in JGMS's report and included in this section are as follows:

- High—Indicates that waterline piping or the excavation may come in contact with potentially contaminated soil or groundwater
- Medium—Indicates that it is unlikely but possible for the excavation to come in contact with potentially contaminated soil or groundwater
- Low—Indicates no evidence that contaminants would be encountered during construction
- NC—Sites visited but determined to be "not of environmental concern"
- Not visited—Site not visited, either because of access restrictions or because it could not be located (applies to JGMS sites only)

3.21.2 General Project Area

JGMS (2014) reviewed and investigated the general project area. There are no active state cleanup sites or Superfund sites in the Pojoaque Basin (NMED 2014c; EPA 2014c). The closest active state cleanup site is the Ortiz Landfill Santa Fe site, approximately 3.5 miles southwest of the general project area (NMED 2014c). The closest Superfund site is the North Railroad Avenue Plume in Española, New Mexico, approximately 5 miles north of the general project area (EPA 2012b, 2014c).

LANL is west of the Pojoaque Basin, outside of the general project area. Potential legacy contamination from LANL has been a public health concern for other water supply projects drawing from the Rio Grande. Pollutants from LANL could enter the Rio Grande from several west bank tributaries, including Los Alamos Canyon below the Otowi Bridge. However, these tributaries enter the Rio Grande downstream of the proposed point of diversion for the RWS, so contamination from LANL is of less concern for this project.

Groundwater quality and contamination by hazardous materials is an area of focus in the Pojoaque Basin, as many residents rely on wells for their domestic water needs. Materials of concern are uranium, arsenic, fluoride, iron, manganese, nitrate, sulfate, and total dissolved solids. In 2009 NMED and LANL investigated water quality at select wells in the Pojoaque Basin. Results revealed that some wells exceeded EPA's MCLs for municipal water systems and WQCC human health standards (McQuillan et al. 2009). These wells had potentially hazardous concentrations of chemicals, such as arsenic, barium, fluoride, nitrate, selenium, and uranium. Hazardous concentrations of these chemicals could result in increased cancer risk, circulatory problems, increased blood

pressure and likelihood of bone fractures, or shortness of breath (EPA 2012c, 2013a, 2013b, 2013c, 2014d, 2014e).

3.21.3 Sites of Concern

Hazardous materials sites in the general project area are detailed in the JGMS environmental investigation report (JGMS 2014; **Appendix E**). Sites were identified based on the presence of hazardous substances and releases, hazardous waste, landfills, solid-waste disposal sites, wastewater, underground storage tanks, aboveground storage tanks, leaking underground storage tanks, petroleum products, solvents, pesticides, herbicides, batteries, and discarded automotive cars and parts.

Table 3-28, below, reports IHS-, EDR-, and JGMS-identified sites of concern for public health and safety in the Pojoaque Basin. It also shows the hazard ranking of each site, as published in the JGMS report.

Table 3-28. Sites of Concern in the General Project Area

Site Location in the Pojoaque Basin	Total Number of Sites	Sites with High Hazard Ranking	Sites with Medium Hazard Ranking	Sites with Low Hazard Ranking	Sites "Not of Environmental Concern"	Sites Identified But Not Visited For Analysis[1]
Pueblo of Nambé	64	0	10	33	10	11
Pueblo of Pojoaque	65	3	9	30	13	10
Pueblo of Tesuque	51	0	10	31	9	1
Pueblo de San Ildefonso	64	1	6	34	15	8
Santa Fe County	54	0	12	30	3	9
Totals for the Pojoaque Basin Project Area	**298**	**4**	**47**	**158**	**50**	**39**

Source: JGMS 2014
[1] Applies only to JGMS identified sites.

Of the 298 sites identified by JGMS, only four received a hazard ranking of high. Three sites in the exterior boundaries of the Pueblo of Pojoaque had a hazard ranking of high. All three are along U.S. Highway 84/285: Kokoman Discount Liquors, Jake's Dirty Shorts Laundry, and Kicks 66/Jiffy Lube. One site in the exterior boundaries of the Pueblo de San Ildefonso, IHS Open Dump Site 512, was given a hazard ranking of high but was determined to be outside of the RWS project boundary. Given the size and distance of this site to the project components, it is unlikely that there would be any effects from this site.

3.22 Socioeconomic Resources

The following section provides the methods used to analyze the existing socioeconomic resource conditions, followed by a description of existing socioeconomic conditions.

3.22.1 Methods

The socioeconomic area of analysis is the Pueblo of Pojoaque, Pueblo of Tesuque, Pueblo of Nambé, and Pueblo de San Ildefonso. Also analyzed is the portion of Santa Fe County that would be served by the proposed RWS but that is not within Pueblo boundaries. Santa Fe County level data is provided where more detailed information is absent and for comparison. State and regional information is provided for context when appropriate.

Detailed information on the data sources, methods of data collection, and socioeconomic conditions of the Pojoaque Basin are provided in **Appendix G**, Supplemental Socioeconomic Baseline Conditions.

3.22.2 Socioeconomic Area of Analysis Demographics

3.22.2.1 Population

In the socioeconomic area of analysis, the Pueblo of Pojoaque had the highest population density in 2014, and the Pueblo de San Ildefonso had the lowest, as shown in **Table 3-29**, Area of Analysis Population Totals (1980-2014). The Pueblo of Pojoaque and the non-Pueblo areas of Santa Fe County in the area of analysis had substantially higher population densities than those for Santa Fe County as a whole, New Mexico, and the U.S.

Note that populations listed for the Pueblos includes both Pueblo members and county residents living on private in-holdings.

In the socioeconomic area of analysis as a whole, from 1980 to 2014, population growth was the highest on the Pueblo of Pojoaque and lowest on the Pueblo de San Ildefonso. Most of the locations in the socioeconomic area of analysis had population growths similar to those of the U.S., New Mexico, and Santa Fe County. The Pueblo of Pojoaque had substantially higher growth, likely due to the increased development in the area in the last decade, including the construction of an apartment complex and Buffalo Thunder Resort and Casino.

Population projections are not available for all geographic areas examined in the analysis area. Recent population projections indicate that Santa Fe County's growth is expected to slow between 2014 and 2030. Estimates produced by Santa Fe County for 2030 indicate an overall 12 percent population growth. Pueblo areas are estimated to continue having lower growth rates than the County as a whole, at 4.9 percent change between 2014 and 2030. Unincorporated portions of the County, such as the non-Pueblo portion of the analysis area, are expected to remain slightly above that of the County average, at a 16.9 percent change (Santa Fe County 2014a). County and Pueblo/non-Pueblo population projections did not provide specific assumptions related to water availability in the region.

Specific population projections and associated water demand for the Pueblo of Tesuque was based on recent modeling exercises. Assuming a population of 812 in 2016 and a rate of growth of 0.37 percent per year, population projection is estimated to be 894 in 2036 and 999 in 2066. Based on these population levels, annual residential water demand is also anticipated to increase, from 28,156,000 gallons in 2016, to 30,999,450 gallons in 2036, to 34,640,325 gallons in 2066.

Table 3-29. Area of Analysis Population Totals (1980-2014)

Location	1980	1990	1980-1990 Percent Change	2000	1990-2000 Percent Change	2014	2000-2014 Percent Change	1980-2014 Percent Change
Pueblo of Pojoaque	1,143	2,556	123.6	2,712	6.1	3,811	40.52	233.42
Pueblo of Tesuque	369	697	88.9	806	15.6	727	-9.80	97.02
Pueblo of Nambé	1,097	1,402	27.8	1,764	25.8	1,195	-8.56	74.57
Pueblo de San Ildefonso	1,491	1,499	0.5	1,524	1.7	1,924	26.25	29.04
Santa Fe County area of analysis	N/A	N/A	N/A	N/A	N/A	2,010	N/A	N/A
Santa Fe County	75,360	98,928	31.3	129,292	30.7	146,361	13.20	94.22
New Mexico	1,303,445	1,563,579	20.0	1,819,046	16.3	2,080,085	14.35	59.58
U.S.	226,548,632	252,730,369	11.6	281,421,906	11.4	314,107,084	11.61	38.65

Source: U.S. Census Bureau 1980, 1990, 2000, 2014a
N/A = Not available

Commercial water demand is also anticipated to increase. Based on proposed casino expansion, total future demand is anticipated to increase from 9,950 gallons per day in 2016 to 60,300 gallons per day in 2066 (Souder, Miller and Associates 2016).

3.22.2.2 Housing

The availability of housing units can be an indicator of how well a community could handle a sharp influx of workers and families, such as one that could occur during a large infrastructure project.

All locations in the socioeconomic area of analysis had an increase in total housing units from 2000 to 2014, except for the Pueblo of Pojoaque and the Pueblo of Tesuque. In addition, all locations had an increase in vacant housing units between 2000 and 2014, except the Pueblo of Tesuque. The percentage of renter-occupied housing versus owner-occupied housing varies throughout the area of analysis. The rate of ownership of occupied housing is higher than that of the county and state for the Pueblo of Nambé, Pueblo de San Ildefonso, and Pueblo of Tesuque. The rate was slightly lower than county levels for the Pueblo of Pojoaque.

All Pueblos in the socioeconomic area of analysis reported a higher rate of long-term residence (since 1989 or earlier), compared with the rate in New Mexico and the national average. In particular, on the Pueblo of Nambé, over 43 percent of residents have lived in their current residences since 1989 or before. The rate of long-term residence is lower for non-Pueblo areas of Santa Fe County at 25.9 percent; however, it is still higher than the Santa Fe County average of 18.3 percent and the state and national level of about 19 percent.

Residential home values in the socioeconomic area can fluctuate depending on access to basic needs, such as drinking water. In 2014, the Pueblo of Tesuque had the lowest median home value, and the non-Pueblo areas of Santa Fe County within the socioeconomic area of analysis had the highest. All of this area, except for the Pueblo of Tesuque, had higher median home values than both New Mexico and the U.S.

The Pueblo of Tesuque had the highest median rents in 2014. Most of the socioeconomic area of analysis had median rents below those for Santa Fe County and the U.S., and about equal with those for New Mexico.

3.22.2.3 Income Distribution and Poverty Level

In the socioeconomic area of analysis, in 2014 only the Pueblo of Tesuque had a median household income substantially lower than the reference areas of Santa Fe County, New Mexico, and the U.S.; the non-Pueblo areas of Santa Fe County in the socioeconomic area of analysis were substantially higher than the reference areas.

For the percentage of individuals living below the poverty line, all locations were similar to the reference areas. Since 2000, however, the number of individuals below the poverty level had a higher rate of increase for Santa Fe County as a whole compared to the Pueblos. Similarly, families below the poverty line have decreased on the Pueblos and increased in Santa Fe County as a whole, with the exception being the Pueblo of Tesuque. This may be due to a lower level of impacts on Pueblo residents from the recent economic depression.

3.22.2.4 Employment

Employment is a key economic indicator, because patterns of growth and decline in a region's employment are largely driven by economic cycles and local economic activity. In the socioeconomic area of analysis, the unemployment rate varied from 5.6 percent in the Pueblo of Tesuque to 9.8 percent on the Pueblo de San Ildefonso. Overall, the unemployment rate on the Pueblos was higher than that of the non-Pueblo population in the area of analysis and the state, as shown in **Table 3-30**, below. The data for the Pueblo of Tesuque may be affected by the small sample size.

Table 3-30. Area of Analysis Employment Status in the Population 16 and Older (2014)

Location	Total Population 16 and Older	In the Labor Force	Unemployed
Pueblo of Pojoaque	2,946	1940	200
	100%	65.9%	6.8%
Pueblo of Tesuque	546	375	31
	100%	68.7%	5.7%
Pueblo of Nambé	1,522	900	131
	100%	59.1%	8.6%
Pueblo de San Ildefonso	1,496	941	555
	100%	62.9%	9.8%
Santa Fe County area of analysis	916	704	52
	100%	76.9%	5.7%
Santa Fe County	120,282	76,685	6,872
	100%	63.8%	5.7%
New Mexico	1,625,155	977,579	93,106
	100%	60.2%	5.7%
U.S.	248,775,628	158,965,511	14,504,781
	100%	63.9%	5.8%

Source: U.S. Census Bureau 2014a
Note: American Community Survey (ACS) estimates are based on data collected over five years. They represent the average characteristics of population and housing between January 2010 and December 2014 and do not represent a single point in time.

Across the socioeconomic area of analysis, the employment sectors with the most employees are professional, scientific, management, and administration; education, healthcare, social assistance; arts, entertainment, recreation, and accommodation and food services; and public administration (**Table 3-31**, Area of Analysis Employment Characteristics (2014)). West of the Pojoaque Basin, including Pueblo and non-Pueblo populations, a large number of workers are employed at LANL. This is reflected in the higher level of professional, scientific, management, and administrative employment than in the county. Other important employers in the Pojoaque Basin include casinos and hotels on the Pueblos of Pojoaque, Tesuque, and Nambé, and area schools (Pitts 2006).

Table 3-31. Area of Analysis Employment Characteristics (2014)

	Pueblo of Pojoaque	Pueblo of Tesuque	Pueblo of Nambé	Pueblo de San Ildefonso	Santa Fe County Area of Analysis	Santa Fe County	New Mexico	U.S.
Agriculture, forestry, fishing and hunting, and mining	15	11	13	8	14	793	28,509	2,807,292
	0.9%	3.2%	1.7%	1.0%	1.2%	1.1%	4.4%	2.0%
Construction	122	28	68	58	66	4,607	60,090	8,843,718
	7.0%	8.1%	8.8%	7.3%	5.8%	6.6%	6.9%	6.2%
Manufacturing	15	7	25	18	21	1,911	43,074	14,955,235
	0.9%	2.0%	3.3%	2.3%	1.9%	2.7%	4.9%	10.4%
Wholesale trade	17	2	20	15	6	893	18,038	3,3937,598
	1.0%	0.6%	2.6%	1.9%	0.5%	1.3%	2.1%	2.7%
Retail trade	175	32	65	65	134	7,842	98,645	16,598,718
	10.1%	9.3%	8.5%	8.2%	11.8%	11.3%	11.3%	11.6%
Transportation/ warehousing and utilities	26	4	18	23	34	2,200	39,326	7,066,666
	1.5%	1.2%	2.3%	2.9%	3.0%	3.2%	4.5%	4.9%
Information	21	1	8	10	36	1,089	13,961	3,064,078
	1.2%	0.3%	1.0%	1.3%	3.2%	1.6%	1.6%	2.1%
Finance and insurance and real estate and rental leasing	60	5	7	22	31	3,945	39,473	9,467,555
	3.4%	1.5%	0.9%	2.8%	2.7%	5.7%	4.5%	6.6%
Professional, scientific, management, and administration	331	51	158	195	215	10,521	95,808	15,618,627
	19.0%	14.8%	20.5%	24.6%	19.0%	15.1%	10.9%	10.9%
Education, healthcare, and social assistance	321	53	146	174	176	14,951	220,881	33,297,237
	18.4%	15.4%	19.0%	21.9%	15.5%	21.5%	25.2%	23.2%
Arts, entertainment, recreation, and accommodation and food services	329	80	70	70	78	10,165	95,461	13,610,162
	18.9%	23.3%	9.1%	8.8%	6.9%	14.6%	10.9%	9.5%

Table 3-31. Area of Analysis Employment Characteristics (2014) (cont.)

	Pueblo of Pojoaque	Pueblo of Tesuque	Pueblo of Nambé	Pueblo de San Ildefonso	Santa Fe County Area of Analysis	Santa Fe County	New Mexico	U.S.
Other services except public administration	91	13	16	21	147	4,083	41,932	7,112,579
	5.2%	3.8%	2.1%	2.6%	13.0%	5.9%	4.8%	5.0%
Public administration	217	57	155	114	95	6,661	70,749	7,055,768
	12.5%	16.6%	20.2%	14.4%	8.4%	9.6%	8.1%	4.9%
Total Employment	**1,740**	**344**	**769**	**793**	**1,133**	**69,661**	**875,947**	**143,435,233**

Source: U.S. Census Bureau 2014a

Notes: ACS estimates are based on data collected over five years. They represent the average characteristics of employment between January 2010 and December 2014 and do not represent a single point in time.

The definitions of industries are based on the North American Industry Classification System Manual (1997). An overview is provided on the U.S. Census Bureau website (http://www.census.gov/eos/www/naics/). Employment estimates may vary from the official labor force data released by the Bureau of Labor Statistics because of differences in survey design and data collection.

3.22.3 Community and Social Conditions

Throughout the Southwest, there is a long history of water rights and water infrastructure projects to ensure continued and reliable access to drinking water. As Santa Fe County and the Pojoaque Basin continue to expand, water infrastructure will continue to play an important role in the local economy. This is because such projects can contribute to a higher quality of life, such as access to a reliable source of drinking water; however, it may also allow for continued economic expansion of the area in a variety of ways.

Regardless of race or culture, most residents have a strong connection to the lands that surround and encompass their communities. They view the lands as playing a significant role by providing economic opportunities, a rural community character, a connection to the western landscape and history, and other intangible benefits. This section describes the communities and groups whose social or economic interests are tied to the land and the key economic and social factors for these areas.

3.22.3.1 Communities of Interest

In addition to the geographically defined community, segments of the population in the socioeconomic area of analysis are defined by common interests or concerns. These groups are briefly defined below.

American Indian Communities

The four American Indian Pueblos comprise most of the socioeconomic area of analysis. Pueblo members have a unique relationship with the land, based on traditional uses and cultural values. The values they place on these lands include those of religious, spiritual, and traditional aspects. These values are defined solely by the concerned Pueblos and are integral to Pueblo history, sense of place, and community identity.

Traditional Communities

Starting in the seventeenth century, Hispanic settlements and homesteads were established under Spanish and then Mexican land grants. Land and water were key components of these settlement patterns, because agriculture was a basis for most land use. Those living on these settlements focused on the communal acequia system to provide drinking water and irrigation. Some of their descendants remain, and their focus is typically on continued water availability, small-scale farming, and acequia culture.

Individuals and Groups Who Prioritize Increased Development

Some groups or individuals would like to see increased development in the socioeconomic area of analysis, in response to the proposed RWS and other projects.

Individuals and Groups Who Prioritize Rural Lifestyles

The socioeconomic area of analysis has a rural Southwestern feel, with small communities and a relaxed pace of life. This lifestyle attracted many individuals to the area, for such reasons as to raise a family or to retire. This group values these aspects of

the community and may be concerned that this lifestyle could be affected by any dramatic economic growth in the area.

Groundwater Well Owners

Many individuals in the socioeconomic area of analysis own and operate their own groundwater well. In many cases, they have incurred substantial upfront costs to install a groundwater well system, allowing for relatively low annual costs for water consumption. Based on input received during the public scoping period, members of this group are concerned about the costs and benefits of connecting to the RWS; many are concerned with decreasing water table depths and water quality from their current wells.

3.22.3.2 Key Economic Sectors

Major industries in the Santa Fe County area center on tourism and recreation. This includes all associated industries, such as food, lodging, arts, and entertainment. Education and healthcare also contribute a large portion of the jobs in the area. Agriculture and tourism play important roles in the Pojoaque Basin's economy. Details for these industries are below.

Agriculture and Livestock Grazing

Small-scale agriculture and livestock grazing is a traditional use of lands in the socioeconomic area of analysis and continues to be important today. While some of the smaller farms may use drinking water sources for irrigation, there are water sources specifically available for irrigation, independent of the proposed RWS. One such source is the Nambé Falls Reservoir. It provides supplemental irrigation water for the Pojoaque Valley Irrigation District, the Pueblo de San Ildefonso, the Pueblo of Nambé, and Pueblo of Pojoaque.

Tourism and Recreation

Visitors to Santa Fe County spent approximately $692 million in 2011. This directly supported 7,487 jobs and resulted in $209 million direct and $278 million direct, indirect, and induced labor income. Tourism tax receipts totaled $159.2 million. Based on 2011 direct, indirect, and induced tourism spending, the economy of Santa Fe County was estimated to be 15.6 dependent on tourism (Tourism Economics 2012).

Much of the tourism in the socioeconomic area of analysis is centered around heritage tourism, in which travelers seek out the crafts, food, and activities that authentically represent the area's stories and people of the past. The socioeconomic area of analysis is in the Northern Rio Grande National Heritage Area, a place that Congress recognized for its unique contribution to the American experience. In particular, the Rio Grande National Heritage Area is recognized as a center of Pueblo and Spanish governance and settlement (Northern Río Grande National Heritage Area, Inc. 2013).

One component of heritage tourism in the area is Southwestern artists and galleries. The artisans in the area are renowned for their style and craftsmanship, ranging from sculpture to beadwork to pottery. Many visitors also attend guided tours of the Pueblos in the area to experience dances, feast days, and ceremonies open to the public. The Pueblo of

Pojoaque is home to the Poeh Center, a cultural center and museum dedicated to preserving the art, language, and tradition of the native Pueblo culture.

There are also many gaming facilities in the area, which offer such amenities as casinos, restaurants, a golf course, spas, entertainment, and event spaces. Gaming represents a locally important source of revenue for some Pueblos, notably Tesuque and Pojoaque. Under the 2007 Amended Tribal-State Class III Gaming Compact, the Pueblos have agreed to report net win (the amount wagered on slot machines minus payouts and regulatory fees) quarterly to the New Mexico Gaming Control Board. Of the net win, 3.0 to 9.75 percent is taken for revenue sharing with the State of New Mexico, depending on the total revenues. Tribal casinos are not required to report revenues on non-slots gaming; an example is table games, where the total net win in 2013 was $22 million for the Pueblo of Pojoaque and $61 million for the Pueblo of Tesuque (NMGCB 2014).

3.22.4 Water Service and Rates

Potable water in the socioeconomic area of analysis is mainly for domestic, commercial, industrial, and community use. The cost of drinking water can depend on if a water user is connected to a public water distribution system, if a private groundwater well is being used, or if the user is a member of a Pueblo.

The only public water utility in the socioeconomic area of analysis is the Tesuque Mutual Domestic Water Consumers Association. It serves residents of the Tesuque Village area if they choose to connect. For an average household use of 5,000 gallons per month, the Tesuque Mutual Domestic Water Consumers Association charges $37.50, which does not include any fees or connection costs.

In the Santa Fe County service area, which currently does not extend into the non-Pueblo Santa Fe County portion, 5,000 gallons per month would cost a water user $45.10, excluding fees or additional costs. See **Table 3-32**, Comparative Water Rates Surrounding the Area of Analysis, for a comparison of water rates from nearby public utilities. If non-Pueblo water users choose to connect to the RWS once it is operational, they would be charged at Santa Fe County rates. Pueblo water rates would be established by individual Pueblos. The socioeconomic area of analysis relies heavily on groundwater withdrawals to meet local water supplies. There are 1,537 wells in the area of analysis, with a maximum allowable withdrawal of 4,471 afy. According to the Office of the State Engineer, domestic use is the largest groundwater use in the area of analysis, at about 90 percent of the total groundwater withdrawn. Full details for groundwater use are in **Section 3.4**, Groundwater, and the Technical Memorandum on Groundwater (HDR and EMPSi 2014).

The cost to pump and treat groundwater from a private groundwater well can vary. It depends on the cost of installation and the electricity to pump the water to the surface, the depth of the groundwater, and any additional filtering or treatment needed to make the water safe to consume. These are all site-specific conditions, so it is difficult to make an equal comparison to public systems.

Each Pueblo is in charge of setting water rates for their system. For many Pueblos, charging individuals for water use is contrary to the cultural perception of water as a community value. The Pueblo de San Ildefonso, for example, does not charge individual Pueblo members for water services.

Table 3-32. Comparative Water Rates Surrounding the Area of Analysis

Gallons per Month	Santa Fe County	City of Santa Fe	City of Española	Tesuque MDWCA	Los Alamos County	Eldorado AWSD
0	$14.50	$18.42	$17.96	$20.00	$7.55	$13.40
1,000	$20.62	$24.48	$21.94	$22.50	$11.74	$22.80
2,000	$26.74	$30.54	$26.32	$25.00	$15.93	$32.20
3,000	$32.86	$36.60	$30.70	$27.50	$20.12	$41.60
4,000	$38.98	$42.66	$35.08	$34.00	$24.31	$52.13
5,000	$45.10	$48.72	$39.46	$37.50	$28.50	$62.63
6,000	$53.53	$54.78	$43.84	$41.00	$32.69	$73.13
7,000	$61.96	$60.84	$48.22	$51.50	$36.88	$86.13
8,000	$70.39	$82.19	$52.60	$56.00	$41.07	$99.13
9,000	$78.82	$103.90	$56.98	$60.50	$45.26	$112.13
10,000	$87.25	$125.61	$61.36	$65.00	$49.45	$125.13

Source: Santa Fe County 2014b
Note: Average County residential use per household is about 5,000 gallons per month.
MDWCA = Mutual Domestic Water Consumers Association
AWSD = Area Water and Sanitation District

3.22.5 Public Services

Information on select public services in the socioeconomic area of analysis is included below. Additional information, including area education, medical services, and public safety, is in **Appendix G.**

Fire Protection

The Santa Fe County Fire Department is a combination of paid staff and volunteers. It protects approximately 1,900 square miles of unincorporated area and the incorporated town of Edgewood. Within these borders, the Fire Department protects approximately 76,000 residents and several million square feet of commercial development. Additionally, there are two volunteer fire departments. The Pojoaque Volunteer Fire District covers the north-central portion of the county serving the communities of Nambé, Pojoaque, Jacona, Jaconita, El Rancho, Arroyo Seco, Cuyamungue, the Pueblo of Nambé, the Pueblo of Pojoaque, and the Pueblo de San Ildefonso. The Pojoaque District is also home to the Northern Region paid paramedic crew. The Tesuque Fire District in the north-central portion of Santa Fe County provides fire and emergency medical services to the communities of Tesuque Village, Chupadero, Rio El Medio, Tano, Casa de San Juan, Sundance Estates, Vista Redondo, Los Camonitos, Hyde Park Estates, and the Pueblo of Tesuque.

Community Electrical and Gas Utilities

Electricity is provided to the socioeconomic area of analysis through the JMEC (through member-owned Tri-State Generation and Transmission, Inc.) and the PNM. The JMEC is the largest electric cooperative in the state and provides service in five counties, including the northern portion of the socioeconomic area of analysis; PNM serves the southern

portion of the socioeconomic area of analysis. The JMEC charges between $0.08185/kilowatt hour (kWh) and $0.14285/kWh, depending on the price structure and time of day. These rates have been in place since June 2013 (JMEC 2014). PNM charges between $0.0906237/kWh and $0.1283520/kWh, depending on the amount of electricity consumed. These rates have been in place since August 2011 (PNM 2014).

3.22.6 Fiscal Conditions

Local Government Revenues

Santa Fe County's major revenue sources are property taxes and gross receipts tax (GRT). The property tax rate in 2012 was $19.230 per $1,000 of net taxable value property for residential property and $28.176 per $1,000 for nonresidential property (NMDFA 2012). Property tax obligations (revenue assuming 100 percent collection) and assessed values are shown in **Table 3-33**, below.

Table 3-33. Property Tax Obligations and Assessed Values

Location	Residential		Nonresidential	
	Total Assessed Value	Tax Obligation	Total Assessed Value	Tax Obligation
Santa Fe County				
2011	$5,181,081,479	$101,059,539	$1,603,357,420	$45,896,583
2012	$5,288,665,467	$101,700,458	$1,589,436,330	$44,784,632
% Change	2.1	0.6	-0.9	-2.4
State of New Mexico				
2011	$30,069,455,982	$853,088,939	$16,073,611,208	$495,843,626
2012	$30,701,128,897	$874,014,104	$16,371,012,537	$503,226,122
% Change	2.1	2.5	1.9	1.5

Sources: NMDFA 2011, 2012

GRT is a major component of both state and local government revenue and is imposed on the following:

- Selling property in New Mexico
- Leasing or licensing property in New Mexico
- Granting a right to use a franchise in New Mexico
- Performing services in New Mexico
- Selling research and development services performed outside New Mexico, the product of which is initially used in New Mexico

The GRT rate varies throughout the state. Section 9-11-12.1 NMSA 1978 authorizes the New Mexico Department of Taxation and Revenue to enter into agreements with Pueblos, Tribes, or nations to collect any gross receipt taxes they impose. The agreements provide that if a Pueblo grants a 25 percent credit against its tax and meets other specified conditions, the state grants a 75 percent credit against state and local gross receipts tax

due from taxpayers who are subject to both taxes. As a result, taxpayers pay the same tax as they would under state and local taxes alone, and dual taxation is eliminated. Tribal taxes apply only to businesses operating on land owned by a Tribe or held by the U.S. in trust for the Tribe.

Rates for all of the Pueblos are the same as Santa Fe County, 6.8750 percent. Annual distributions of GRT revenue in 2014 totaled to approximately $1,052,100 for the Pueblo of Pojoaque, $217,100 for the Pueblo of Tesuque, $46,600 for the Pueblo of Nambé, and $44,382,900 for Santa Fe County as a whole. No information was available for the Pueblo de San Ildefonso (NMDTR 2014). Additional details for property tax and GRT are included in **Appendix G**.

Future budget challenges identified by Santa Fe County are as follows:

- Maintaining its infrastructure and other assets
- Finding ways to increase revenue without increasing taxes
- Finding balance between the needs and resources of the Public Safety Department
- Managing water resources to ensure a sustainable and reliable supply of water for residents
- Drawing business to the County in order to diversify the local economy, while balancing the need and interests of citizens (Santa Fe County 2014c)

3.23 Environmental Justice

The following section provides the methods used to analyze the existing environmental justice conditions, followed by a description of existing conditions.

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, requires that federal agencies identify and address any disproportionately high and adverse human health or environmental impacts of their programs, policies, and activities on minority and low-income populations.

Environmental justice refers to the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic groups, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and Tribal programs and policies.

Guidance on environmental justice terminology developed by the CEQ provides the following definitions (CEQ 1997):

- Low-income population—This is based on annual statistical poverty thresholds developed by the U.S. Census Bureau. In 2014, the poverty level was based on total income of $12,071 for an individual and $24,008 for a family of four (U.S. Census Bureau 2014b). A low-income community may include either a group of individuals living in geographic proximity to one

another, or dispersed individuals, such as migrant workers or American Indians.

- Low-income population area—This is defined as an area where the number of individuals living below the poverty line exceeds 50 percent of the total population, or if the percentage of the low-income population is meaningfully greater than the low-income population percentage in the broader region.
- Minority—These are individuals who are American Indian, Alaska Native, Asian, Pacific Islander, Black, or Hispanic.
- Minority population area—An area is so defined if either the aggregate population of all minority groups combined exceeds 50 percent of the total population or if the percentage of the population comprising all minority groups is meaningfully greater than the minority population percentage in the broader region. Like a low-income population, a minority population may include individuals living in geographic proximity to one another, or dispersed individuals.
- Comparison population—For the purpose of identifying a minority population or a low-income population concentration, the comparison population used in this study is Santa Fe County as a whole.

3.23.1 Methods

For environmental justice, the area examined is the same as that for the socioeconomic area of analysis (see **Section 3.22**, Socioeconomic Resources). However, it was determined that in addition to the data for Pueblos and Santa Fe County, census data should be examined for a more defined geographic scale than the one used for the socioeconomics section. To get a more in-depth look at the conditions on the community level, census-designated places (CDPs) in the socioeconomic area of analysis were used to determine low-income or minority populations. This includes 11 CDPs that represent communities in each Pueblo and the areas of Santa Fe County in the socioeconomic area of analysis, as listed below:

- The CDPs on the Pueblo of Pojoaque are Pojoaque, Cuyamungue, Jacona, and Jaconita
- The CDPs on the Pueblo of Tesuque are Peak Place and the Pueblo itself
- The Nambé CDP is mostly on the Pueblo of Nambé boundary but also extends into the Pueblo of Pojoaque boundary
- The CDPs on the Pueblo de San Ildefonso are the Pueblo itself and El Rancho
- The CDPs in non-Pueblo areas of Santa Fe County in the socioeconomic area of analysis are Cuyamungue Grant and Tesuque

Portions of the Jaconita and El Rancho CDPs also include non-Pueblo areas of Santa Fe County, but they mostly lie within the Pueblo of Pojoaque and the Pueblo de San Ildefonso, respectively.

Note that census data at this smaller geographic scale may be affected by the small sample size of some data.

3.23.2 Low-Income Populations

The lowest poverty rate is in the Pueblo of Pojoaque in the socioeconomic area of analysis, with 13.0 percent, and the highest is on the Pueblo de San Ildefonso, at 14.5 percent. None of the CDPs have a low-income population over 50 percent, but the Peak Place CDP (30.3 percent) has a poverty level nearly 10 percentage points above the poverty rate for New Mexico (20.9 percent). See **Table 3-34**, Area of Analysis Population in Poverty (2014), **Table 3-35**, below, and **Figure 3-21**, Environmental Justice Area of Analysis.

Table 3-34. Area of Analysis Population in Poverty (2014)

	Pueblo of Pojoaque	Pueblo of Tesuque	Pueblo of Nambé	Pueblo de San Ildefonso	Santa Fe County Area of Analysis	Santa Fe County	New Mexico	U.S.
Percent of population in poverty 2014	13.0	14.0	13.9	14.5	14.1	16.7	20.9	15.6
Median household income 2014	$52,625	$60,500	$51,438	$42,604	$63,875	$52,958	$44,968	$53,482

Source: U.S. Census Bureau 2014a

Table 3-35. Area of Analysis Key Community Poverty Data (2014)

Community	Geographic Area	Total Population	Percent of Individuals Below Poverty
Cuyamungue CDP	Pueblo of Pojoaque	568	14.2
Cuyamungue Grant CDP	Santa Fe County	203	15.8
El Rancho CDP	Santa Fe County, Pueblo de San Ildefonso	1,180	9.4
Jacona CDP	Pueblo of Pojoaque	437	19.5
Jaconita CDP	Pueblo of Pojoaque, Santa Fe County	503	7.2
Nambé CDP	Pueblo of Nambé, Pueblo of Pojoaque	2,150	13.9
Peak Place CDP	Pueblo of Tesuque	340	30.3
Pojoaque CDP	Pueblo of Pojoaque	2,257	13.0
San Ildefonso Pueblo CDP	Pueblo de San Ildefonso	677	14.5

Table 3-35. Area of Analysis Key Community Poverty Data (2014) (cont.)

Community	Geographic Area	Total Population	Percent of Individuals Below Poverty
Tesuque CDP	Santa Fe County, Pueblo of Tesuque	867	14.0
Tesuque Pueblo CDP	Pueblo of Tesuque	176	15.3
Santa Fe County	N/A	146,361	16.7
New Mexico	N/A	2,080,085	20.9
U.S.	N/A	314,104,084	15.6

Source: U.S. Census Bureau 2014a
Note: ACS estimates are based on data collected over five years. They represent the average characteristics of populations between January 2010 and December 2014 and do not represent a single point in time.

3.23.3 Minority Populations

Based on 2014 Census data, all of the areas in the socioeconomic area of analysis have an aggregate minority population greater than 50 percent. The two largest minority populations are Hispanic or Latino and American Indian or Alaskan Native. Persons of Hispanic or Latino ethnicity range between 41.7 percent and 70.0 percent, while American Indian or Alaska Native persons make up between 0.2 percent and 71.0 percent (see **Table 3-36**, below). When analyzed by CDPs, most contain minority populations for the purposes of analysis. The exception is the Tesuque CDP, which is entirely in the non-Pueblo Santa Fe County areas of the socioeconomic area of analysis, and it has an aggregate minority population of less than 50 percent (see **Table 3-37**, Area of Analysis Key Community Race/Ethnicity Data (2014)).

Table 3-36. Area of Analysis Populations by Race/Ethnicity (2014)

Population	Pueblo of Pojoaque	Pueblo of Tesuque	Pueblo of Nambé	Pueblo de San Ildefonso	Santa Fe County Area of Analysis	Santa Fe County	New Mexico	United States
Total population	2,257	867	2,150	677	2,010	146,361	2,080,085	314,107,084
Hispanic or Latino ethnicity of any race	1,580 70.0%	329 41.%	1,267 58.9%	146 21.6%	934 46.5%	146,361 51.0%	2,080,085 47.0%	53,070,096 16.9%
White alone	1,585 70.2%	774 89.3%	1,213 56.4%	142 21.0%	1788 89.0%	122,044 83.4%	1,521,876 73.2%	231,849,713 73.8%
Black or African American alone	22 0.5%	0 0.0%	6 0.3%	0 0.0%	0 0.0%	1,097 0.7%	42,515 2.0%	39,564,785 12.6%

Table 3-36. Area of Analysis Populations by Race/Ethnicity (2014) (cont.)

Population	Pueblo of Pojoaque	Pueblo of Tesuque	Pueblo of Nambé	Pueblo de San Ildefonso	Santa Fe County Area of Analysis	Santa Fe County	New Mexico	United States
American Indian or Alaskan Native alone	381 16.9%	2 0.2%	533 24.8%	481 71.0%	32.0 1.6%	4,507 3.1%	190,350 9.2%	2,565,520 0.8%
Asian alone	18 0.8%	0 0.0%	13 0.6%	0 0.0%	10 0.5%	1,675 %	28,578 1.4%	15,710,381 5.0%
Native Hawaiian and Other Pacific Islander alone	0 0.0%	0 0.0%	7 0.3%	0 0.0%	0 0.0%	70 0.0%	1,271 0.1%	535,761 0.2%
Some other race	184 8.2%	79 9.1%	275 12.8%	47 6.9%	161 8.0%	12,972 8.9%	230,398 11.1%	14,754,895 4.7%
Two or more races	78 3.5%	12 1.4%	103 4.8%	7 1.0%	19 0.9%	3,996 2.7%	65,097 3.1%	9,125,751 2.9%
Classified as minority population based on CEQ guidelines?	Yes	Yes	Yes	Yes	Yes	N/A	N/A	N/A

Source: U.S. Census Bureau 2014a

Note: ACS estimates are based on data collected over five years. They represent the average characteristics of populations between January 2010 and December 2014 and do not represent a single point in time. Racial and ethnic category totals will equal more than 100 percent of the population of a given area. This is because the Hispanic/Latino ethnicity includes those of all races; that is, an individual can identify as both African American and Hispanic.

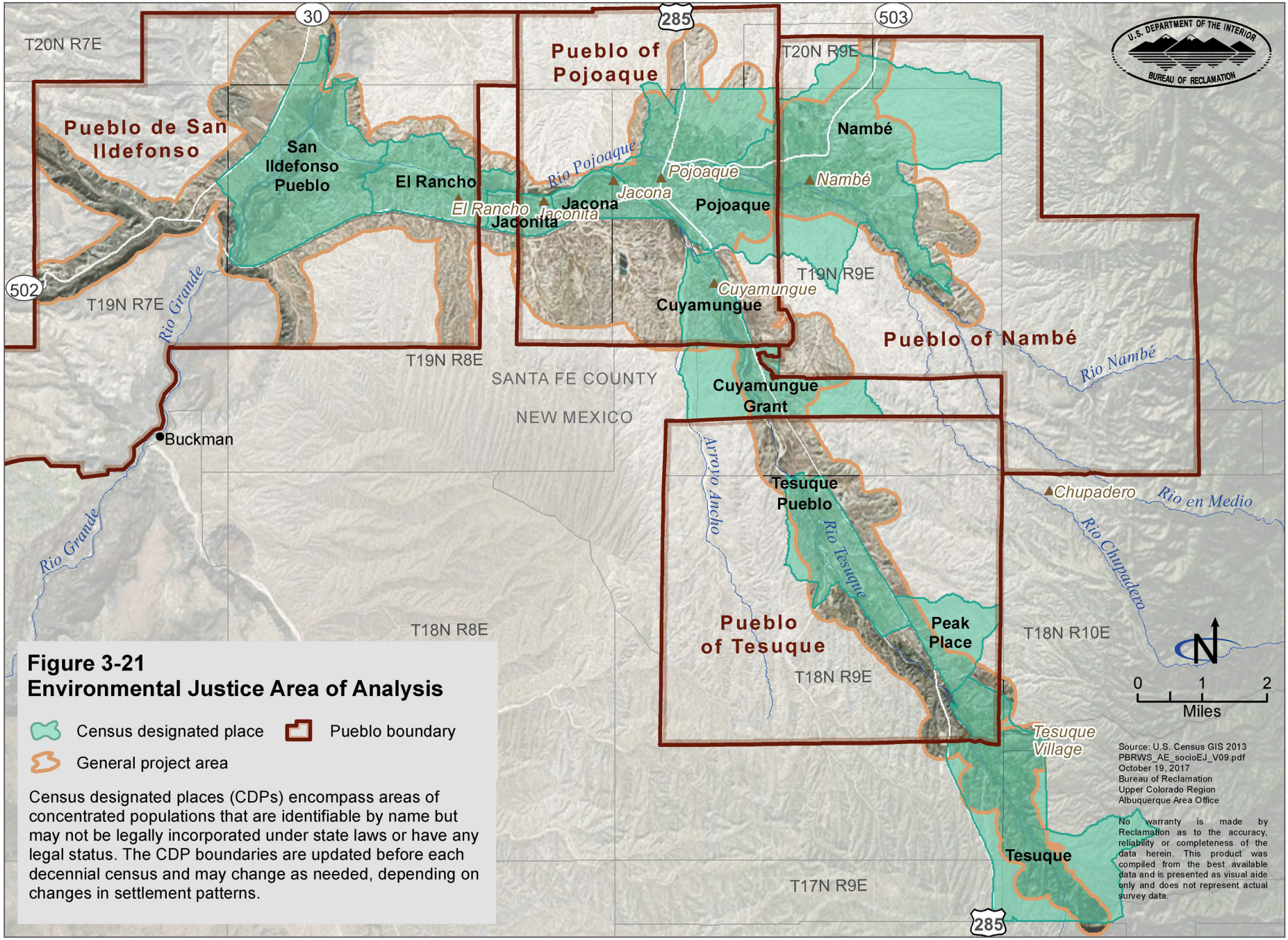


Figure 3-21
Environmental Justice Area of Analysis

Census designated place
Pueblo boundary
General project area

Census designated places (CDPs) encompass areas of concentrated populations that are identifiable by name but may not be legally incorporated under state laws or have any legal status. The CDP boundaries are updated before each decennial census and may change as needed, depending on changes in settlement patterns.

Source: U.S. Census GIS 2013
PBRWS_AE_socioEJ_V09.pdf
October 19, 2017
Bureau of Reclamation
Upper Colorado Region
Albuquerque Area Office

No warranty is made by Reclamation as to the accuracy, reliability or completeness of the data herein. This product was compiled from the best available data and is presented as visual aide only and does not represent actual survey data.

Table 3-37. Area of Analysis Key Community Race/Ethnicity Data (2014)

Community	Geographic Area	Total Population	Percent Population Racial or Ethnic Minority
Cuyamungue CDP	Pueblo of Pojoaque	568	84
Cuyamungue Grant CDP	Santa Fe County	203	65.5
El Rancho CDP	Santa Fe County, Pueblo de San Ildefonso	1,180	77.7
Jacona CDP	Pueblo of Pojoaque	437	68.6
Jaconita CDP	Pueblo of Pojoaque, Santa Fe County	503	71
Nambé CDP	Pueblo of Nambé, Pueblo of Pojoaque	2,150	78.8
Peak Place CDP	Pueblo of Tesuque	340	89.7
Pojoaque CDP	Pueblo of Pojoaque	2,257	83.5
San Ildefonso Pueblo CDP	Pueblo de San Ildefonso	677	93.5
Tesuque CDP	Santa Fe County, Pueblo of Tesuque	867	22.7
Tesuque Pueblo CDP	Pueblo of Tesuque	176	98.3
Santa Fe County	N/A	146,361	56.6
New Mexico	N/A	2,080,085	60.4
U.S.	N/A	314,104,084	37.7

Source: U.S. Census Bureau 2014a
Note: ACS estimates are based on data collected over five years. They represent the average characteristics of populations between January 2010 and December 2014 and do not represent a single point in time.

As noted in **Section 3.22.4**, Water Service and Rates, all Pueblo communities and many of the CDPs, which have been identified as minority populations, rely on groundwater for domestic water supply and are lacking community water infrastructure. As a result, these populations are subject to water quality issues, as indicated in **Section 3.4**, Groundwater**,** and **Section 3.21**, Solid and Hazardous Materials.

3.24 Energy and Utilities

The following sections provide the methods used to analyze existing energy supplies and consumption within the general project area, followed by a description of existing conditions.

3.24.1 Methods

The Pojoaque Basin serves as the area for analysis for energy supplies and consumption since the utility providers in the area—PNM, JMEC, and the New Mexico Gas Company (NMGC)—measure key loads and other infrastructure components over a broader geographic scale. The existing electric utility network is describe using the following: Available utility data were obtained from PNM, JMEC, and Tri-State Generation and Transmission Inc. (Tri-State).

3.24.2 Infrastructure and Consumption

JMEC provides electricity in the north-central portion of the Pojoaque Basin. JMEC is a member of the Tri-State, a wholesale electric power supplier owned by 44 electrical cooperatives for which Tri-State generates, purchases, and transmits power. NMGC provides natural gas for heating and other uses across the Pojoaque Basin. Not all homes are served by NMGC, however, and rely upon on-site, refillable propane tanks, wood-burning stoves and fireplaces, or other means for heating and cooling.

Tri-State's owned and contracted portfolio of electric energy is derived from coal, natural gas, and oil-fired and combustion turbine generation facilities, located throughout its four-state member service territory. Tri-State owns and operates plants in Colorado and New Mexico, and it receives a share of power from plants in Arizona, New Mexico, and Wyoming. The association purchases federal hydropower from the Western Area Power Administration and from various other providers of renewable energy, such as wind power, small hydropower, and biomass. Approximately 59 percent of Tri-State's power comes from coal, 24 percent from renewable energy, 15 percent from various power purchases, and 2 percent from natural gas.

JMEC's utility network in the Pojoaque Basin is served by a 69 kilovolt (kV) primary distribution line from Tri-State's Hernandez substation. This 69kV line feeds three circuits (or delivery points) in the analysis area, including Nambé, El Rancho, and Cuyamungue. In 2015, JMEC's relevant delivery points had peak power loads (the maximum load during a [given day] [EIA 2016a]) totaling 9,811 kilowatts (kW)[22]. The individual totals are:

- Nambé—4,593 kW
- El Rancho—2,801 kW
- Cuyamungue—2,417 kW

PNM also supplies electricity to the Pojoaque Basin, specifically to portions of the Pueblo of Tesuque and Tesuque Village. PNM's power generation comes primarily from coal, with lesser amounts of power from nuclear and natural gas; about 6 percent of the energy portfolio comes from renewable resources, such as wind and solar. Major generation facilities for PNM are the San Juan Generating Plant, a coal-burning facility in the San Juan Basin; the Palo Verde Nuclear Power Generating Plant, located 55 miles west of Phoenix Arizona; and several natural gas plants and wind or solar facilities across New Mexico. PNM's circuit to the region that includes the Pueblo of Tesuque and Tesuque Village had a peak power load of approximately 5,000 kW in 2015[23].

PNM, JMEC, and Tri-State have no plans for utility-scale renewable energy projects in the Pojoaque Basin. Distributed energy resources such as small-scale roof-top solar generation or small windmills continue to be built intermittently and in limited numbers across the Pojoaque Basin. Other types of renewable-energy projects are occurring in the

[22]Adam, Roybal, PE, JMEC, Systems Engineer, personal communication with William Penner, EMPSi, August 2, 2016.
[23]Doug Campbell, PNM, Manager of Environmental Planning and Permitting, personal communication with William Penner, EMPSi, August 4, 2016.

broader Española area, including a planned 1.5-megawatt solar facility on Ohkay Owingeh lands that would service the Tribally owned casino and other facilities.

Energy use in the Pojoaque Basin is generally residential with commercial use coming from the more developed business corridor along U.S. Highway 84/285, and, to a lesser extent, along other highways such as SH 502, SH 503, and SH 30. Most of these businesses along the U.S. Highway 84/285 corridor are Tribal enterprises such as the Camel Rock Casino, Buffalo Thunder Casino and Resort, and Cities of Gold Casino, along with golf courses, gas stations, and hotels. Heating, cooling, and other energy loads come from a mixture of electric and gas. As described in **Section 3.22**, Socioeconomic Resources, the Pueblo of Pojoaque is experiencing the greatest amount of recent population and economic growth in the Pojoaque Basin—with consequent increases in energy use—coming from new apartments and construction of Buffalo Thunder Resort and Casino, which includes nearly 400 rooms.

CHAPTER 4 ENVIRONMENTAL CONSEQUENCES

4.1 Introduction

This chapter presents the potential impacts on the human and natural environment that could occur from implementing the alternatives presented in **Chapter 2**. It is organized by the resource topics introduced in **Chapter 3**. The area of impact analysis for each resource topic is the same as described for the resource in **Chapter 3**, unless otherwise noted. Under each topic is a discussion of impact indicators, analysis methods and assumptions, and the direct and indirect impacts from implementing each alternative. Presented at the end of the chapter are separate sections describing cumulative impacts, short-term uses and long-term productivity, unavoidable adverse impacts, and irreversible and irretrievable commitments of resources.

Where information was incomplete or unavailable, Reclamation used the best available information or made assumptions to facilitate the analysis. These assumptions set guidelines for analysis but should not be interpreted as constraining or redefining the actions proposed for each alternative described in **Chapter 2**. Any specific resource assumptions are provided in the *Analysis Methods and Assumptions* section for that resource.

4.2 Impact Analysis Terminology

Potential impacts are described in terms of context, duration, and intensity, which are generally defined as follows:

- Context—This describes the area or location in which the impact would occur. Context is defined for each resource.
- Duration—This describes the length of time that an impact would occur. Short-term impacts would generally occur during construction, and long-term impacts would occur beyond construction and from operation of the proposed facilities. Construction of the entire RWS is anticipated to take about 6 years. Segments of the water system could become operational before the full buildout of the system. Diverting water into the system would be phased in as the system comes online and demand increases.
- Intensity—This is the severity or extent of the impact. Impacts are quantified as appropriate and when supported by existing data. Where quantitative data is not available, impacts are described qualitatively. Intensity is based on the direct, indirect, and cumulative impacts.
- Direct impacts—These are caused by the action and occur at the same time and place.
- Indirect impacts—These impacts are caused by the action. They occur later in time or farther removed in distance but are still reasonably foreseeable. Indirect impacts may include growth-inducing impacts and other impacts related to induced changes in the pattern of land use, population density, or

growth rate and related impacts on water and other natural resources, including ecosystems.

- Cumulative impact—As defined in 40 CFR, Subpart 1508.7, a cumulative impact "is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions." Cumulative impacts can result from individually minor but collectively significant actions taking place over time. Cumulative impacts discussions are included in the respective section of each resource analyzed and are discussed in **Section 4.25**, Cumulative Impacts.

4.3 Surface Water

This section addresses potential impacts on surface waters and channel geomorphology from proposed actions associated with each alternative.

4.3.1 Impact Indicators

The following indicators, as described in **Table 3-1**, are used to analyze impacts on surface water:

- Change in annual average flows on the Rio Grande downstream of the project at the Otowi Bridge gage
- Changes in sediment loads and flows in river channels
- Estimated NBS and bank erosion hazard indices

4.3.2 Analysis Methods and Assumptions

The Rio Grande and Pojoaque Basins make up the area of analysis for surface water, which includes the general project area. Conditions in the Rio Pojoaque watershed were estimated based on calculations developed by the Jemez y Sangre Regional Water Plan (Jemez y Sangre Water Planning Council 2003) for existing conditions. This regional water plan estimated water budgets, which are average sources and uses of water. This regional water plan was previously described in **Section 3.3**, Surface Water. Potential project impacts in the Rio Pojoaque watershed were evaluated relative to this baseline.

For each alternative, the amount of soil (area) that would be disturbed is described in **Chapter 2**. The existing conditions, estimated NBS, and bank erosion hazard indices are presented in **Section 3.3**, Surface Water.

4.3.3 RWS Alternatives

4.3.3.1 Alternative A—No Action

Under Alternative A, No Action, the water rights and contracts portfolio secured to provide RWS supply would be released back to the respective right holders. In the short term, the flows on the Rio Grande at the Embudo, Otowi Bridge, and the Rio Chama Reservoirs under Alternative A would remain unchanged. New water from the project's San Juan-Chama contract and Top of the World Farms rights would not be brought into

the area. Santa Fe County could use its Top of the World Farms rights for other purposes. Similarly, the Pueblo of Nambé could apply its federally reserved right within the Rio Pojoaque watershed. The sovereign use of existing rights or future federally reserved rights under this alternative are largely unknown at this time.

Under Alternative A the existing form and function of arroyos and streams in the area would persist. No soil would be disturbed by project activities. Streams and arroyos in the area would continue to reflect low sinuosity, high width-to-depth ratios, pool-riffle geometry, areas of active channel migration, and primarily unstable to moderately unstable bank conditions.

In the future, population growth and economic development in the Pojoaque Basin would proceed with existing and future groundwater wellfields as the primary water source. The Jemez y Sangre Regional Water Plan estimated that current commercial, municipal, and industrial water uses in the Pojoaque Basin amount to, on average, 1,665 afy (Jemez y Sangre Water Planning Council 2003). Current permitted groundwater use in the Pojoaque Basin is 4,471 afy. Under Alternative A, water use is projected to increase in the future, largely supplied by more intensive groundwater pumping. Expanded groundwater pumping would cause increased depletions of surface water, due to their hydrological connections.

Section 4.4, Groundwater, provides additional detail on No Action groundwater uses.

Reclamation evaluated future climate change scenarios (see **Section 3.9**, Climate Change), up to 2089. In general, Reclamation's evaluation of various climate change scenarios indicates the potential for drier conditions overall. This would lead to declines in annual average flows in the Rio Grande at the Otowi Bridge gage.

Mitigation and Residual Impacts

No mitigation or residual impacts are anticipated from Alternative A.

4.3.3.2 Impacts Common to All Action Alternatives

A portfolio of San Juan-Chama contract and native Rio Grande water rights would provide supply to the RWS. A portion of the portfolio consists of new water brought into the basin for specific use by this project. A total of 1,752 afy from the Top of the World Farms rights (1,141 af held by the BIA and 611 af held by Santa Fe County) would enter the area as increased base flow of the Rio Grande. The Top of the World water rights have historically been used above the Pojoaque Basin. Allowing this water to flow to the RWS collection point would result in additional base flow (less river carriage losses) in the Rio Grande above Otowi gage (INTERA 2016b). A total of 1,192 afy of existing rights would be repurposed for the project (302 af from Pueblo of Nambé federally reserved right and up to 890 afy from Santa Fe County).

Lastly, up to 1,079 afy of San Juan-Chama Project water could be released to meet RWS needs. Of this amount, 369 afy was previously unallocated; 710 afy was potentially used as part of the offset for Cochiti Lake evaporation under Public Law 88-293 (Reclamation 2015a). Reclamation studied the risk of not meeting the evaporation offset requirement with the RWS contract in place. Modeling indicates that, in up to 6 percent of the years examined, evaporation offset of the recreational pool would not be met at Cochiti Lake by the end of any given year. In these years, Reclamation could use operational

flexibilities, such as alternative deliveries to Cochiti Lake, or staged delivery, to mitigate any shortages in the Cochiti Lake pool.

The implementation of any of the RWS action alternatives would, over time, reduce groundwater pumping in the Pojoaque Basin and increase reliance on surface water supplies. Current groundwater use depletes surface water flows in the Pojoaque Basin and the Rio Grande, due to the hydrological connectivity between groundwater and surface water. Reduction in groundwater use over time would result in increased base flows in these surface watercourses.

Table 4-1, below, provides the estimated improvement in surface water base flows generated by households connecting to the RWS. Community, domestic, commercial and industrial uses currently served by groundwater within the service areas of the Pueblos are assumed to connect to the RWS by the year 2024. The extent that non-Pueblo commercial and domestic well use may convert to the RWS is not known at present. The number of eligible non-Pueblo connections may range from 0 to 100 percent by the year 2050. See **Section 4.4**, Groundwater, for additional details of groundwater impacts under project conditions.

Table 4-1. Surface Water Changes from Reduced Pojoaque Basin Groundwater Use

	Increase in Surface Base Flows (afy) for	
Time Frame	Combined Nambé-Pojoaque-Tesuque Watershed	Entire Study Area
Existing	0	0
Year 2035 (with project)	446 to 974	423 to 1,004
Year 2050 (with project)	513 to 1,136	475 to 1,172
Year 2070 (with project)	561 to 1,206	517 to 1,247
Year 2100 (with project)	598 to 1,263	523 to 1,312

Source: INTERA 2016a

Reclamation modelers evaluated the impacts of project diversions using the above water rights and contract portfolio and projected declines in groundwater uses (INTERA 2016a). The demands for the RWS, as a percentage of average Rio Grande flows, range from 0.2 percent in May to 0.6 percent from July to October (Reclamation 2015b). Modeling indicated that the project would result in a slight increase in Rio Grande flows below the Otowi Bridge gage on an annual basis.

Table 4-2, below, shows the average annual supply and demand for the RWS after full project demand. Based on the results of modeling, native Rio Grande flows below the Otowi gage would increase only up to an additional 24 af, which is less than 0.01 percent of annual flows; therefore, the project would have minimal impacts on New Mexico's obligations under the Rio Grande Compact. The withdrawals would have no direct impact on the bank stress or erosive power of the Rio Grande.

Table 4-2. Projected RWS Supply and Demand After Full Project Buildout

Description	Average Annual Volumes (afy)
Water Supply	
Top of the World Farms (BIA portion)	1,119
Top of the World Farms (County of Santa Fe portion)	599
Nambé Reserved Right	302
Non-Pueblo Pumping Cessation	947
San Juan-Chama Contract	1,057
Supply Subtotal	**4,024**
RWS Demand	**4,000**
Supply less Demand	**24**

Sources: INTERA 2016a, 2016b
Notes: RWS demands, increased surface water base flow from pumping cessation, and operation of the San Juan-Chama Project contract are after full buildout of the system.
Water rights transferred from the Top of the World Farms and San Juan-Chama waters are expressed at the RWS collection, incorporating Rio Grande carriage losses. Carriage losses were estimated at 21.6 afy for San Juan-Chama water and 34.2 afy for Top of Worlds flows.
Non-Pueblo pumping cessation was based on the permitted groundwater amount; the amount transferred as a water right to the project, 890 afy, is based on reduced permitted rates.
Average annual volumes assume steady-state condition after streams recover flows after pumping ceases.

The San Juan-Chama Project contract water would not be required for the first 10 years, because the initial water demand can be fulfilled with other water rights in the RWS supply portfolio. Full buildout after this time would require the San Juan-Chama Project contract water.

During operation, the water treatment, short-term storage tanks, pumping plant, and possible backup facilities would be impervious surfaces in the watershed. Such surfaces generally decrease rainwater infiltration and increase the potential for surface runoff and associated surface erosion. This can subsequently increase sediment loads in rivers and arroyos. However, the overall increase in impervious surfaces represents a very small area, relative to the overall watershed; therefore, the direct impact of these surfaces on runoff and erosion would be negligible.

The construction of the water transmission and distribution system would create other direct impacts common to Alternatives B through E. The water transmission and distribution system includes the installation of buried pipelines, some of which would be underneath numerous arroyos, tributaries, the Rio Pojoaque, and the Rio Tesuque (see **Table 4-3**, below).

Alternative B has 9,857 feet of pipelines in the active channel, Alternative C has 8,428 feet, Alternative D has 8,370 feet, and Alternative E has 7,193 feet. Pipelines within the active channel may require scour protection, the extent of which varies by alternative. The preliminary engineering design calls for riprap placement in areas where a pipeline crossing the active channel is more than 100 feet long.

Table 4-3. Length of Pipelines in the Active Channel

	Length of Transmission and Distribution Pipelines Crossings in Feet			
	Alternative			
Jurisdiction	B	C	D	E
Pueblo of Nambé	3,686	3,686	3,686	3,293
Pueblo of Pojoaque	3,889	2,680	2,680	2,047
Pueblo de San Ildefonso	1,571	1,350	1,350	1,124
Pueblo of Tesuque	393	393	335	506
Santa Fe County	319	319	319	223
Total	**9,858**	**8,428**	**8,370**	**7,193**

Source: Reclamation GIS 2017

Mitigation and Residual Impacts

The Regional Water Authority would manage its water rights portfolio to ensure no impacts on the Rio Grande Compact (flows below Otowi gage).

All pipelines would be buried below the potential scour depth to prevent potential exposure. Pipelines would also be encased in controlled low-strength material. These mitigation measures would decrease stress and erosion around the pipe installations and would decrease associated in-stream sediment loads. Given these mitigation measures, there should be no residual impacts on surface waters from pipeline crossings.

4.3.3.3 Alternative B—HKM Implementable

Alternative B, HKM Implementable, would provide surface water collection with a side-channel surface diversion structure located approximately 0.1 mile upstream of the Otowi Bridge on the Rio Grande. Construction of the side channel surface diversion would require temporary dewatering of a portion of the Rio Grande. However, because the water diverted out of the construction area would remain in the river, downstream surface flows and water rights would not be affected. This temporary dewatering would not affect New Mexico's ability to deliver water under the Rio Grande Compact. While the sources of surface water supply under this alternative are the same as those under the other RWS action alternatives, the side channel surface diversion could be affected by extremely low flows or by poor raw water quality.

The lowest Rio Grande water surface elevation that can provide the maximum daily RWS demand is 5,492.1 feet, which equates to Rio Grande flows of 250 cfs. Between 1971 and 2014, there has been an average of 1 day per year that river flows fall below this threshold (USGS, various years). Diverting flows to meet maximum daily demand at this level represents approximately 5 percent of the Rio Grande flows (Reclamation 2015b). On an annual basis, the water contracts and rights of the project would offset the project diversions (INTERA 2016a).

Diversions for the RWS would decline due to physical limitations of the side channel surface diversion after this water surface is reached. Additionally, poor raw source water may cause filters or settling processes to exceed design limits, resulting in reduced

collection or cessation of collection. Poor raw water quality consists of high levels of typically occurring suspended solids or ash generated from wildfires. **Section 3.5**, Water Quality, describes past occurrences of wildfires and turbid flows and their impacts on surface water quality in the Rio Grande.

Based on the risk of cessation of surface water collection during certain times of the year, excess water would be collected when the available water supply exceeds demand and as permitted by the project's water rights and contracts. This water in excess of demand would be stored in injection or passive infiltration ASR facilities. The total annual project supply of 4,000 afy would not change under this alternative, but the timing of when diversions occur may be different.

Three shallow passive infiltration and recovery reaches are proposed as one option for a backup supply under this alternative. Raw or treated water that is not required for immediate consumption or storage in tanks would be allowed to infiltrate into the shallow aquifer in these reaches. In-stream structures would impound this water, allowing percolation into the shallow aquifer. The water would flow through the shallow aquifer and would be recovered by groundwater pumping for use in the RWS.

The average and maximum number of days where surface diversions may be inhibited is shown in **Table 4-4**, Days of Adverse Conditions Affecting Surface Diversions. On average, historical flows in the Rio Grande fell below 250 cfs in times that could create a shortage condition 1 day of the year. The most this low flow condition was observed was 7 days per year. High turbidity conditions can inhibit surface withdrawals if the total sediment extracted from the river were to exceed the filtration capacity of the pretreatment and water treatment plant. The turbidity condition when this occurs is based both on the amount of suspended solids in the river and the amount of water withdrawn. On average, high turbidity may inhibit surface diversions 15.5 days per year. The maximum number of days this condition was observed in the past was 91 days per year. This potentially lengthy impairment to water would limit the effectiveness of providing a reliable water supply.

While, historically, flows on the Rio Grande are rarely less than 250 cfs, some of Reclamation's climate change scenarios indicate a potential for lower flows in the future (Reclamation 2015b). Even when Rio Grande flows are below this volume, the side channel surface diversion might still be able to divert a reduced portion of the required demand. Operations could be adjusted to provide more San Juan-Chama water during these periods. Likewise, the backup supply, ranging from 217.2 to 467.7 afy, would supplement times when Rio Grande surface water is not available (**Appendix I**, Water Resources Technical Report). **Section 4.4** discusses the backup supply alternatives.

Long-term climate projections indicate a potential for flows to be reduced from current conditions by 0 percent to 39 percent in drought years by year 2080. The potential for increased turbidity of the raw source water under climate change was not evaluated. Reclamation did note that flood risk could increase under various climate change scenarios. High flows can be associated with higher suspended sediment, although no direct relationship was found between a specific high flow and turbidity that would cause surface water collection suspensions. The occurrence of wildfires and associated ash content in river flows is similarly not estimated in Reclamation's climate change scenarios. However, climate trends may have increased the historical frequency of wildfires in the nearby Rio Jemez watershed (Harpold et al. 2013).

Table 4-4. Days of Adverse Conditions Affecting Surface Diversions

Condition	Average Days Per Year	Maximum Days Per Year	Maximum Backup Supply (afy)
Historical Conditions (1971 to 2014)			
Low flows when surface diversions cease	0.5	7	217.2
High turbidity where water treatment filtration capacity is exceeded	15.5	91	1,395.9
Climate Change Conditions—Low Flows When Surface Diversions Cease			
Warm, wet conditions (year 2080)	0.5	7	217.2
Central tendency (year 2080)	1.6	44	283.8
Hot, dry conditions (year 2080)	4.8	93	467.7

Sources: Reclamation 2015b; USGS various years
Note: Climate change effects on sediment loading of Rio Grande was not available Climate change scenarios were evaluated using flow quantities only.

An analysis in the feasibility report (Reclamation 2015b) showed poor correlation between flow volume and total suspended sediment (TSS), where high flows do not necessarily correspond with high TSS. Therefore, the mean flow and TSS and the median flow and TSS values, as presented in the feasibility report, were used to estimate sediment loads.

Sediment loads in the Rio Grande upstream and downstream of the withdrawal were calculated based on the mean and median flow and TSS and the average and maximum monthly water demands. **Table 4-5**, Average Sediment Removal from the Rio Grande, shows the amount of sediment removed from the Rio Grande with the side channel surface diversion. Approximately 34 percent of suspended solids in the diverted flow would be removed via pretreatment and would be returned to the Rio Grande. The remaining solids would be settled, dewatered, and transported to the Caja del Rio landfill. This analysis shows that water withdrawal and sediment return reduces by 0.2 percent the total sediment load in the Rio Grande and that it causes only a small change in the TSS concentration during operation of the project. The returned sediment amount would have a negligible impact on the existing geomorphology or surface flows of the Rio Grande (**Appendix I**).

The scour estimate at the primary source water collection point is between 5 and 18 feet. Bank erosion is not anticipated to impact the side channel surface diversion pumping plant; however, its foundation would be susceptible to bank erosion and migration. Riprap would protect the structure.

Table 4-5. Average Sediment Removal from the Rio Grande

Statistic	Suspended Solids in the River Above Diversion (Tons)	Diverted Sediment and Hauled Off-Site (Tons)	Suspended Solids in the River Below Diversion (Tons/Percent Change)
Average month	5,798	12	5,786/-0.2
Average of maximum demand month	8,733	16	8,717/-0.2

Sources: Reclamation 2015b; USGS various years

The extent that pipelines in the active channel may require scour protection under this alternative is shown in **Table 4-6**, below. The preliminary engineering design calls for riprap placement in areas where a pipeline crossing the active channel is more than 100 feet long. This erosion protection criterion would result in riprap protecting approximately 5,860 feet in various pipeline crossings, under Alternative B.

Table 4-6. Scour Protection for Pipelines in the Active Channel—Alternative B

	Feet of Transmission and Distribution Pipeline Crossings in the Active Channel	
Jurisdiction	Riprap Scour Protection	Channel Compaction Scour Protection
Pueblo of Nambé	2,379	1,307
Pueblo of Pojoaque	2,568	1,321
Pueblo de San Ildefonso	796	775
Pueblo of Tesuque	117	275
Santa Fe County	0	319
Total	**5,860**	**3,997**

Source: Reclamation GIS 2017

An additional 3,997 feet of pipeline crossings do not meet this immediate criterion of requiring riprap protection. Channel compaction is performed for these pipeline crossings.

Mitigation and Residual Impacts

The side channel surface diversion can be affected by extreme low flows or high turbidity flows. These conditions may add to the difficulty in forecasting and coordinating the San Juan-Chama Project water releases to prevent rapid, short-term fluctuations to reservoir storage. A portion of the project's San Juan-Chama contract was historically used in some years to offset evaporation losses of Cochiti Lake (Reclamation 2015a). Reclamation examined potential operational changes of San Juan-Chama Project reservoirs as a means to meet the Cochiti Lake offset requirements in certain years.

Returning sediment to the Rio Grande from pre-treatment at the side channel surface diversion would have a negligible direct impact on the river's total sediment loads;

however, mitigation measures should be in place to prevent excessive sediment deposition in the immediate vicinity of the discharge point near the side channel surface diversion. These might include releasing the effluent suspended solids at a higher velocity to facilitate entrainment into the flow.

During the construction of the side channel surface diversion, riprap would be installed in the bank area around the diversion structure (Reclamation 2015b). This would be done to minimize near-bank stress, subsequent erosion, and potential bank migration. These mitigation measures would prevent increased near-bank stress and erosion.

4.3.3.4 Alternative C

The parallel river interceptor drain would not be affected by high turbidity conditions of the Rio Grande raw water and would be less affected by extreme low flows than the side channel surface diversion. During low flow events, operations could be adjusted to provide more San Juan-Chama water. While the collection system would extract water from surface flows of the Rio Grande, the riverbed materials would filter suspended sediment.

Table 4-7, below, shows crossings that would require scour protection.

Table 4-7. Scour Protection for Pipelines in the Active Channel—Alternative C

	Transmission and Distribution Pipeline Crossings in the Active Channel (Feet)	
Jurisdiction	Riprap Scour Protection	Channel Compaction Scour Protection
Pueblo of Nambé	2,379	1,307
Pueblo of Pojoaque	1,401	1,279
Pueblo de San Ildefonso	636	715
Pueblo of Tesuque	117	275
Santa Fe County	0	319
Total	**4,533**	**3,895**

Source: Reclamation GIS 2017

Mitigation and Residual Impacts

No surface water mitigation is proposed for the RWS under Alternative C. Residual impacts on Rio Grande flows are the same as under Alternative B; however, fewer dissolved solids would be present (and extracted) during the water treatment process.

4.3.3.5 Alternative D

The water supply impacts of the infiltration gallery collection system would be the same as the impacts of the parallel river interceptor drain described under Alternative C.

Table 4-8, below, shows crossings that would require scour protection.

Table 4-8. Scour Protection for Pipelines in the Active Channel—Alternative D

	Transmission and Distribution Pipeline Crossings in the Active Channel (Feet)	
Jurisdiction	Riprap Scour Protection	Channel Compaction Scour Protection
Pueblo of Nambé	2,379	1,307
Pueblo of Pojoaque	1,401	1,279
Pueblo de San Ildefonso	636	715
Pueblo of Tesuque	117	218
Santa Fe County	0	319
Total	**4,533**	**3,838**

Source: Reclamation GIS 2017

Mitigation and Residual Impacts

No surface water mitigation is proposed for the RWS under Alternative D. Residual impacts are the same as those described under Alternative C.

4.3.3.6 Alternative E (Preferred Alternative)

The water supply impacts of the horizontal radial well collector system would be the same as the impacts of the parallel river interceptor drain described under Alternative C.

Table 4-9, below, shows crossings that would require scour protection.

Table 4-9. Scour Protection for Pipelines in the Active Channel—Alternative E

	Transmission and Distribution Pipeline Crossings in the Active Channel (Feet)	
Jurisdiction	Riprap Scour Protection	Channel Compaction Scour Protection
Pueblo of Nambé	2,109	1,183
Pueblo of Pojoaque	1,008	1,039
Pueblo de San Ildefonso	494	630
Pueblo of Tesuque	0	506
Santa Fe County	0	223
Total	**3,611**	**3,581**

Source: Reclamation GIS 2017

Mitigation and Residual Impacts

No surface water mitigation is proposed for the RWS under Alternative E. Residual impacts are the same as those described under Alternative C.

4.3.3.7 Summary of Impacts

The sources of water for the RWS are the same under all action alternatives. In all alternatives, the source of supply is surface waters of the Rio Grande. Alternatives C to E would collect these surface waters through the hyporheic zone, while Alternative B would directly collect the surface water. Alternative B could require different deliveries of flows at times, based on susceptibility of the surface diversion to low surface flows or highly turbid flows. In addition, more dissolved solids would be present (and extracted) during the water treatment process, and concentrated sediment would be returned to the Rio Grande under Alternative B. Alternatives C to E might also be affected by low flow conditions, depending on the yield obtained through the river alluvium. In certain years, operational changes of the San Juan-Chama Project reservoirs may occur in order to offset evaporation at Cochiti Lake. Flows on the Rio Grande below the Otowi Bridge would not be measurably affected by the project on an average annual basis.

4.3.4 Rio Pojoaque Irrigation Improvement Project

4.3.4.1 Alternative RP-A—No Action

There would be no direct impacts on surface water quantity if the Rio Pojoaque irrigation improvement project were not implemented. The existing Rio Pojoaque irrigation system would continue to operate as it currently does.

Mitigation and Residual Impacts

No mitigation or residual impacts are anticipated from Alternative RP-A.

4.3.4.2 Impacts Common to All Action Alternatives

The goal of the Rio Pojoaque irrigation improvement project is to increase the efficiency of irrigation diversions into the Ortiz Ditch. Project impacts vary by alternative, although river seepage would be influenced.

Mitigation and Residual Impacts

At the time of this writing, no information is available on the additional irrigation diversions that the project might produce. The increase in irrigation uses would be within the existing water rights of the Pueblo de San Ildefonso. The current offsets for operating the irrigation project are accounted for through a San Juan-Chama contract. Future offsets for any additional irrigation diversions would be accounted for in the same way.

4.3.4.3 Alternative RP-B

The Rio Pojoaque irrigation improvement project under Alternative RP-B would extend the existing Rio Pojoaque Barrier Dam. The existing dam is in the southern portion of the Rio Pojoaque channel, approximately 1.26 miles upstream of the Rio Grande confluence. A low-flow channel provides water to the irrigation turnout above the barrier dam. Excess low-flows would back up behind the expanded barrier dam and would seep into the shallow infiltration gallery; higher flows would pass over the barrier dam. The existing infiltration gallery would capture this increased infiltrated flow for irrigation use on the Ortiz ditch.

The proposed barrier dam would cross the full Rio Pojoaque channel at a height of 3 feet above the streambed (HKM 2008). Extending the barrier dam to the full channel would facilitate capture of flows and increase seepage to the shallow infiltration gallery. Seepage would increase from the current average of 5,000 afy.

The extension of the existing Rio Pojoaque Barrier Dam across the northern channel would directly impact the soil area, the near-bank stress and erosion, discharge, and in-stream sediment load. The construction of the dam extension would directly impact the land surface area where the dam intersects the bank. In addition, the dam itself would increase near-bank stress and erosion on the upstream and downstream sides of the structure.

By promoting infiltration upstream of the structure, the dam would decrease downstream discharge in the Rio Pojoaque and would decrease the flow velocity upstream of the structure. The dam would also function as a grade and flow-control structure. Decreased flow velocity upstream of the dam would increase upstream sediment deposition. These impacts would decrease the downstream sediment supply, which might be offset by decreased downstream flow. Decreased downstream flow would reduce stream power for erosion and sediment transport.

Mitigation and Residual Impacts

The channel-spanning dam would impact geomorphology by changing sediment loads and downstream discharge. Upstream aggradation would continue to occur and could widen the channel; downstream, riparian vegetation in the channel would likely be entrenched and encroached on.

Mitigation measures might include releasing, once every year, high volume, high sediment flows over the dam. This would flush sediment downstream and would address longer-term sediment deficits caused by the dam. Mitigation of water quality impacts from increased sediment transport is discussed in **Section 4.5**, Water Quality.

4.3.4.4 Alternative RP-C (Preferred Alternative)

The Rio Pojoaque irrigation improvement project under Alternative RP-C would continue the irrigation diversion at the existing Rio Pojoaque Barrier Dam. Ditch flows would be supplemented by connecting the irrigation system to the Rio Pojoaque farther upstream, using a new conveyance system.

The flows on the Rio Pojoaque would be altered. Currently, seepage losses on the Rio Pojoaque are estimated at 5,000 afy. Irrigation diversions moved farther upstream through a conveyance system could reduce Rio Pojoaque seepage between the point of diversion and the existing Rio Pojoaque Barrier Dam.

The diversion of Rio Pojoaque water from the Rio Pojoaque into a new conveyance system would directly impact the soil area. Constructing the conveyance system would disturb soil in the short term, increasing the soil available for erosion and transport. By not modifying the structure of the existing Rio Pojoaque Barrier Dam, geomorphologic changes would be limited to changes in river flows.

Mitigation and Residual Impacts

No mitigation is proposed under Alternative RP-C. Mitigation of water quality impacts from increased sediment transport is discussed in **Section 4.5**.

4.3.4.5 Alternative RP-D

Alternative RP-D would provide for more efficient collection of irrigation water by expanding the Rio Pojoaque infiltration gallery. Seepage in the Rio Pojoaque is estimated at 5,000 afy. The expanded infiltration gallery, coupled with the existing surface water turnout at the Rio Pojoaque Barrier Dam, could collect a portion of the seepage flows. This would allow the irrigation system to capture a greater volume of water, based on the existing irrigation water right.

Installing a new infiltration gallery pipe and gravel in the Rio Pojoaque would directly impact near-bank stress and erosion and in-stream sediment during construction. It also would impact downstream discharge in the long term. The construction impacts would be similar to those from the Rio Pojoaque irrigation improvement project dam extension under Alternative RP-B. In addition, the reduction of downstream flow may decrease stream power, thereby decreasing sediment transport capacity and allowing riparian vegetation to encroach on the channel.

Mitigation and Residual Impacts

No mitigation is proposed under Alternative RP-D. Mitigation of water quality impacts from increased sediment transport is discussed in **Section 4.5**.

4.3.4.6 Alternative RP-E

The Rio Pojoaque irrigation improvement project would collect shallow alluvial seepage to provide for improved irrigation reliability. Seepage, irrigation impacts, and impacts on sediment transport would be the same as those described under Alternative RP-D.

Mitigation and Residual Impacts

No mitigation is proposed under Alternative RP-E. Mitigation of water quality impacts from increased sediment transport is discussed in **Section 4.5**.

4.3.4.7 Summary of Impacts

Water in the Rio Pojoaque could be altered by various project elements. The Rio Pojoaque irrigation improvement project would operate by inducing additional river seepage (Alternative RP-B), decreasing river seepage (Alternative RP-C), or capturing existing river seepage (Alternatives RP-D and RP-E). The project would improve irrigation efficiency and water use within the existing Pueblo de San Ildefonso water rights.

Alternative RP-B would produce the greatest change to river geomorphology by altering the structure of the Rio Pojoaque Barrier Dam. The other alternatives, which alter the point of diversion and river seepage, would have reduced impacts, based on changes in river flows.

4.3.5 Rio Tesuque Channel Modification Project

4.3.5.1 Alternative RT-A—No Action

Under No Action, the form and function of the Rio Tesuque and its associated floodplains would continue. Historically, the level of channel migration has been low in the reaches of concern.

Mitigation and Residual Impacts

No mitigation or residual impacts are anticipated under Alternative RT-A.

4.3.5.2 Impacts Common to All Action Alternatives

The goals of the Rio Tesuque channel modification project vary among the alternatives. Some alternatives involve channel restoration, others focus on specific flood concerns, and others on irrigation diversion efficiency. As a result, there are no common impacts among the action alternatives. Alternatives that promote seepage or irrigation diversion changes could affect river flows.

Mitigation and Residual Impacts

Mitigation and residual impacts vary by alternative.

4.3.5.3 Alternative RT-B

The Rio Tesuque channel would be restored between the Upper Navajo Diversion Dam, at RM 10.9, to the U.S. Highway 84/285 bridge, at RM 10.5. The total length of the Rio Tesuque that would be directly affected is 0.4 mile. The proposed channel cross section would promote additional flooded area, which is described in **Section 4.11**, Wetlands, Non-wetland Waters, and Floodplains. Channel velocities and shear stress would be reduced using the proposed channel cross section geometry, although channel velocities would still exceed 8 feet per second for most floods. Given the high gradient of the river, the impacts of the channel restoration would not continue upstream of the modified river reach and largely would not affect the river downstream of the U.S. Highway 84/285 bridge (**Appendix I**). Overbank retention storage would promote seepage into the shallow aquifer from higher flood flows. Current estimates of seepage on the Rio Tesuque are 2,500 afy (Jemez y Sangre Water Planning Council 2003).

Mitigation and Residual Impacts

No mitigation is proposed under Alternative RT-B. Construction-related water quality issues and mitigation are discussed in **Section 4.5**.

4.3.5.4 Alternative RT-C

The channel realignment of the Rio Tesuque would occur in the same location and length of channel as under Alternative RT-B. Velocities and shear stresses would be reduced, compared with Alternative RT-A. The new channel cross-section would be overtopped by floodwaters, having a 4 percent annual chance of occurrence (also known as a 25-year flood). When this occurs, flows would merge with the older, remnant channel.

Similar to Alternative RT-B, the changes in flow velocities and shear stresses would not continue upstream of the modified river reach and largely would not affect the river downstream of the U.S. Highway 84/285 bridge (**Appendix I**).

Mitigation and Residual Impacts

Riprap protection or vegetation banks between the new channel and remnant channel may be required to prevent bank erosion during channel overtopping. Construction-related water quality issues and mitigation are discussed in **Section 4.5**.

4.3.5.5 Alternative RT-D (Preferred Alternative)

The Rio Tesuque channel modification project, under Alternative RT-D, would remove 1,320 to 1,426 cubic yards of accumulated sediment just upstream of the TP-806 Bridge, between RMs 8.4 and 8.2. Approximately 0.2 mile of the channel would be affected. This alternative would require permitting from USACE under Sections 404 and 401 of the CWA. Removing the accumulated sediment upstream of the TP-806 bridge would not affect floods more frequent than the 50-year flood (2 percent annual chance of occurrence). Higher flood flows would have lower water surface elevations and lower velocities.

Alternative RT-D would reduce immediate flooding concerns at the TP-806 Bridge. However, the geomorphologic conditions at the bridge would continue. Further aggradation upstream of the bridge may re-create the piled sediment conditions.

Mitigation and Residual Impacts

No mitigation is proposed under Alternative RT-D. Construction-related water quality issues and mitigation are discussed in **Section 4.5**.

4.3.5.6 Alternative RT-E

Under Alternative RT-E, subsurface infiltration galleries would be installed to improve water quality in diverted irrigation flows. The intent of this alternative is to provide suspended sediment filtering of diverted water in order to reduce maintenance costs required to dredge the Upper Navajo Diversion Ponds. This alternative would require permitting from the USACE under Sections 404 and 401 of the CWA.

The overall volume of diverted water would not change, although the timing would. Rather than diverting surface flows at specific times, the subsurface infiltration galleries would operate over a longer period and at a slower flow rate. The infiltration design of 6 cfs could lower subsurface and surface flows.

Mitigation and Residual Impacts

Construction-related water quality issues and mitigation are discussed in **Section 4.5**.

4.3.5.7 Summary of Impacts

Impacts would be limited to the modified reach length, given the high stream gradients. The types of impacts vary by alternative, as follows:

- Alternative RT-B—Channel velocities and shear stress would be reduced. Overbank retention storage would increase seepage.

- Alternative RT-C—Channel velocities and shear stress would be reduced.
- Alternative RT-D—There would be some reduction in channel water surface elevations during infrequent floods.
- Alternative RT-E—Irrigation diversions would occur over a longer period, but at a reduced rate.

4.3.6 Pueblo de San Ildefonso Future Projects Alternatives

4.3.6.1 Alternative SI-A—No Action

Under Alternative SI-A, No Action, there would be no construction associated with water-related infrastructure improvements on the Pueblo de San Ildefonso and, therefore, no impacts on surface waters or area geomorphology. There would be no direct project impacts, and the existing form and function of arroyos, streams, and rivers in the area would persist.

Mitigation and Residual Impacts

No mitigation or residual impacts are anticipated under Alternative SI-A.

4.3.6.2 Alternative SI-B—Proposed Wastewater and Water Infrastructure

The construction of wastewater and water infrastructure on the Pueblo de San Ildefonso would have similar impacts on surface water and geomorphology as described under **Section 4.3.3.2**, Impacts Common to All Action Alternatives. However, taking people off of septic systems would decrease groundwater recharge, which could impact surface water flows.

For the wastewater system improvements, the proposed wastewater treatment facility is outside of the FEMA-designated floodplain. Twenty-four feet of rehabilitated sewer pipe and 375 feet of new sewer pipe would be in active portions of channels and arroyos. Pipeline that could be exposed from stream migration or erosion may require armoring or other protection.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.3.3.3**, Alternative B—HKM Implementable, and **Section 4.3.3.4**, Alternative C.

4.4 Groundwater

This section addresses potential impacts on groundwater from actions associated with each alternative.

4.4.1 Impact Indicators

The indicator, as described in **Table 3-1**, used to analyze impacts on groundwater is modeled changes in groundwater elevations.

4.4.2 Analysis Methods and Assumptions

The Pojoaque Basin, including the RWS general project area and other projects, is the area of analysis for groundwater. A local and regional groundwater model was developed to determine the influence of alternatives. Impacts of the alternatives, estimated from modeling, were evaluated for the short term (as households connect to the RWS) and long term (after full RWS demand is reached). As groundwater is currently the primary water supply for the Settlement Pueblos and Santa Fe County residents in the general project area, the impacts are generally described in the context of potential impacts on existing wells in the area.

4.4.3 RWS Alternatives

4.4.3.1 Alternative A—No Action

Groundwater would continue to be the primary source of drinking water. Increased groundwater withdrawals are likely in order to satisfy future water demands, which would lower groundwater levels.

The groundwater model of this alternative shows the changes in depths to groundwater. Historically, groundwater levels have dropped since the mid-1940s. The extent of this decline has ranged from an average of 3 feet up to 8.2 feet (see **Section 3.4**, Groundwater). Projections based on anticipated future demand in the general project area would change the depth to groundwater under Alternative A, as shown in **Table 4-10**, below.

Table 4-10. Future Changes in Depths to Groundwater—Alternative A

	Estimated Future Drawdowns by 2100 (Feet)		
Area	**Minimum**	**Average**	**Maximum**
Bishop's Lodge area	2	16	35
Pueblo of Tesuque	4	17	82
Pueblo of Nambé	1	24	70
County area, between the Pueblo of Pojoaque and the Pueblo of Tesuque	27	64	79
Pueblo of Pojoaque	6	23	57
County area, between the Pueblo de San Ildefonso and the Pueblo of Pojoaque	15	17	18
Pueblo de San Ildefonso	1	10	17
Overall service area	1	20	82

Source: Balleau 2003

If groundwater levels decline significantly, then certain private wells may become inoperable because groundwater would fall below the well intake elevations. Based on the pattern of groundwater level reduction from the modeling and known well depths

from Office of the State Engineer records, the number of existing wells that could be affected is shown in **Table 4-11**, below. These existing wells could experience a reduction in yield or become inoperable with continued groundwater extraction and with future demands.

Table 4-11. Number of Existing Well Impacts—Alternative A

Area	Potential Number of Wells Affected by Future Changes in Depth to Groundwater
Bishop's Lodge Area	3
Pueblo of Tesuque	7
Pueblo of Nambé	7
County area, between the Pueblo of Pojoaque and the Pueblo of Tesuque	23
Pueblo of Pojoaque	8
County area, between the Pueblo de San Ildefonso and the Pueblo of Pojoaque	2
Pueblo de San Ildefonso	14
Overall service area	64

Sources: Balleau 2003; New Mexico Office of the State Engineer 2016

Mitigation and Residual Impacts

New wells would need to be constructed, or at the very least, pumps would need to be lowered below water levels to allow continued operation of wells affected by declining groundwater caused by future pumping demands.

4.4.3.2 Impacts Common to All Action Alternatives

The shift from reliance on groundwater supplies to surface water from the RWS would generally result in increases in groundwater levels in the general project area, as compared with Alternative A. **Table 4-12**, Changes in Pojoaque Basin Groundwater Use—Alternatives B through E, shows projected reductions in groundwater pumping over time under the action alternatives. Service areas on the Pueblo de San Ildefonso and portions of the Pueblo of Pojoaque would likely be connected to the RWS by the end of 2021. The remaining service areas would be completed by approximately 2024. Groundwater use would be reduced by an estimated 1,055 to 1,636 afy by 2025, depending on the number of non-Pueblo households connecting to the system. After this time, the remaining service areas would be connected to the RWS. Groundwater use after full project buildout would be reduced by an estimated 1,884 afy.

Groundwater modeling projections, based on anticipated reduction in existing private well pumping from the RWS project, would decrease the depth to groundwater (see **Table 4-13**, Future Changes in Depths to Groundwater with Full Project Buildout (Year 2050)—Alternatives B to E). The cessation of well pumping would alter surface water baseflows, as discussed in **Section 4.3**.

Table 4-12. Changes in Pojoaque Basin Groundwater Use—Alternatives B through E

Service Area	Reduction in Groundwater Pumping by 2025 with RWS (afy)	Reduction in Groundwater Pumping by 2040 with RWS (afy)	Reduction in Groundwater Pumping after Full Buildout (afy)
Pueblo de San Ildefonso	128 to 235	144 to 282	282
Pueblo of Pojoaque	525 to 720	553 to 807	807
Pueblo of Nambé	207 to 316	232 to 359	359
Pueblo of Tesuque	170 to 185	173 to 191	191
Santa Fe County	25 to 181	58 to 245	245
Total Service Area	**1,055 to 1,637**	**1,160 to 1,884**	**1,884**

Source: INTERA 2016a
Note: Estimates in each Pueblo include both Pueblo households and water use and non-Pueblo households within the respective Pueblo boundaries. The Santa Fe County totals are non-Pueblo households in Bishop's Lodge, the Jacona Land Grand, the inter-Pueblo area, and the Cuyamungue Grant.

Table 4-13. Future Changes in Depths to Groundwater with Full Project Buildout (Year 2050)—Alternatives B to E

	Estimated Future Change in Groundwater Levels (Feet) Compared with Base Condition[1]		
Area	Minimum	Average	Maximum
Bishop's Lodge area	+1	+2	+21
Pueblo of Tesuque	+1	+7	+28
Pueblo of Nambé	+0	+2	+10
County area, between the Pueblo of Pojoaque and the Pueblo of Tesuque	+1	+6	+10
Pueblo of Pojoaque	+0	+2	+10
County area, between the Pueblo de San Ildefonso and the Pueblo of Pojoaque	+1	+1	+1
Pueblo de San Ildefonso	+1	+1	+2
Rio Grande Source Water Collection Area	Varies by Alternative		
Overall service area	**+0**	**+3**	**+28**

Source: INTERA 2016a
[1] Average annual volumes assume steady-state condition after streams recover flows after pumping ceases.

Water treatment, water transmission and distribution pipelines, short-term storage tanks, pumping plants, electrical power service, and access roads are not expected to have a discernable impact on groundwater levels. Alternatives may have project elements, such as the ASR systems considered under Alternative B, that impact groundwater. The

impacts on groundwater are discussed separately under each alternative because combinations of changes in groundwater use and project elements under each alternative can have different impacts.

Mitigation and Residual Impacts

Reclamation would develop a groundwater model, in association with the New Mexico Office of the State Engineer. Future well installations would be evaluated to determine long-term impacts. It would follow the Office of the State Engineer permit conditions required for monitoring, scheduling, limitations, and replacements.

4.4.3.3 Alternative B—HKM Implementable

Surface water collected from the Rio Grande via the side channel surface diversion would be vulnerable to drought and water quality issues. This alternative would use backup water supplies to ensure a firm, reliable water supply when water availability or quality on the Rio Grande would not meet the RWS demand. Additional details on timing and operation of backup elements are necessary to understand surface and groundwater interaction.

The extent that a backup water supply might be required is provided in **Table 4-14**, below. Historic flows in the Rio Grande from 1971 to 2015 were examined to estimate either those days when low flow would result in system demand shortages or those days when the amount of suspended solids in the raw water would exceed the proposed water treatment plant design limits. The maximum backup supply in any given year was calculated at 1,395.9 af, which is over one-third of the annual treated water. Most of the estimated backup supply requirement is due to high concentrations of suspended sediments. When only extremely low flow events are considered, the maximum required backup supply is 217.2 afy.

Table 4-14. Project Backup Supply

River Events	Anticipated Maximum Backup Supply (afy)
Historic combination of low flows or high sediment loading	1,395.9
Historic low flows only	217.2
Climate change influenced low flows by 2050	217.2 to 382.6
Climate change influenced low flows by 2080	217.2 to 467.7

Source: Appendix I (Section I-5.1.2, Required Backup Supply for Rio Grande Low Flows and High Suspended Sediment).
Note: Climate change scenarios are an evaluation of flow quantities only.

Reclamation evaluated multiple climate change scenarios and the potential impacts on flows of the Rio Grande at Otowi gage. The relationship between suspended solids in the Rio Grande and river flow is not definite; as such the climate change modeling performed did not estimate how source water quality might change. The required backup supply from low-flow events alone was found to potentially increase with anticipated changes in climate. The most adverse climate change scenario anticipated that the backup supply needs might increase to 382.6 afy by 2050 and 467.7 afy by 2080. These estimates do not include any potential future changes in suspended solids in the river. Future climate

change scenarios may require the need for backup supplies to increase by 250 afy by 2080, based on the most adverse climate change scenario evaluated.

Alternative B includes the use of ASR (injection or passive infiltration) wells as a backup option. This backup option would temporarily recharge local groundwater before pumping extracts it. ASR facilities constructed as backup options under Alternative B would be located far enough from existing groundwater wells to avoid influencing these wells (AMEC Foster Wheeler 2016). Proposed ASR facilities would also be located at least 2 miles from the rivers and tributaries and away from mapped faults to maintain control of stored water.

Key considerations for project elements associated with Alternative B that may impact groundwater are as follows:

- Temporary dewatering to excavate 16,400 cubic yards of soil for the proposed side channel surface diversion structure would lower local groundwater levels but is not anticipated to impact the regional groundwater system (Reclamation 2015b).
- The side channel surface diversion structure may not be able to provide water under low water elevations. Groundwater levels near the Rio Grande are not expected to be affected any more than has occurred during extreme drought conditions in the past. This is because additional water would be introduced into the diversion reach (see **Section 4.3**).
- Temporary construction impacts are discussed in **Section 4.5**, Water Quality.

Mitigation and Residual Impacts

No mitigation or residual impacts are anticipated with ASR facilities, if operated to avoid aquifer depletion. The water recharged in passive infiltration or injection ASR facilities has been evaluated to confirm that source water quality would not degrade aquifer systems. Water compatibility and geochemical modeling have been performed (1) to understand surface water and groundwater interactions with ASR operation and (2) to identify any water conditioning that might be needed before recharge to minimize dissolution of minerals from the aquifer (DBS&A 2015).

An operational plan would need to be developed to minimize degradation of water quality and reduce migration of water intended for recovery. Wells in areas with environmental sensitivities may require site-specific mitigation.

4.4.3.4 Alternative C

Alternative C would include a parallel river interceptor drain to the east of the Rio Grande for primary source water collection. Estimated parallel river interceptor drain yield, at low river flows, is assumed to produce 6.23 mgd, which would meet maximum water demands, even in low river flows (INTERA 2016a). Installing the interceptor drain piping may require temporary dewatering (depending on the construction technique used), which would lower local groundwater levels; however, the temporary dewatering is not anticipated to impact the regional groundwater system. Other construction techniques, such as biopolymer slurry trenches, would not require dewatering.

Modeling indicates that operating the parallel river interceptor drain could change groundwater level, affecting nine existing supply wells (INTERA 2016a). The maximum drawdown of the interceptor drain is 8 feet, with a drawdown of 3 feet at the nearest existing well. The impacts on these existing wells would change groundwater levels by less than 10 percent.

Mitigation and Residual Impacts

No mitigation or residual impacts are anticipated with the parallel river interceptor drain.

The collection system must be back flushed every 5 years, or as needed. Submersible pumps must be maintained and kept clear of deep-rooted vegetation (Reclamation 2015b). These maintenance operations are not anticipated to impact groundwater levels.

4.4.3.5 Alternative D

Alternative D would include an infiltration gallery to the east of the Rio Grande for primary source water collection. Estimated infiltration gallery yield, at low river flows, is assumed to produce 6.23 mgd, which would meet maximum water demands, even in low river flows (INTERA 2016a). Impacts are the same as those described under Alternative C. The infiltration gallery, at full buildout, is assumed to perform similar to the parallel river interceptor drain. Modeling conducted by Reclamation indicates that operating the infiltration gallery could result in groundwater level changes affecting nine existing supply wells. The maximum drawdown of the infiltration gallery is 8 feet, with a drawdown of 3 feet at the nearest existing well. The impacts on these wells would change groundwater levels by less than 10 percent.

Mitigation and Residual Impacts

Mitigation and residual impacts would be the same as those described under Alternative C.

4.4.3.6 Alternative E (Preferred Alternative)

Alternative E would collect Rio Grande surface flows by horizontal radial well collectors. Estimated horizontal radial well collector yield, at low river flows, is assumed to produce 6.23 mgd, which would meet maximum water demands, even in low river flows (INTERA 2016a). Source contributions to the well collectors, at full buildout, would be 3,355 afy from Rio Grande recharge and 556 afy from groundwater that previously discharged to the river.

Alternative E would include emergency use wells as a potential supplemental water supply. Emergency use wells have the potential to influence nearby private water supply wells. While these wells would be distributed through the service area, the potential influence may be to generate temporary drops in groundwater levels.

Temporary construction impacts are discussed in **Section 4.4.4.2**, Impacts Common to All Action Alternatives.

Modeling conducted by Reclamation indicates that operating the horizontal radial well collectors could result in groundwater level changes affecting 10 supply wells (INTERA 2016a). The maximum drawdown is around 4 feet, with a drawdown of 2.5 feet at the

nearest registered groundwater well. The impacts on these wells would change groundwater levels by less than 10 percent.

Mitigation and Residual Impacts

Mitigation and residual impacts would be the same as those described under Alternative C. Emergency use wells in areas with environmental sensitivities may require site-specific mitigation. An operational plan would need to be developed to minimize degradation of groundwater quality.

4.4.3.7 Summary of Impacts

The shift from reliance on groundwater supplies to surface water from the RWS to improve water supply reliability would generally result in increases in groundwater levels, as compared with Alternative A, No Action. Surface water base flows are projected to increase in both the Pojoaque Basin and the Rio Grande compared with Alternative A, No Action. The alternatives with proposed subsurface collection systems (Alternatives C, D, and E) would result in localized groundwater level reductions (INTERA 2016a), with up to 10 existing water supply wells within this impact zone.

4.4.4 Rio Pojoaque Irrigation Improvement Project

4.4.4.1 Alternative RP-A—No Action

Under Alternative RP-A, there would be no structure changes to the Rio Pojoaque Barrier Dam or irrigation operations. The extent of seepage from the river to the shallow alluvium would remain the same.

Mitigation and Residual Impacts

No mitigation is proposed under Alternative RP-A.

4.4.4.2 Impacts Common to All Action Alternatives

The Rio Pojoaque irrigation improvement project alternatives would affect the balance between surface flows and shallow alluvium flows. For some alternatives, the seepage would increase, while under other alternatives it may decrease. The assumption is that the potential for shallow alluvium recharge would not have large influences on the deeper aquifer.

Mitigation and Residual Impacts

No mitigation is proposed under the Rio Pojoaque irrigation improvement project alternatives.

4.4.4.3 Alternative RP-B

Under Alternative RP-B, the Rio Pojoaque Barrier Dam would be extended to induce additional seepage into the shallow alluvium. This recharge would then be extracted for irrigation, using the existing Ortiz Ditch infiltration gallery. The assumption is that the recharged water would be temporarily stored and then would be either diverted for irrigation or would appear as increased Rio Pojoaque baseflow below the barrier dam; therefore, no long-term impacts on groundwater levels are anticipated.

Mitigation and Residual Impacts

No mitigation is proposed under Alternative RP-B.

4.4.4.4 Alternative RP-C (Preferred Alternative)

Under Alternative RP-C, additional irrigation diversions from the Rio Pojoaque would reduce river seepage between the new point of diversion change and the Rio Pojoaque Barrier Dam. This dam and the Ortiz Ditch diversion would continue their previous functions.

Mitigation and Residual Impacts

No mitigation is proposed under Alternative RP-C.

4.4.4.5 Alternative RP-D

Retrofitting the infiltration gallery would extract additional water stored in the alluvium. This could decrease groundwater levels, compared with Alternative RP-A.

Mitigation and Residual Impacts

No mitigation is proposed under Alternative RP-D.

4.4.4.6 Alternative RP-E

Alternative RP-E is similar to Alternative RP-D, in that the existing infiltration gallery would be modified to increase water extracted from the alluvium. This could decrease groundwater levels, compared with Alternative RP-A.

Mitigation and Residual Impacts

No mitigation is proposed under Alternative RP-E.

4.4.4.7 Summary of Impacts

The Rio Pojoaque irrigation improvement project alternatives would either induce additional river seepage, which would be partially captured by the existing infiltration gallery (under Alternatives RP-B, RP-D, and RP-E), or would prevent river seepage through a lined channel (under Alternative RP-C). The assumption is that the potential for shallow alluvium recharge would not have large influences on the deeper aquifer.

4.4.5 Rio Tesuque Channel Modification Project

4.4.5.1 Alternative RT-A—No Action

Under Alternative RT-A, No Action, the channels of the Rio Tesuque and methods of diverting irrigation water would remain unchanged. The extent of river seepage would not change from existing conditions.

Mitigation and Residual Impacts

No mitigation is proposed under Alternative RT-A.

4.4.5.2 Impacts Common to All Action Alternatives

Alternatives that promote seepage or irrigation diversion changes could affect river flows. Currently, the project alternative impacts on infiltration and groundwater are not known. Depth to groundwater associated with cessation of pumping ranges from between 1 and 28 feet, with the largest increase occurring toward the Pueblo of Tesuque southern boundary (INTERA 2016a).

Mitigation and Residual Impacts

No mitigation is proposed for the Rio Tesuque channel modification project alternatives.

4.4.5.3 Alternative RT-B

The stream restoration under Alternative RT-B would be associated with four overbank detention ponds. The ponds could capture some of the overbank flood-waters. The ponds may be deep enough to influence the groundwater table. The assumption is that the detention pond recharge or evaporation losses would not have large influences on the deeper aquifer.

Mitigation and Residual Impacts

No mitigation is proposed under Alternative RT-B.

4.4.5.4 Alternative RT-C

The stream alignment change would not change the overall length of the channel, although the elevation of the channel would increase. This could alter the gradient between the channel surface water and depth to groundwater. Groundwater modeling has not been conducted; however, the assumption is that the channel alignment would not have large influences on the deeper aquifer.

Mitigation and Residual Impacts

No mitigation is proposed under Alternative RT-C.

4.4.5.5 Alternative RT-D (Preferred Alternative)

Alternative RT-D would influence water surface elevations and flooded areas during infrequent floods (see **Section 4.11**, Wetlands, Non-wetland Waters, and Floodplains). There would be no change in the flow regimes for frequent floods and flows. Based on the infrequent influence of Alternative RT-D on flow changes, the assumption is that this alternative would not influence the deeper aquifer.

Mitigation and Residual Impacts

No mitigation is proposed under Alternative RT-D.

4.4.5.6 Alternative RT-E

Expanding the additional capacity of the Upper Navajo Diversion Pond infiltration gallery would extract surface water through the river alluvium at a more constant, but slower, rate than the current surface diversions. The assumption is that this alternative would not influence the deeper aquifer.

Mitigation and Residual Impacts

No mitigation is proposed under Alternative RT-E.

4.4.5.7 Summary of Impacts

The goals of the Rio Tesuque channel modification project vary between alternatives. Some involve channel restoration, others focus on specific flood concerns, and others focus on irrigation diversion efficiency. Alternatives RT-B, RT-C, and RT-E could change river seepage. Other alternatives are targeted at flood conditions and are not likely to have long-term influences on the river alluvium or groundwater. The assumption is that the alternatives would not have a large influence on the deeper aquifer.

4.4.6 Pueblo de San Ildefonso Future Projects Alternatives

4.4.6.1 Alternative SI-A—No Action

Under Alternative SI-A, No Action, there would be no construction associated with water-related infrastructure improvements on the Pueblo de San Ildefonso and, therefore, no impacts on groundwater.

Mitigation and Residual Impacts

No mitigation is proposed under Alternative SI-A.

4.4.6.2 Alternative SI-B—Proposed Wastewater and Water Infrastructure

The land application of wastewater biosolids from the wastewater system improvements would not influence groundwater quality in the deeper aquifer; therefore, groundwater would not be affected. However, taking people off of septic systems would decrease groundwater recharge. Installing the separate water-related infrastructure would not impact groundwater. Temporary construction impacts are discussed in **Section 4.5**, Water Quality.

Mitigation and Residual Impacts

No mitigation is proposed for the proposed wastewater and water infrastructure.

4.5 Water Quality

This section addresses potential impacts on water quality from actions associated with each alternative.

4.5.1 Impact Indicators

The following indicators, as described in **Table 3-1**, are used to analyze impacts on water quality:

- Conditions of CWA Sections 401, 402, and 404 permits
- Water quality of any discharges and changes to impaired waterways
- Contaminant levels and potential for contamination in the drinking water supply

4.5.2 Analysis Methods and Assumptions

The Pojoaque Basin, including the general project area, is the area of analysis for water quality. Water quality data from the EPA, the USGS, the NMED, and other sources were compared with surface water quality standards. TMDLs, implementation plans, and NPDES permits were also examined. This information was taken into consideration when determining potential project impacts on water quality.

4.5.3 RWS Alternatives

4.5.3.1 Alternative A—No Action

Alternative A, No Action, would not result in direct impacts on water quality in the general project area; however, increases in water demands would increase groundwater use. Indirect impacts over time would depend on multiple factors and how they evolve. These factors include changes in the hydrology/hydrogeology, water demands, water quality initiatives, operation and maintenance of water supply systems, and disposal of wastewater/hazardous materials. If there were less available water due to increases in water demand, less stream flow, or other causes, lower stream flows and lower groundwater levels generally would lead to poorer water quality.

Initiatives to protect or improve water quality, such as TMDLs, stormwater BMPs, and wellhead protection areas, could improve water quality over the long term. The operation and maintenance of existing water systems (Pueblo and private wells) would impact water quality. These existing water systems would continue to age and, possibly, be under-maintained, which would result in deteriorating drinking water quality. The assimilative capacity of the soils and water are limited. Risks of overloading the soils from septic systems could reduce the water quality.

Individual and separate water systems are less likely to be maintained, consistently operated, and monitored for water quality. The source water quality may also decline, depending on disposal methods for wastewater. The expected drinking water quality would likely vary significantly within a system having a wide range of individual water systems (see **Chapter 3**, **Table 3-11**, Summary of Groundwater Samples in the Region). There are various contaminants currently in the drinking water supply. These contaminants would continue to impact drinking water quality as long as current drinking water sources continued to be used.

Mitigation and Residual Impacts

No mitigation is proposed for Alternative A.

4.5.3.2 Impacts Common to All Action Alternatives

For all action alternatives, requirements and conditions of all necessary construction and operational permits and plans, including CWA Sections 401, 402, and 404 permits, would be met; water quality is expected to improve.

Construction Impacts

The construction of the RWS facilities would create direct impacts common to Alternatives B through E. Construction of these project elements would disturb the area's soil, increasing the sediment available for transport into rivers and arroyos. Additionally,

construction near arroyos or the placement of protective riprap would disturb channels and increase the amount of sediment available for transport. Construction would also directly disturb channel banks, increasing the amount of sediment available for erosion and decreasing bank stability.

Operational Impacts

Bringing a new drinking water source to the Pojoaque Basin through the RWS could result in drinking water with fewer contaminants. The RWS would supply safe drinking water to the users and alleviate health and safety issues associated with the individual water systems (see **Section 3.21**, Solid and Hazardous Materials). All action alternatives may result in direct impacts on water quality associated with the available water supply in relationship to the water demand. All action alternatives are anticipated to provide similar quantities of water and therefore have similar impacts on water quality.

When the available water supply is large relative to the water demand, then any change in water quality is likely to be undetectable. If the water supplies were low and a large percent were diverted to meet water demand, then the remaining water would be stressed and may experience a decline in water quality. When there is less water, its biological, chemical, and physical properties tend to become impaired. For example, increased diversion may affect turbidity, hardness, total dissolved solids, organic constituents, or any other constituents that could be present in the river. The impacts on water quality are likely to be proportional to the amount of remaining un-diverted water.

A portion of supplied water becomes wastewater. The existing wastewater systems would be used both with and without the RWS. A local resident observed and documented potential return flow indications of septic fields to the Rio Nambé. During a field inspection near Terra Verde, County Road 113, and County Road 117 in March 2013, he found estimated return flows of 30 gpm with algal growth (Bent 2013). In May 2014, a Reclamation survey team also found algae between Rio Nambé RMs 3.8 and 4.5. The latter survey also noted evidence of grazing in the riparian area, which may contribute to nutrient loading of the surface water. Key parameters in wastewater that affect algae growth are nutrients, nitrogen, and phosphorus. The concentrations of these parameters would be similar with or without the RWS.

All action alternatives have a common primary source water collection reach. Any potential water quality impacts are most likely to occur in a reach near and just below the collection point. There is the potential for legacy contamination and forest/range fires to influence runoff and sediment transport, which affect water quality. However, previous monitoring has found suspended sediment and related constituents were only slightly increased in the samples after fires (NMED 2011). Also trace metals and radiochemical measurements were indistinguishable from background, except in specific areas.

Possible contamination pathways from legacy waste sites in the technical areas of LANL enter the Rio Grande downstream of the primary source water collection reach (Chem Risk LLC 2010). The first drainage from the Los Alamos Technical Areas to the Rio Grande is Los Alamos Canyon, entering the Rio Grande just downstream of Otowi Bridge. Sampled trace metals and radiochemical measurements provided no indications that the legacy contamination from LANL is entering the Rio Grande (New Mexico Bureau of Mines and Mineral Resources 1990). Flows from the Los Alamos Canyon

would not contribute to or be captured by the RWS source water collection, located upstream of Otowi Bridge.

The hexavalent chromium plume being managed beneath Mortandad Canyon at LANL is over 4 miles west and south of the proposed RWS primary source water collection location on the Rio Grande (Department of Energy 2005). This is far enough away that it would not impact the quality of water collected for the RWS.Drinking water quality would be similar or improved under the action alternatives, compared with Alternative A. The collected water would be treated to meet national and state drinking water standards before being delivered to customers. Water quality standards are compared with the summary of groundwater samples within the general project area compiled in **Table 4-15**, below.

Existing groundwater wells are influenced by unique geochemical characteristics. The presence of volcanic ash (volcaniclastics) and naturally occurring uranium result in higher concentrations of arsenic and uranium in well water. The median uranium concentration was 0.06 mg/l; this exceeded the regional median value of 0.006 mg/l and drinking water standards of 0.03 mg/l. The average uranium concentration exceeded 0.1 mg/l. Most existing groundwater wells exceeded water quality standards for arsenic and fluoride. Well samples had concentrations of constituents indicative of domestic wastewater influences.

The primary sources of water for the RWS would be the same under all action alternatives. All sources would be mixed with and delivered via waters of the Rio Grande. Raw water quality at the Rio Grande diversion would vary, depending on multiple factors, such as stream flow, upstream water quality conditions, and proportions of contributions from the water rights portfolio.

The alternative primary source water collection methods are unlikely to have much influence on water quality. The subsurface collection methods would provide natural filtration through the alluvium. Differences in raw water quality would be addressed as part of the operation of the water treatment plant. After treatment, the delivered water would be of similar quality under all action alternatives and would meet national and state drinking water standards. Pilot water treatment plant testing developed treatment processes to meet the required standards, with the overall goal of limiting contaminant levels to 80 percent or less of the maximum contaminant level for each regulated water quality constituent. Contaminant levels in treated water may be lower than this goal where the source water contaminant levels are already low. (Reclamation 2016b).

Operations at the water treatment plant would not impact delivered waters. Water from processing would be recycled, as permitted by the Filter Backwash Recycling Rule (EPA 2002). No process treatment water would be discharged from the treatment plant to the river or its tributaries. Dewatered solids from the treatment processes would be delivered to a landfill. One exception is the pretreated filtering of source water sediment in Alternative B. Naturally present sediments with coarse particle sizes would be returned to the river under Alternative B; however, since these would be present in the river anyway, this is not considered to be an adverse impact.

Table 4-15. Comparison of Drinking Water Standards and Existing Quality

Water Source	Concentration Ranges (mg/L)								
	Arsenic	Barium	Fluoride	Iron	Manganese	Nitrate	Sulfate	Uranium	Total Dissolved Solids
Existing regional groundwater	<0.0002 to 0.0895	<0.001 to 1.42	<0.01 to 6.5	<0.01 to 26	<0.001 to 1.394	<0.01 to 191	0.5 to 7050	<0.0002 to 1.82	7 to 11,351
Rio Grande (raw water)	0.0037 to 0.0130	0.50 to 2.90	0.34 to 0.39	17.6 to 120	1.0	0.12 to 0.13	36.5 to 49	0.01 to 0.06	245.9
RWS Pilot Treatment Plant Goals (after treatment)	<0.008	<0.0016	<1.6	<0.24	<0.04	< 8	<200	<0.024	< 0.1 Nephelometric Turbidity Unit
EPA/WQCC Standards (max)	0.01	0.002	4/2	0.3	0.05	44	250	0.03	500

Sources: Linhoff et al. 2016; NMED 2013; Reclamation 2016b

Note: The "RWS Pilot Treatment Plant (after treatment)" is the stated water quality goals of the treatment process. Finished water is targeted to be less than the stated goals.

Little impact on turbidity is anticipated; this is because (1) for most flow conditions, it would represent a low percent of the total sediment being transported by the river, and (2) higher turbidity levels are normally associated with organic material, dissolved solids, and suspended fine silt and clay particles, rather than coarser sand particles. None of the constituents mentioned would be affected by the primary source water collection. The collection would not involve effluent discharges or any chemicals, petroleum, or other products that could affect water quality; because of this, no other water quality impacts have been identified.

Mitigation and Residual Impacts

Construction-Related

Components of the project are the construction of the primary source water collection facility, water treatment plant, short-term storage tanks, water transmission and distribution pipelines, and electrical power service. This construction would disturb the land. Standard construction BMPs would be in place to address water quality impacts from construction.

During the construction of the primary source water collection, water treatment, and short-term storage facilities, a stormwater pollution prevention plan (SWPPP) would be implemented at each construction site. These plans include BMPs for erosion prevention, such as stockpiling soil for reuse and surrounding construction zones with barriers to prevent or limit stormwater and sediment runoff. After construction, disturbed areas would be vegetated. These mitigation measures would prevent short-term (construction) and long-term (operation) erosion; therefore, they would prevent increased sediment loads in rivers and arroyos during construction and operation. If they are implemented properly, there should be no residual impacts on watercourses from primary source water collection, water treatment, and short-term storage facilities.

Similar to the construction of the primary source water collection, treatment, and short-term storage systems, an SWPPP would be implemented during construction of the water transmission and distribution system on land surfaces. As described above, the SWPPP and vegetation mitigation measures would minimize erosion and sediment loads in rivers and arroyos and would prevent residual impacts on geomorphology. BMPs listed in the Storm Water Management Guidelines for Construction and Industrial Activities manual (NMDOT et al. 2012) would be incorporated during project construction, as applicable.

During the installation of the water transmission pipeline crossings in arroyos, mitigation measures would be used to decrease long-term arroyo erosion. For arroyo crossings less than 100 feet wide, backfill would be compacted around the pipe to reduce erosion. For arroyo crossings greater than 100 feet wide, backfill would be compacted and riprap would be placed to control erosion (Reclamation 2015b). The extent of the scour protection would vary by alternative, described separately in the following project alternative sections.

The horizontal drilling method for installing pipelines can result in unintended releases of drilling fluid into the environment. The drilling fluid is generally a mixture of water and bentonite, but it may include polymers and other additives to alter the fluid's density or workability (Crowell 2014). The drilling fluid acts to cool the drill and, in a manner similar to a biopolymer slurry, to maintain the horizontal borehole before the pipe is put

into place. Normally, drilling fluid is recaptured, but it can inadvertently escape if there is insufficient cover or fractured geology. The impact of drilling fluid contamination is similar to suspended solids, with possible chemical or biological oxygen demand impacts from additives.

Project construction would require measures to reduce the potential inadvertent releases of drilling fluid (USACE 1998). These measures include subsurface surveys to identify gravel strata and high or perched groundwater tables for potential seepage; measurements of soil permeability; specifications for minimum cover depths; and drilling fluid pressure limits. Detecting and minimizing the impacts of an inadvertent release of drilling fluids would include specifying drilling fluid composition, monitoring drilling fluid pressure, and requiring a spill cleanup action plan.

Operational-Related

The RWS would treat water and provide for distribution system water quality monitoring to meet state and national water quality standards. Treatment goals in many cases would be used to exceed water quality standards, such that contaminants would be less than 80 percent of the regulated standard. Wastewater and solids resulting from treatment processes would also be regulated under state and national water quality regulations. No mitigation would be required for project operation.

4.5.3.3 Alternative B—HKM Implementable

The side channel surface diversion structure on the Rio Grande would have a direct impact on bank stress and erosion, discharge, and in-stream sediment. The construction and operation of the structure would increase NBS and erosion in the vicinity of the structure, which could ultimately result in bank migration. Under Sections 404 and 401 of the CWA, in-channel work would require permitting by the USACE. Under Alternative B, surface water would be directly withdrawn from the Rio Grande. The sediment would be removed from the water at the collection point, and then a portion would be returned to the Rio Grande from pretreatment. An average of approximately 27,000 gpd of brine would be generated at the water treatment plant; this would increase to an average of 149,000 gpd of brine at full future demand, which would be discharged to the Rio Grande. A National Pollutant Discharge Elimination System (NPDES) permit would be required for the sediment return and brine discharge.

Mitigation and Residual Impacts

No additional mitigation is proposed for Alternative B.

4.5.3.4 Alternative C

Impacts on water quality are the same as described under **Section 4.5.3.2**, Impacts Common to All Action Alternatives. The raw surface water source would be partially naturally filtered for ash, sediment, and certain microorganisms with the parallel river interceptor drain under Alternative C. This may change the treatment process but would still result in a similar final treated water quality for delivery. As described under Alternative B, brine from the water treatment plant would be discharged to the Rio Grande, and an NPDES permit would be required.

Mitigation and Residual Impacts

No additional mitigation is proposed for Alternative C.

4.5.3.5 Alternative D

Impacts on water quality are the same as described under **Section 4.5.3.2**, Impacts Common to All Action Alternatives. The raw surface water source would be partially naturally filtered for ash, sediment, and certain microorganisms with the infiltration gallery for Alternative D. This may change the treatment process but still would result in a similar final treated water quality for delivery. As described under Alternative B, brine from the water treatment plant would be discharged to the Rio Grande, and an NPDES permit would be required.

Mitigation and Residual Impacts

No additional mitigation is proposed for Alternative D.

4.5.3.6 Alternative E (Preferred Alternative)

Impacts on water quality are the same as described under **Section 4.5.3.2**, Impacts Common to All Action Alternatives. The raw surface water would be partially naturally filtered for ash, sediment, and certain microorganisms with the horizontal radial well collectors for Alternative E. This may change the treatment process but would still result in a similar final treated water quality for delivery. An average of approximately 27,000 gpd of brine would be generated at the water treatment plant; this would increase to an average of 149,000 gpd of brine at full future demand, which would be discharged to the Rio Grande. A National Pollutant Discharge Elimination System (NPDES) permit would be required for the sediment return and brine discharge.

Mitigation and Residual Impacts

No additional mitigation is proposed for Alternative E.

4.5.3.7 Summary of Impacts

RWS alternatives and options under various alternatives have the potential to impact resources that might alter the form and function of the Pojoaque Basin watercourses and the Rio Grande. These impacts are as follows:

- Soil disturbance and liberation of sediment
- Near-bank stress and changes in erosional trends
- Flow changes
- Sediment loading
- Brine discharge

Construction-related impacts on water quality would be temporary. Construction of project elements would disturb the soil and increase the amount of sediment available for erosion. However, implementing SWPPPs and promoting vegetation growth would minimize erosion and sediment loads in rivers and arroyos and would prevent residual impacts on surface water quality.

Surface water quality conditions, such as the apparent nutrient-rich waters in the Rio Nambé and other areas, would not change with the RWS project compared with Alternative A. Under the project, groundwater use is expected to decline by up to 1,884 af per year. The reduction in groundwater use is anticipated to increase base flows in the Pojoaque Basin and potentially improve water quality.

Project operation would improve drinking water quality. Pilot water treatment plant operations and certification of the treatment facilities under the CWA would meet all of the following water quality criteria: pathogen removal and inactivation; limits on nitrates, lead, copper, uranium, and other constituents; and limits on turbidity, taste, and odor. Water quality of treated RWS water would be the same under each action alternative and is expected to generally be an improvement in water quality compared with conditions under Alternative A.

4.5.4 Rio Pojoaque Irrigation Improvement Project

4.5.4.1 Alternative RP-A—No Action

Under Alternative RP-A, there would no changes to the structure of the Rio Pojoaque Barrier Dam, the infiltration gallery for Ortiz Ditch, or associated irrigation infrastructure. Water quality issues would not change from current conditions.

Mitigation and Residual Impacts

No mitigation is proposed for Alternative RP-A.

4.5.4.2 Impacts Common to All Action Alternatives

Water quality impacts for the Rio Pojoaque irrigation improvement project are related to temporary construction of the project. Construction would disturb the area's soil, increasing the sediment available for transport into the Rio Pojoaque watershed. Construction could also directly disturb channel banks, increasing the amount of sediment available for erosion and decreasing bank stability. Some alternatives that involve in-channel work would require permitting under Sections 404 and/or 401 of the CWA.

Mitigation and Residual Impacts

All construction would be subject to an SWPPP and vegetation mitigation measures to prevent erosion and minimize sediment loads in rivers and arroyos. Residual water quality impacts from increased sediment loads during construction would be temporary.

4.5.4.3 Alternative RP-B

The extended diversion dam would impact sediment transport, as discussed in **Section 4.3.4.3**, Alternative RP-B. Construction in the Rio Pojoaque channel would be regulated and permitted under Sections 404 and 401 of the CWA. In addition, gabions or riprap, or both, would be installed where the dam meets the bank and on the downstream channel bottom to reduce near-bank stress and erosion.

Mitigation and Residual Impacts

During construction of the Rio Pojoaque Barrier Dam extension, an SWPPP would be implemented at the construction site. If implemented properly, the construction would cause no residual impacts on geomorphology. Water quality impacts during construction would be temporary.

4.5.4.4 Alternative RP-C (Preferred Alternative)

Construction of the conveyance system would increase sediment transport and impact water quality as described in **Section 4.5.4.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

During the construction of the conveyance system, an SWPPP would be implemented at the construction site. If implemented properly, the construction would cause no residual impacts on water quality. Water quality impacts during construction would be temporary.

4.5.4.5 Alternative RP-D

Construction in the Rio Pojoaque channel would increase sediment transport and impact water quality, as described in **Section 4.5.4.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Construction would be regulated and permitted under Sections 404 and 401 of the CWA. If implemented properly, the construction would cause no residual impacts on water quality. Water quality impacts during construction would be temporary.

4.5.4.6 Alternative RP-E

Impacts would be the same as those under Alternative RP-D.

Mitigation and Residual Impacts

Mitigation and residual impacts would be the same as those under Alternative RP-D.

4.5.4.7 Summary of Impacts

Impacts of the Rio Pojoaque irrigation improvement project are related to temporary water quality impacts during construction. In-channel work would be permitted under Sections 404 and 401 of the CWA. All construction would be done under an SWPPP, and disturbed areas would be vegetated. Water quality impacts during construction would be temporary.

4.5.5 Rio Tesuque Channel Modification Project

4.5.5.1 Alternative RT-A—No Action

Under Alternative RT-A, there would be no changes to the Rio Tesuque reaches. Water quality issues on the Rio Tesuque would not change.

Mitigation and Residual Impacts

No mitigation is proposed under Alternative RT-A.

4.5.5.2 Impacts Common to All Action Alternatives

While the goals and affected Rio Tesuque reaches can vary between alternatives, all alternatives would require some construction within the channel. Construction would disturb the area's soil, increasing the sediment available for transport into the Rio Tesuque. Construction would also directly disturb channel banks, increasing the amount of sediment available for erosion and decreasing bank stability. In-stream construction would be permitted under Sections 404 and 401 of the CWA.

Mitigation and Residual Impacts

Construction areas would have an implemented SWPPP and BMPs, where appropriate. If implemented properly, the construction would cause no residual impacts on surface water quality. Water quality impacts during construction would be temporary.

4.5.5.3 Alternative RT-B

Construction impacts and permitting would be the same as those in **Section 4.5.5.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Mitigation and residual impacts would be the same as those in **Section 4.5.5.2**, Impacts Common to All Action Alternatives.

4.5.5.4 Alternative RT-C

Construction impacts and permitting would be the same as those in **Section 4.5.5.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Mitigation and residual impacts would be the same as those in **Section 4.5.5.2**, Impacts Common to All Action Alternatives.

4.5.5.5 Alternative RT-D (Preferred Alternative)

Construction impacts and permitting would be the same as those in **Section 4.5.5.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Mitigation and residual impacts would be the same as those in **Section 4.5.5.2**, Impacts Common to All Action Alternatives.

4.5.5.6 Alternative RT-E

Construction impacts and permitting would be the same as those in **Section 4.5.5.2**, Impacts Common to All Action Alternatives. The change in surface flows for this alternative is discussed in **Section 4.3.5**, Rio Tesuque Channel Modification Project.

Mitigation and Residual Impacts

Mitigation and residual impacts would be the same as those in **Section 4.5.5.2**, Impacts Common to All Action Alternatives.

4.5.5.7 Summary of Impacts

Water quality impacts from increased sediment transport during construction would be temporary. General and project-specific permitting requirements under Sections 404 and 401 of the CWA would minimize the water quality impacts.

4.5.6 Pueblo de San Ildefonso Future Projects Alternatives

4.5.6.1 Alternative SI-A—No Action

The wastewater system upgrades and future water infrastructure projects would not be implemented under Alternative SI-A, No Action. Households that currently have septic systems would remain on them, contributing to nitrates to the groundwater. Pressures on available water resources and potential water quality issues associated with the disposal of wastewater would continue.

Mitigation and Residual Impacts

No mitigation is proposed under the No Action Alternative.

4.5.6.2 Alternative SI-B—Proposed Wastewater and Water Infrastructure

Direct and indirect impacts on water quality would be limited, because all actions would be properly permitted to meet water quality standards or prevent impacts on underground sources of drinking water. Water quality impacts from wastewater facilities would be limited, because secondary-level membrane bioreactor treatment is proposed. Finally, treated effluent would be pumped or gravity fed through pipelines to land disposal areas or would be injected underground. Underground injection would be regulated under the EPA's Safe Water Drinking Act, typically as a class 1 nonhazardous waste well. This should reduce the Pueblo's reliance on septic tanks and leach fields and improve localized conditions.

The construction of the wastewater system improvements and other water-related infrastructure would disturb the soil area, which increases sediment available for transport into rivers and arroyos. Rehabilitating 11,671 feet of sewer pipeline would use trenchless technologies, such as pipe bursting or slip lining, which would minimize disturbance. The surface could still be excavated for access pits to manage pipe runs, where existing pipe segments are damaged. Pipe bursting may result in surface subsidence. Constructing 38,221 feet of new sewer pipeline would disturb the surface.

During operation, any aboveground water facilities would be impervious surfaces in the watershed. Impervious surfaces generally decrease rainwater infiltration and increase the potential for surface runoff and associated surface erosion. This can subsequently increase sediment loads in rivers and arroyos.

Mitigation and Residual Impacts

An SWPPP would be implemented during construction. This plan would include BMPs for erosion prevention, such as stockpiling soil for reuse and surrounding construction zones with barriers to prevent the runoff of water and sediment. After construction, disturbed areas would be vegetated using a native grass seed mixture. These mitigation measures would prevent erosion on short-term (construction) and long-term (operation) scales; therefore, they would prevent increased sediment loads in rivers and arroyos during construction and operation. If they were implemented properly, there should be no residual impacts on surface water quality. Additional analysis will be possible once more details on the project are available.

The sewer pipeline should be installed below the treated water pipeline, to prevent cross-contamination. Dewatering wastewater sludges for disposal would reduce the potential release of materials during transport.

4.6 Geology and Soils

This section addresses potential impacts on geology and soils from actions associated with each alternative.

4.6.1 Impact Indicators

The following indicators, as described in **Table 3-1**, are used to analyze impacts on geology and soils: Acres of disturbance and change in geological characteristics that influence geological hazard risks.

4.6.2 Analysis Methods and Assumptions

4.6.2.1 Soils

Within the general project area, a narrower area of potential disturbance was developed for soils. It was focused on the areas where soils are likely to be affected by surface-disturbing activities associated with the RWS and the other proposed actions. Therefore, the area of analysis for soil resources has the same extent as the cultural resources area of analysis and includes, at a minimum, a 100-foot-wide buffer along all pipeline alignments and around all other project infrastructure. However, the buffer may be wider in certain areas.

With specific regard to impact on soils, the short term is defined as that period during which construction would occur. The long term is defined as the project's physical footprint after construction is complete and remediation is done; acres of disturbance quantifies the extent of these impacts. For a complete comparison of potential total surface disturbance by proposed action and alternative, see **Table 2-4**, RWS Surface Disturbance Comparison, **Table 2-32**, Rio Pojoaque Irrigation Improvement Project Surface Disturbance, and **Table 2-34**, Rio Tesuque Channel Modification Project Surface Disturbance.

The acres of long-term disturbance would be less than the acres of short-term disturbance. This is because BMPs would be applied to remediate areas disturbed by construction occurring outside of the completed project's physical footprint.

The impact analysis for soils in this section is limited to soil types that are most sensitive to disturbance or those that may have the greatest impact on project infrastructure or human safety. As described and defined in **Section 3.6**, Geology and Soils, these sensitive soil types include erosive soils, expansive clays, and corrosive soils. Due to the differences among these sensitive soils and their relation to the project, the short-term and long-term impacts on each of these sensitive soil types were not uniformly analyzed.

Regarding expansive clays and corrosive soils, only long-term impacts were analyzed. The analysis is limited in this manner in order to disclose potential hazards. The assumption is that proper construction practices would mitigate against siting project facilities over expansive clays and erosive soils; the consequences of such a failure were not analyzed because they are not foreseeable. Rather, the intersection of expansive clays and corrosive soils with project facilities over the long term is provided. This was done in order to disclose the potential risks if proper construction practices were not employed.

Further, no permanent facilities would be sited in the larger area that encompasses the short-term area of disturbance during construction. Therefore, only the acreage affected over the long term was used to disclose the potentiality of these risks.

Conversely, impacts on erosive soils were analyzed only over the short term. During construction, when the greatest number of acres would be disturbed, and before remediation is finished, erosive soils would be at their most susceptible to the impacts of wind and water. BMPs during construction would be used to mitigate against erosion of these and other soils.

Over the long term, the physical footprint of the RWS and other proposed actions would serve as a barrier between erosive soils and the impacts of wind and water. Therefore, long-term impacts on erosive soils are not expected.

4.6.2.2 Geologic Hazards

Changes in geological characteristics that influence geologic hazard risks are largely described qualitatively. While deep injection and recovery wells may increase the risk of geologic hazards, the extent of the risk is subject to factors that are not quantifiable. Therefore, the distance between proposed deep injunction and recovery well locations and known fault lines is the only quantitative metric that can be presented.

A review of seismologic literature notes that the basic mechanism for the activation of a slip on a fault by subsurface fluid injection is well established (Easton and Rubinstein 2015). While most of the documented instances of such induced seismicity have focused on the injection of wastewater from oil and gas operations and carbon capture and storage demonstration sites, the triggering mechanism can logically be applied to deep injection and recovery wells. This is due to the similarities between the injection well types.

While recent studies are expanding our understanding of these events and their triggers, a seismic event from fluid injection appears to depend on a host of site-specific geologic factors. Examples are the existence of faults that are favorably oriented with respect to the regional stress field and anisotropic and heterogeneous permeability of the host aquifer (Kaven et al. 2015).

Additionally, while certain criteria may be used to determine if the conditions capable of triggering a fault would be created in the injection zone, the method provides less certainty than direct evidence from monitoring instruments (Sminchak et al., undated). As

a result, without further research on injection-induced seismicity and a greater understanding of the specific geology underlying the proposed deep injection and recovery well locations, only a general discussion of geologic hazard risks from the construction, maintenance, and operation of deep injection and recovery wells can be provided.

Additionally, the literature on induced seismicity is largely in the context of deep injection wells; as a result, impacts from the construction, maintenance, and operation of shallow injection or passive infiltration and recovery wells are not expected to occur. This is because of the greater distance between the depth of these wells and the location of faults. Because deep injection and recovery wells are considered under Alternative B only, the geologic hazards indicator is analyzed only under the discussion of that alternative.

4.6.3 RWS Alternatives

4.6.3.1 Alternative A—No Action

Under Alternative A, the RWS would not be built. As a result, there would be no disturbance to sensitive soils and no change in the existing geologic conditions that would alter the risk of geologic hazards occurring. There would be no impacts on soils and geology.

Mitigation and Residual Impacts

There would be no mitigation or residual impacts associated under the No Action Alternative.

4.6.3.2 Impacts Common to All Action Alternatives

Sensitive Soils

Soils would be affected by the RWS in the short term and the long term when project-related activities disturb a surface area. Compared with Alternative A, the action alternatives would directly impact sensitive soils. This is because project-related activities would disturb surface areas containing these soils during construction and by the physical presence of project facilities overlying these soils. Where project facilities overlie and contact expansive clays or corrosive soils, there may be a potential for long-term impacts on the structural integrity of project facilities. For example, if a concrete water storage facility were sited over soils that are corrosive to concrete, then, without the proper mitigation techniques and construction practices, the short-term storage tank may gradually corrode. The failure of such a facility could have indirect impacts on human safety and the broader RWS.

During the short term, construction would cause the exposure of erosive soils to wind and water. This would be as a result of the intentional or incidental removal of vegetation during site clearing for RWS facilities. Without the vegetation, the erosive impacts of wind and water on soils would be worsened. Eroded soils would be transported from their present location, and their loss may inhibit the remediation and post-construction revegetation of disturbed areas.

Other possible indirect impacts on soils under the action alternatives are potential erosion at other locations or inundation outside of the general project area during major storms. This would be due to concentrated runoff from infrastructure and introduced hardscapes.

The nature and type of potential impacts from RWS activities on sensitive soils is consistent across alternatives; however, the alternatives would vary, in terms of the magnitude of the impact, as measured by the number of acres disturbed. Because the nature and type of impact on sensitive soils are consistent, the discussion of each alternative only seeks to describe the magnitude of the nature and types of impacts associated with each alternative.

The total acres of disturbance by alternative are summarized in **Table 2-4**, RWS Surface Disturbance Comparison.

Geologic Hazards

There are no direct or indirect impacts common to all action alternatives for this impact.

Mitigation and Residual Impacts

Mitigation includes implementing BMPs related to siting, grading, excavating, compacting, and building and to stormwater pollution prevention planning. Also mitigation may include conducting detailed preconstruction soil analyses in areas that could house permanent RWS facilities, such as the water treatment plant and short-term storage tanks. This would ensure proper construction techniques are used in areas with soils that are corrosive to concrete or steel. It would also ensure that permanent facilities were sited on stable soils and that proper construction techniques are implemented on expansive clays or other less stable substrates.

Remediation would restore areas disturbed during construction. It would include revegetating, stabilizing exposed soils, and contouring the land to minimize potential short- and long-term erosion. The results would be less long-term soil disturbance and less potential for indirect impacts, such as adjacent erosion during major storms.

4.6.3.3 Alternative B—HKM Implementable

Sensitive Soils

Under Alternative B, a side channel surface diversion would be used to collect surface water from the Rio Grande, with three options for backup water supply. The nature and type of impacts on sensitive soils are the same as described under **Section 4.6.3.2**, Impacts Common to All Action Alternatives.

Table 4-16, below, summarizes the disturbance of sensitive soils under this alternative. These totals differ from the acreages provided in **Table 2-4**, as there is overlap among categories, and not all soils that would be disturbed by the proposed RWS are classified as sensitive. Compared with Alternative A, Alternative B would result in additional impacts on sensitive soils. Erosive soils would be the most-affected sensitive soil type, 863 acres of which would be disturbed in the short term. The least-affected sensitive soil type would be expansive clay, as no acres would be affected in the long term.

Table 4-16. Impacts on Sensitive Soils under Alternative B (Acres)

Rating	Corrosion of Steel	Corrosion of Concrete	Erosive Soil	Expansive Clay
	Long-Term Impacts	Long-Term Impacts	Short-Term Impacts	Long-Term Impacts
Low	0	48	N/A	N/A
Moderate	15	2	N/A	N/A
High	35	0	863	0

Sources: Reclamation GIS 2017; NRCS GIS 2014
Note: Erosive soil and expansive clay acreages are based on the presence of these soils; rating categories are not applicable to these soil types.

Geologic Hazards

ASR—Deep Injection and Recovery Wells

Easton and Rubinstein (2015) note that the basic mechanism for the activation of a slip on a fault by subsurface fluid injection is well established. Deep injection and recovery wells could increase the risk of induced seismicity by lubricating nearby faults under certain geologic conditions. As described in **Section 3.6.2**, Geology, the Pojoaque Basin contains known faults and fault systems. Therefore, the combination of deep injection and the presence of existing faults may lead to an increased risk of induced seismicity in the area, when compared with Alternative A.

Other Backup Water Supply Options

The remaining two backup water supply options would not use the deep injection of fluids found under Backup Option 1. The potential backup water supply techniques under the action alternatives are not associated with any known impacts that would alter the geologic characteristics or introduce known geologic hazards. Therefore, Backup Options 2, 3, and 4 would not increase the risk of geologic hazards beyond the existing level of risk associated with Alternative A, No Action.

Mitigation and Residual Impacts

Recommended mitigation and residual impacts would be the same as described under **Section 4.6.3.2**, Impacts Common to All Action Alternatives.

4.6.3.4 Alternative C

Under Alternative C, parallel river interceptor drains would be used to collect subsurface water from the Rio Grande. No backup water supply options would be considered under this alternative. The nature and type of impacts on sensitive soils are the same as described under **Section 4.6.3.2**, Impacts Common to All Action Alternatives.

Table 4-17, below, summarizes the disturbance of sensitive soils under Alternative C. These totals differ from the acreages provided in **Table 2-4**, because there is overlap among categories; moreover, not all soils that would be disturbed by the proposed RWS are classified as sensitive.

Table 4-17. Impacts on Sensitive Soils under Alternative C (Acres)

Rating	Corrosion of Steel	Corrosion of Concrete	Erosive Soil	Expansive Clay
	Long-Term Impacts	Long-Term Impacts	Short-Term Impacts	Long-Term Impacts
Low	0	23	N/A	N/A
Moderate	1	1	N/A	N/A
High	24	0	819	0

Sources: Reclamation GIS 2017; NRCS GIS 2014
Note: Erosive soil and expansive clay acreages are based on the presence of these soils; rating categories are not applicable to these soil types.

Compared with Alternative A, Alternative C would result in additional impacts on sensitive soils. Erosive soils would be the most-affected sensitive soil type, 819 acres of which disturbed in the short term. The least-affected sensitive soil type would be expansive clay, as no acres would be affected in the long term.

There are no geologic hazards associated with Alternative C.

Mitigation and Residual Impacts

Recommended mitigation and residual impacts would be the same as those under **Section 4.6.3.2**, Impacts Common to All Action Alternatives.

4.6.3.5 Alternative D

Under Alternative D, an infiltration gallery would be used to collect subsurface water from the Rio Grande. No backup water supply options would be considered. The nature and type of impact on sensitive soils is the same as described under **Section 4.6.3.2**, Impacts Common to All Action Alternatives.

Table 4-18, below, summarizes the disturbance of sensitive soils under this alternative. These totals differ from the acreages provided in **Table 2-4**, because there is overlap among categories; moreover, not all soils that would be disturbed by the proposed RWS are classified as sensitive. Compared with Alternative A, Alternative D would result in additional impacts on sensitive soils. Erosive soils would be the most-affected sensitive soil type, 827 acres of which would be disturbed in the short term. The least-affected sensitive soil type would be expansive clay, as no acres would be affected in the long term.

There would be no geologic hazards under Alternative D.

Mitigation and Residual Impacts

Recommended mitigation and residual impacts would be the same as under **Section 4.6.3.2**, Impacts Common to All Action Alternatives.

Table 4-18. Impacts on Sensitive Soils under Alternative D (Acres)

Rating	Corrosion of Steel	Corrosion of Concrete	Erosive Soil	Expansive Clay
	Long-Term Impacts	Long-Term Impacts	Short-Term Impacts	Long-Term Impacts
Low	0	23	N/A	N/A
Moderate	1	1	N/A	N/A
High	23	0	827	0

Sources: Reclamation GIS 2017; NRCS GIS 2014
Note: Erosive soil and expansive clay acreages are based on presence of these soils; rating categories are not applicable to these soil types.

4.6.3.6 Alternative E (Preferred Alternative)

Under Alternative E, horizontal radial wells would be used to collect subsurface water from the Rio Grande. Existing wells would provide a supplemental water supply for emergency use. Since emergency use wells already exist, no new geologic impacts would occur; therefore, this backup water supply option would not increase the risk of geologic hazards beyond the existing level of risk associated with Alternative A.

The nature and type of impacts on sensitive soils are the same as described under **Section 4.6.3.2**, Impacts Common to All Action Alternatives. **Table 4-19**, below, summarizes the disturbance of sensitive soils under Alternative E. These totals differ from the acreages provided in **Table 2-4**. This is because there is overlap among categories, and not all soils that would be disturbed by the proposed RWS are classified as sensitive.

Compared with Alternative A, Alternative E would result in additional impacts on sensitive soils; however, this would have the fewest impacts on sensitive soils out of all the action alternatives. Erosive soils would be the most-affected sensitive soil type, 601 acres of which would be disturbed in the short term. The least-affected sensitive soil type would be expansive clay, as no acres would be affected in the long term.

There would be no geologic hazards under Alternative E.

Table 4-19. Impacts on Sensitive Soils under Alternative E (Acres)

Rating	Corrosion of Steel	Corrosion of Concrete	Erosive Soil	Expansive Clay
	Long-Term Impacts	Long-Term Impacts	Short-Term Impacts	Long-Term Impacts
Low	0	22	N/A	N/A
Moderate	2	1	N/A	N/A
High	22	0	601	0

Sources: Reclamation GIS 2017; NRCS GIS 2014
Note: Erosive soil and expansive clay acreages are based on presence of these soils; rating categories are not applicable to these soil types.

Mitigation and Residual Impacts

Recommended mitigation and residual impacts are the same as described under **Section 4.6.3.2**, Impacts Common to All Action Alternatives.

4.6.3.7 Summary of Impacts

As compared with Alternative A, Alternatives B, C, D, and E would impact sensitive soils. Alternative B would have the most impacts on sensitive soils, and Alternative E would have the fewest impacts.

Only Alternative B presents the potential for geologic hazards associated with proposed deep injection ASR wells. Alternatives A, C, D, and E do not include injection wells and therefore would not contribute to potential impacts from well-induced seismic events.

Despite differences in the plan components across the action alternatives, the magnitude of the associated total surface disturbance varies only by a maximum of 262 acres in the short term (Alternative B versus Alternative E) and 27 acres over the long term (Alternative B versus Alternative E; see **Table 2-4**). Alternative B has the greatest total disturbance over both the short term and long term. Total acres of disturbance by alternative are summarized in **Table 2-4**.

Impacts specific to sensitive soils are as follows:

- Erosive soils (short-term impacts)
  - Least impact—Alternative E (601 acres)
  - Greatest impact—Alternative B (863 acres)
- Corrosive to concrete (long-term impacts)
  - Least impact—Alternatives D and E (23 acres)
  - Greatest impact—Alternative B (50 acres)
- Corrosive to steel (long-term impacts)
  - Least impact—Alternative E (24 acres)
  - Greatest impact—Alternative B (50 acres)
- Expansive clay (long-term impacts)—No acres would be affected under the RWS alternatives

4.6.4 Rio Pojoaque Irrigation Improvement Project

4.6.4.1 Alternative RP-A—No Action

Under Alternative RP-A, the Rio Pojoaque irrigation improvement project would not be completed. The objectives of the project described in **Section 1.4** would not be realized.

Mitigation and Residual Impacts

There would be no mitigation or residual impacts associated with Alternative RP-A, No Action.

4.6.4.2 Impacts Common to All Action Alternatives

The action alternatives would involve the following:

- Ground disturbance in and next to the Rio Pojoaque
- Improvements designed to increase irrigation water availability to the Pueblo de San Ildefonso

Soils would be affected by the action alternatives of the Rio Pojoaque irrigation improvement project in the short term and long term when project-related activities disturb a surface area. The total acres of surface disturbance by alternative are summarized in **Table 2-32**.

Compared with Alternative RP-A, the action alternatives could directly impact sensitive soils. This is because project-related activities would disturb surface areas containing these soils during construction and by the physical presence of project facilities overlying these soils. Where project facilities overlie and come in contact with expansive clays or corrosive soils, there may be a potential for long-term impacts on the structural integrity of project facilities. For example, if a concrete-lined conveyance canal or steel-sheet pile dam were sited over soils that are corrosive to concrete or steel, then, without the proper mitigation techniques and construction practices, the facilities may gradually corrode. The failure of such a facility could have minor indirect impacts on soils, due to the resulting erosion.

During the short term, construction would expose erosive soils to wind and water. This would be a result of the intentional or incidental removal of vegetation during site clearing for project facilities. Without the vegetation, the erosive impacts of wind and water on soils would be worsened. Eroded soils would be transported from their present location, and their loss may inhibit remediation and post-construction revegetation of disturbed areas. Expansive clays would not be affected by the Rio Pojoaque irrigation improvement project action alternatives.

Other possible indirect impacts on soils under the action alternatives are potential erosion at other locations or inundation outside of the general project area during major storms. This would be due to concentrated runoff from infrastructure or introduced impermeable surfaces.

The nature and type of potential impacts from Rio Pojoaque irrigation improvement project activities on sensitive soils are not consistent across action alternatives; there would be no impacts under Alternatives RP-B and RP-D and varied magnitudes of similar impacts under Alternatives RP-C and RP-E. Impacts would include short- and long-term impacts on sensitive soils, with the potential to corrode concrete or steel or to be erosive.

Mitigation and Residual Impacts

Mitigation includes implementing BMPs related to siting, grading, excavating, compacting, and building and to stormwater pollution prevention planning. Also mitigation may include conducting detailed preconstruction soil analyses in areas that could house permanent Rio Pojoaque irrigation improvement project facilities. This would ensure that proper construction techniques are used in areas with soils that are

corrosive to concrete or steel. It would also ensure that permanent facilities would be sited on stable soils and that proper construction techniques would be implemented on expansive clays or other less stable substrates.

Remediation would restore areas disturbed during construction. It would include revegetating, stabilizing exposed soils, and contouring the land to minimize potential short- and long-term erosion. The results would be less long-term soil disturbance and less potential for indirect impacts, such as adjacent erosion during major storms.

4.6.4.3 Alternative RP-B

Soils would be affected under Alternative RP-B of the Rio Pojoaque irrigation improvement project in the short term and in the long term with the northern extension of the existing Pojoaque River Barrier Dam. This dam extension would disturb soils at the surface and subsurface. This is because the barrier would include steel-sheet piling driven 12 to 15 feet below the riverbed, flanked by riverbed excavations to accommodate gabions. Similar to Alternative RP-A, No Action, there would be no impacts on sensitive soils under Alternative RP-B.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.6.4.2**, Impacts Common to All Action Alternatives.

4.6.4.4 Alternative RP-C (Preferred Alternative)

Soils would be affected under Alternative RP-C of the Rio Pojoaque irrigation improvement project in the short term. In the long term, soils would be affected with the surface disturbance resulting from construction of an approximately 9,300-foot-long, system to convey water from an infiltration gallery or headgate to the existing Pueblo de San Ildefonso irrigation system.

Alternative RP-C of the Rio Pojoaque irrigation improvement project would impact approximately 5 acres of soils corrosive to steel and concrete in the long term and 11 acres of erosive soils in the short term (Reclamation GIS 2017). The location of the conveyance system on soils with the potential to corrode concrete would require proper mitigation techniques and construction practices to limit the corrosive effects. The failure of the system could have minor indirect impacts on soils.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.6.4.2**, Impacts Common to All Action Alternatives.

4.6.4.5 Alternative RP-D

Soils would likely be affected by Alternative RP-D of the Rio Pojoaque irrigation improvement project in the short term and in the long term with the surface disturbance resulting from improving infiltration to the Pueblo de San Ildefonso irrigation system. These improvements include installing a larger diameter perforated pipe than the existing pipe and additional gravel; the exact nature and extent of the disturbance would depend on the location and condition of the existing perforated pipe. Similar to Alternative RP-A, No Action, there would be no impacts on sensitive soils under Alternative RP-D.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.6.4.2**, Impacts Common to All Action Alternatives.

4.6.4.6 Alternative RP-E

Soils would be affected by Alternative RP-E of the Rio Pojoaque irrigation improvement project in the short term. In the long term, soils would be affected by the surface disturbance from installing roughly 2,543 feet of 18-inch-diameter perforated pipe and engineered gravel to improve infiltration to the Pueblo de San Ildefonso irrigation system.

Alternative RP-E of the Rio Pojoaque irrigation improvement project would impact sensitive soils—those corrosive to concrete, as well as erosive soils—including approximately 2 acres of soils corrosive to concrete in the long term and 38 acres of erosive soils in the short term (Reclamation GIS 2017). Installation of the perforated pipe in soils with the potential to corrode concrete or to erode would require proper mitigation techniques and construction practices. The failure of the pipe could have minor indirect impacts on soils.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.6.4.2**, Impacts Common to All Action Alternatives.

4.6.4.7 Summary of Impacts

Despite differences in the plan components across the action alternatives, the magnitude of the associated total surface disturbance in the short term varies by only 36 acres, from 2 acres under Alternative RP-B to the maximum of 38 acres under Alternative RP-E. The magnitude of long-term surface disturbance varies by 5 acres, from less than 1 acre under Alternative RP-B to the maximum of 5 acres under Alternative RP-C. Total acres of disturbance by alternative are summarized in **Table 2-32**, Rio Pojoaque Irrigation Improvement Project Surface Disturbance.

Only Alternatives RP-B, RP-C, and RP-E would impact sensitive soils. Alternative RP-B would have fewer impacts on erosive soils in the long term (less than 1 acre) than Alternative RP-C (4 acres) and Alternative RP-E (2 acres). Additionally, Alternative RP-B would have fewer impacts on erosive soils in the short term (less than 1 acre), as compared with Alternative RP-C (10 acres) and Alternative RP-E (36 acres).

4.6.5 Rio Tesuque Channel Modification Project

4.6.5.1 Alternative RT-A—No Action

Under Alternative RT-A, No Action, the Rio Tesuque channel modification project would not be completed. The objectives of the project described in **Section 1.4** would not be realized.

Mitigation and Residual Impacts

There would be no mitigation or residual impacts associated with Alternative RT-A, No Action.

4.6.5.2 Impacts Common to All Action Alternatives

The action alternatives would involve the following:

- Ground disturbance in and next to Rio Tesuque
- Improvements designed to protect and preserve critical wetlands and springs, restore the natural characteristics of the river, and improve infrastructure used to store water for agriculture, wildlife, and cultural resources, such as the Pueblo of Tesuque irrigation system

Soils would be affected by the action alternatives of the Rio Tesuque channel modification project in the short term and in the long term when project-related activities disturb a surface area. The total acres of disturbance by alternative are summarized in **Table 2-34**, Rio Tesuque Channel Modification Project Surface Disturbance.

Compared with Alternative RT-A, No Action, the action alternatives could directly impact sensitive soils. This is because project-related activities and construction would disturb surface areas containing these soils.

In the short term, construction would expose erosive soils to wind and water. This would be a result of the intentional or incidental removal of vegetation during site clearing for project facilities. Without the vegetation, the erosive impacts of wind and water on soils would be worsened. Eroded soils would be transported from their present location, and their loss may inhibit remediation and post-construction revegetation of disturbed areas.

Where project facilities overlie and come in contact with expansive clays or corrosive soils, there may be a potential for long-term impacts on the structural integrity of project facilities. For example, if grade control structures were sited over soils that are corrosive to concrete or steel, then, without the proper mitigation techniques and construction practices, the facilities may gradually corrode. The failure of such a facility could have minor indirect impacts on soils, due to the resulting erosion.

Other possible indirect impacts on soils under the action alternatives are potential erosion at other locations or inundation outside of the general project area during major storms.

The nature and type of potential impacts from Rio Tesuque channel modification project activities on sensitive soils is constant across the action alternatives; however, the alternatives would vary, in terms of the magnitude of the impact, as measured by the number of acres disturbed. Because the nature and type of impact on sensitive soils are constant, the discussion of each action alternative seeks to describe only the magnitude of the nature and types of impacts associated with each alternative.

Mitigation and Residual Impacts

Mitigation includes implementing BMPs related to siting, grading, excavating, compacting, and building and to stormwater pollution prevention planning. Also mitigation may include conducting detailed preconstruction soil analyses in areas where there are Rio Tesuque channel modification project improvements. This would ensure

proper construction techniques are used in areas with erosive or corrosive soils, such as expansive clays or other less stable substrates.

Remediation would restore areas disturbed during construction. It would include revegetating, stabilizing exposed soils, and contouring the land to minimize potential short- and long-term erosion. The results would be less long-term soil disturbance and less potential for indirect impacts, such as adjacent erosion during major storms.

4.6.5.3 Alternative RT-B

Soils would be affected by Alternative RT-B of the Rio Tesuque channel modification project in the short term and the long term with surface disturbance resulting from channel restoration and widening that would involve vegetation clearing, bank destabilization/excavation, raising the main channel bed elevation, and construction of grade control features and detention ponds. These improvements would include clearing approximately 2 acres of vegetation, excavating about 4,600 cubic yards of material from the channel margins, and using staging areas for construction.

Alternative RT-B would impact sensitive soils in the long term and short term, including those soils corrosive to steel and concrete as well as erosive soils (Reclamation GIS 2017). **Table 4-20**, below, summarizes the disturbance of sensitive soils under Alternative RT-B. These totals differ from the acreages provided in **Table 2-34,** because there is overlap among categories, and not all soils that would be disturbed by the proposed project are classified as sensitive.

Table 4-20. Impacts on Sensitive Soils under Alternative RT-B (Acres)

Rating	Corrosion of Steel	Corrosion of Concrete	Erosive Soil
	Long-Term Impact	Long-Term Impact	Short-Term Impact
Low	0	1	N/A
Moderate	1	0	N/A
High	1	0	4

Sources: Reclamation GIS 2017; NRCS GIS 2014
Note: Erosive soil acreages are based on the presence of these soils; rating categories are not applicable to this soil type.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.6.5.2**, Impacts Common to All Action Alternatives.

4.6.5.4 Alternative RT-C

Soils would be affected by Alternative RT-C of the Rio Tesuque channel modification project in the short term and the long term, with surface disturbance resulting from channel restoration. Certain elements of the channel restoration would be similar to those associated with Alternative RT-B, such as vegetation clearing, bank destabilization, and excavation, along with construction of grade control features and detention ponds. However, Alternative RT-C would involve excavating a new channel in the existing

floodplain (east of the incised channel), which would be similar to what the original, non-incised channel may have looked like.

Approximately 3 acres of vegetation would be cleared from the new channel site, along with roughly 5,300 cubic yards of sand and gravel excavated. Approximately 3,000 cubic yards of this excavated material would be compacted and placed in the existing incised channel, with the excess material being hauled to an off-site stockpile location for later maintenance use by the Pueblo of Tesuque.

Alternative RT-C would impact sensitive soils in the long term and short term, including those soils corrosive to steel and concrete as well as erosive soils (Reclamation GIS 2017). **Table 4-21**, below, summarizes the disturbance of sensitive soils under Alternative RT-C. These totals differ from the acreages provided in **Table 2-34** because there is overlap among categories, and not all soils that would be disturbed by the proposed project are classified as sensitive.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.6.5.2**, Impacts Common to All Action Alternatives.

Table 4-21. Impacts on Sensitive Soils under Alternative RT-C (Acres)

Rating	Corrosion of Steel	Corrosion of Concrete	Erosive Soil
	Long-Term Impact	Long-Term Impact	Short-Term Impact
Low	0	4	0
Moderate	0	0	0
High	4	0	10

Sources: Reclamation GIS 2017; NRCS GIS 2014
Note: Erosive soil acreages are based on the presence of these soils; rating categories are not applicable to this soil type.

4.6.5.5 Alternative RT-D (Preferred Alternative)

Soils would be affected by Alternative RT-D of the Rio Tesuque channel modification project in the short term and in the long term by removing a sediment spoil pile from the east side of the Rio Tesuque, just upstream of the TP-806 Bridge. Approximately 1,320 cubic yards of material would be excavated from the spoil pile and hauled to a nearby stockpiling site.

Alternative RT-D would impact approximately 3 acres of sensitive erosive soils in the short term. There would be no long-term impacts on corrosive soils under this alternative (Reclamation GIS 2017).

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.6.5.2**, Impacts Common to All Action Alternatives.

4.6.5.6 Alternative RT-E

Soils would be affected by Alternative RT-E of the Rio Tesuque channel modification project in the short term and in the long term by constructing an infiltration gallery upstream of the Upper Ponds Diversion Dam. The gallery would collect water from Rio Tesuque and transmit it to the Pueblo of Tesuque irrigation system. This would involve excavating approximately 2,700 cubic yards of material to install a main carrier pipe, three perforated collector pipes, and a gravel layer surrounding all pipes.

Alternative RT-E would impact sensitive soils in the long term and short term, including those soils corrosive to concrete, as well as erosive soils. Alternative RT-E would impact approximately 4 acres of erosive soils in the short term and 1 acre of soils corrosive to concrete in the long term. There would be no long-term impacts on soils corrosive to steel under this alternative. (Reclamation GIS 2017).

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.6.5.2**, Impacts Common to All Action Alternatives.

4.6.5.7 Summary of Impacts

Despite differences in the plan components across the action alternatives, the magnitude of the associated total surface disturbance in the short term varies by 9 acres, from 4 acres under Alternative RT-D to 13 acres under Alternative RT-C. The magnitude of long-term surface disturbance varies by 4 acres, from <1 acre under Alternative RT-D to 4 acres under Alternative RT-C. Total acres of disturbance by alternative are summarized in **Table 2-34**, Rio Tesuque Channel Modification Project Surface Disturbance.

As compared with Alternative RT-A, No Action, Alternatives RT-B, RT-C, RT-D, and RT-E would impact sensitive soils; however, Alternative RT-D would have no long-term impacts from corrosive soils. Alternative RT-C would have the greatest long-term and short-term impacts on all sensitive soils, including those corrosive to steel and concrete, as well as erosive soils; even so, these impacts are only slightly larger than those under the other action alternatives.

Impacts specific to sensitive soils are as follows:

- Corrosive to steel (long-term impacts)
  - Least impact—Alternatives RT-D and RT-E (no impact)
  - Greatest impact—Alternative RT-C (4 acres)
- Corrosive to concrete (long-term impacts)
  - Least impact— Alternative RT-D (no impact)
  - Greatest impact—Alternative RT-C (4 acres)
- Erosive soils (short-term impacts)
  - Least impact—Alternative RT-D (3 acres)
  - Greatest impact—Alternative RT-C (10 acres)

4.6.6 Pueblo de San Ildefonso Future Projects Alternatives

4.6.6.1 Alternative SI-A—No Action

Under Alternative SI-A, No Action, no future projects would be built on the Pueblo de San Ildefonso area. Therefore, this alternative would not disturb soils or change the geologic characteristics that influence geologic hazards.

Mitigation and Residual Impacts

There would be no mitigation or residual impacts associated with Alternative SI-A, No Action.

4.6.6.2 Alternative SI-B—Proposed Wastewater and Water Infrastructure

Constructing wastewater system improvements and other water-related infrastructure on the Pueblo de San Ildefonso would have the same type of impacts on sensitive soils as described under **Section 4.6.5.2**, Impacts Common to All Action Alternatives; however, direct and indirect impacts would be on a smaller scale than for the RWS project. The wastewater system improvements would disturb approximately 59 acres in the short term. The other water-related infrastructure projects could disturb the surface within the 680-acre area analyzed.

Table 4-22, Impacts on Sensitive Soils under Alternative SI-B, summarizes the disturbance of sensitive soils from the wastewater system improvements proposed under this alternative. Compared with Alternative SI-A, Alternative SI-B wastewater system improvements would result in additional impacts on sensitive soils. Soils that corrode steel and concrete and erosive soils would all be affected throughout most of the proposed disturbance area for the wastewater system improvements; acres affected would vary by soil type between 48 and 49 acres out of the 59 acres disturbed. The least-affected sensitive soil type would be expansive clay, with 4 acres affected in the long term.

Table 4-22. Impacts on Sensitive Soils under Alternative SI-B (Acres)

Rating	Corrosion of Steel	Corrosion of Concrete	Erosive Soil	Expansive Clay
	Long-Term Impacts	Long-Term Impacts	Short-Term Impacts	Long-Term Impacts
Low	0	0	N/A	N/A
Moderate	0	0	N/A	N/A
High	2	0	48	4

Sources: Reclamation GIS 2017; NRCS GIS 2014

Mitigation and Residual Impacts

Mitigation includes implementing BMPs related to siting, grading, excavating, compacting, and building and to stormwater pollution prevention planning. Also mitigation may include conducting detailed preconstruction soil analyses in areas that

could house permanent wastewater and water infrastructure. This would ensure proper construction techniques are used in areas with soils that are corrosive to concrete or steel. It would also ensure that permanent wastewater and water infrastructure would be sited on stable soils and that proper construction techniques are implemented on expansive clays or other less stable substrates.

Remediation would restore areas disturbed during construction. It would include revegetating, stabilizing exposed soils, and contouring the land to minimize potential short- and long-term erosion. The results would be less long-term soil disturbance and less potential for indirect impacts, such as adjacent erosion during major storms.

4.7 Paleontological Resources

This section addresses potential impacts on paleontological resources from actions under each alternative.

4.7.1 Impact Indicators

As described in **Table 3-1**, the indicator used to analyze impacts on paleontological resources is the acres disturbed in PFYC 1, 2, and 4.

4.7.2 Analysis Methods and Assumptions

The PFYC System is used to assess the relative paleontological resource sensitivity of geological units crossed by the RWS project (see **Section 3.7.1**, Paleontological Potential, for description of PFYC System). While fossils may occur in other geological units, the anticipated short- and long-term disturbance areas for each alternative were overlaid to determine if there are Class 1 units (very low potential), Class 2 units (low potential), and Class 4 units (high potential) in the disturbance areas.

Direct impacts on paleontological resources could result from project actions that would disturb or reveal bedrock, weathered bedrock, or unconsolidated alluvial deposits that contain significant fossils. Construction and controlled excavation could reveal previously undiscovered resources and could allow research and possibly interpretive uses. The assumption is that direct impacts on paleontological resources can be determined only through additional site-specific assessments of the final, proposed disturbance areas for fossil exposures and the extent and depth of the proposed disturbance.

Indirect impacts could include erosion of fossil locations, due to slope regrading and vegetation clearing, or the unauthorized collection of scientifically important fossils, due to increased access to fossil localities.

4.7.3 RWS Alternatives

4.7.3.1 Alternative A—No Action

Under the Alternative A, there would be no new facilities for the RWS that would require short- or long-term ground disturbance; therefore, there would be no direct or indirect impacts on paleontological resources.

Mitigation and Residual Impacts

No mitigation or residual impacts are anticipated under Alternative A.

4.7.3.2 Impacts Common to All Action Alternatives

Under all action alternatives, the proposed RWS would require short- and long-term ground surface disturbance for facility construction and operations. Short-term ground disturbance generally would be for equipment staging and temporary facilities. Short-term ground disturbance acres are inclusive of the long-term disturbed ground surface acreage.

As shown in **Table 4-23**, below, there are no Class 5, Very High Potential, geological units in the proposed disturbance areas under any of the alternatives. Disturbance acreage in Class 4, High Potential, geological units is similar across the action alternatives. Most of the anticipated disturbed acres are in Class 2, Low Potential, geological units and are similar across the alternatives (BLM GIS 2014; Reclamation GIS 2017).

Table 4-23. PFYC Class by RWS Disturbance Areas

Alternative	Long-Term Disturbance	Short-Term Disturbance
Alternative A	0	0
Alternative B	PFYC Class 2 – 9 acres PFYC Class 4 – 41 acres	PFYC Class 2 – 736 acres PFYC Class 4 – 467 acres
Alternative C	PFYC Class 2 – 9 acres PFYC Class 4 – 16 acres	PFYC Class 2 – 726 acres PFYC Class 4 – 415 acres
Alternative D	PFYC Class 2 – 12 acres PFYC Class 4 – 14 acres	PFYC Class 2 – 751 acres PFYC Class 4 – 395 acres
Alternative E	PFYC Class 2 – 8 acres PFYC Class 4 – 16 acres	PFYC Class 2 – 577 acres PFYC Class 4 – 276 acres
Pueblo de San Ildefonso Future Projects Alternatives (Wastewater improvements only)	PFYC Class 2 – 2 acres PFYC Class 4 – 0 acres	PFYC Class 2 – 51 acres PFYC Class 4 – 8 acres

Sources: BLM GIS 2014; Reclamation GIS 2017

Direct and indirect impacts cannot be predicted from the intersection of PFYC class and proposed disturbance. Further assessment and screening would be needed to determine whether there are outcrop exposures or localities that could be affected and to determine the probability for affecting significant paleontological resources at the anticipated extent and depths of construction disturbance.

Mitigation and Residual Impacts

If significant fossils are anticipated in the general project area, ground surveys may need to be conducted before the surface-disturbing action is authorized. Further, on-site monitoring or spot-checking may be necessary at certain locations during construction. If vertebrate fossils or unique or site-specific invertebrate or plant fossils were found and could not be avoided, work would stop to allow for adequate evaluation, preservation,

and data recovery. The recovery and preservation of fossils as the result of paleontological mitigation would permanently preserve the scientific information that may have otherwise never have been discovered and would make the fossils available for further research and education.

Mitigation considerations include assessing the disturbance, the potential for recovering the fossils and for future accelerated erosion, or increased ease of access, which could result in greater looting or unauthorized collecting (BLM 2007). There would be no residual impacts on paleontological resources by implementing the mitigation measures.

4.7.3.3 Alternative B—HKM Implementable

The potential for direct and indirect impacts is similar to that described under **Section 4.7.3.2**, Impacts Common to All Action Alternatives. Under Alternative B, 467 acres in short-term disturbance areas and 41 acres in long-term disturbance areas are in PFYC Class 4, High Potential, geological units for significant paleontological resources. Further assessment and screening would be needed to determine impacts on paleontological resources.

Mitigation and Residual Impacts

Recommended mitigation and residual impacts would be the same as those described under **Section 4.7.3.2**, Impacts Common to All Action Alternatives.

4.7.3.4 Alternative C

The potential for direct and indirect impacts is similar to those described under **Section 4.7.3.2**, Impacts Common to All Action Alternatives. Under Alternative C, 415 acres in short-term disturbance areas and 16 acres in long-term disturbance areas are in PFYC Class 4, High Potential, geological units for significant paleontological resources. Further assessment and screening would be needed to determine impacts on paleontological resources.

Mitigation and Residual Impacts

Recommended mitigation and residual impacts would be the same as those described under **Section 4.7.3.2**, Impacts Common to All Action Alternatives.

4.7.3.5 Alternative D

The potential for direct and indirect impacts would be similar to those described under **Section 4.7.3.2**, Impacts Common to All Action Alternatives. Under Alternative D, 395 acres in short-term disturbance areas and 14 acres in long-term disturbance areas are in PFYC Class 4, High Potential, geological units for significant paleontological resources. Further assessment and screening would be needed to determine impacts on paleontological resources.

Mitigation and Residual Impacts

Recommended mitigation and residual impacts would be the same as those described under **Section 4.7.3.2**, Impacts Common to All Action Alternatives.

4.7.3.6 Alternative E (Preferred Alternative)

The potential for direct and indirect impacts is similar to those described under **Section 4.7.3.2**, Impacts Common to All Action Alternatives. Under Alternative E, 276 acres in short-term disturbance areas and 16 acres in long-term disturbance areas are in PFYC Class 4, High Potential, geological units for significant paleontological resources. Further assessment and screening would be needed to determine impacts on paleontological resources.

Mitigation and Residual Impacts

Recommended mitigation and residual impacts would be the same as those described under **Section 4.7.3.2**, Impacts Common to All Action Alternatives.

4.7.3.7 Summary of Impacts

- Alternative A, No Action, would not include any RWS facility construction, so there would be no potential for impacts on paleontological resources.
- Each of the action alternatives would require ground disturbance within High Potential geological units for the presence of significant paleontological resources. Disturbance acreage within these units is similar, with the most found under Alternative B and the least under Alternative E.
- Further assessment and screening would be needed to determine impacts on paleontological resources.

4.7.4 Rio Pojoaque Irrigation Improvement Project

4.7.4.1 Alternative RP-A—No Action

Under Alternative RP-A, No Action, the Rio Pojoaque irrigation improvement project would not be completed. Moreover, the objectives of the project described in **Section 1.4** would not be realized. There would be no new facilities constructed that would require short- or long-term ground disturbance; therefore, there would be no direct or indirect impacts on paleontological resources.

Mitigation and Residual Impacts

No mitigation or residual impacts are anticipated under Alternative RP-A, No Action.

4.7.4.2 Impacts Common to All Action Alternatives

Under all action alternatives, the proposed construction would require minor short- and long-term ground disturbance for facility construction and operations. Short-term ground disturbance generally would be for equipment staging and temporary facilities.

There are no Class 5, Very High Potential, geological units in the proposed disturbance areas under any of the alternatives. Long-term disturbance acreage mapped in Class 4, High Potential, geological units is less than 1 acre across the action alternatives and no greater than 4 acres in short-term disturbance areas. Long-term disturbed acres in Class 2, Low Potential, geological units range from 0 to 5 acres; short-term disturbance in Class 2 geological units range from 0 to 4 acres (BLM GIS 2014; Reclamation GIS 2017).

Direct and indirect impacts cannot be predicted from the intersection of PFYC class and proposed disturbance. However, based on the anticipated minimal long-term disturbance of Class 4 geological units, impacts are not anticipated.

Mitigation and Residual Impacts

If, after further assessment, significant fossils are anticipated in the general project area, ground surveys may need to be conducted before the surface-disturbing action is authorized. Further, on-site monitoring or spot-checking may be necessary at certain locations during construction. If vertebrate fossils or unique or site-specific invertebrate or plant fossils are found and could not be avoided, work would stop to allow for adequate evaluation, preservation, and data recovery. The recovery and preservation of fossils as the result of paleontological mitigation would permanently preserve the scientific information that may have otherwise never have been discovered and would make the fossils available for further research and education.

Mitigation considerations include assessing the disturbance, the potential for recovering the fossils and for future accelerated erosion, or increased ease of access that could result in greater looting or unauthorized collecting (BLM 2007). There would be no residual impacts on paleontological resources by implementing the mitigation measures.

4.7.4.3 Alternative RP-B

Direct and indirect impacts for the Rio Pojoaque irrigation improvement project would be the same as those described under **Section 4.7.4.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementing any of the action alternatives. No mitigation has been identified.

4.7.4.4 Alternative RP-C (Preferred Alternative)

Direct and indirect impacts for the Rio Pojoaque irrigation improvement project would be the same as those described under **Section 4.7.4.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementing any of the action alternatives. No mitigation has been identified.

4.7.4.5 Alternative RP-D

Direct and indirect impacts for the Rio Pojoaque irrigation improvement project are expected to be the same as those described under **Section 4.7.4.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementing any of the action alternatives. No mitigation has been identified.

4.7.4.6 Alternative RP-E

Direct and indirect impacts for the Rio Pojoaque irrigation improvement project would be the same as those described under **Section 4.7.4.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementing any of the action alternatives. No mitigation has been identified.

4.7.4.7 Summary of Impacts

- Alternative RP-A, No Action, would not include any facility construction, so there would be no potential for impacts on paleontological resources.
- Each of the action alternatives would require minor ground disturbance (5 or fewer acres in the long term and 38 or fewer acres in the short term).
- There is no long-term disturbance anticipated in High Potential geological units for the presence of significant paleontological resources.
- Further assessment and screening would be needed to determine impacts on paleontological resources; however, based on the proposed minimal long-term disturbance of Class 4 geological units, impacts are not anticipated.

4.7.5 Rio Tesuque Channel Modification Project

4.7.5.1 Alternative RT-A—No Action

Under Alternative RT-A, No Action, the Rio Tesuque channel modification project would not be completed; furthermore, the objectives of the project described in **Section 1.4** would not be realized. There would be no new facilities constructed that would require short- or long-term ground disturbance; therefore, there would be no direct or indirect impacts on paleontological resources.

Mitigation and Residual Impacts

No mitigation or residual impacts are anticipated under Alternative RT-A, No Action.

4.7.5.2 Impacts Common to All Action Alternatives

Under all action alternatives, the proposed construction would require minor short- and long-term ground disturbance for facility construction and operations. Short-term ground disturbance generally would be for equipment staging and temporary facilities.

There are no Class 5, Very High Potential, geological units in the proposed disturbance areas under any of the alternatives. Long-term disturbance acreage mapped in Class 4, High Potential, geological units is less than 1 acre across the action alternatives and no greater than 5 acres in short-term disturbance areas. Long-term disturbed acres in Class 2, Low Potential, geological units range from 0 to 4 acres and short-term disturbance in Class 2 geological units ranges from 0 to 12 acres (BLM GIS 2014; Reclamation GIS 2017).

Direct and indirect impacts cannot be predicted from the intersection of PFYC class and proposed disturbance. However, based on the proposed minimal long-term disturbance of Class 4 geological units, impacts are not anticipated.

Mitigation and Residual Impacts

If, after further assessment, significant fossils are anticipated in the general project area, ground surveys may need to be conducted before the surface-disturbing action is authorized. Further, on-site monitoring or spot-checking may be necessary at certain locations during construction. If vertebrate fossils or unique or site-specific invertebrate or plant fossils are found and could not be avoided, work would stop to allow for adequate evaluation, preservation, and data recovery. The recovery and preservation of fossils as the result of paleontological mitigation would permanently preserve the scientific information that otherwise may have never been discovered and to make the fossils available for further research and education.

Mitigation considerations include assessing the disturbance, the potential for recovery of the fossils and for future accelerated erosion, or increasing the ease of access that could result in greater looting or unauthorized collecting (BLM 2007). There would be no residual impacts on paleontological resources by implementing the mitigation measures.

4.7.5.3 Alternative RT-B

Direct and indirect impacts for the Rio Tesuque channel modification project would be the same as those described under **Section 4.7.5.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementing any of the action alternatives. No mitigation has been identified.

4.7.5.4 Alternative RT-C

Direct and indirect impacts for the Rio Tesuque channel modification project would be the same as those described under **Section 4.7.5.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementing any of the action alternatives. No mitigation has been identified.

4.7.5.5 Alternative RT-D (Preferred Alternative)

Direct and indirect impacts for the Rio Tesuque channel modification project would be the same as those described under **Section 4.7.5.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementing any of the action alternatives. No mitigation has been identified.

4.7.5.6 Alternative RT-E

Direct and indirect impacts for the Rio Tesuque channel modification project would be the same as those described under **Section 4.7.5.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementing any of the action alternatives. No mitigation has been identified.

4.7.5.7 Summary of Impacts

- Alternative RT-A, No Action, would not include any facility construction, so there would be no potential for impacts on paleontological resources.
- Each of the action alternatives would require minor ground disturbance (4 or fewer acres in the long term and fewer than 13 acres in the short term).
- Long-term disturbance anticipated in High Potential geological units for the presence of significant paleontological resources is 1 acre or less.
- Further assessment and screening would be needed to determine impacts on paleontological resources; however, based on the proposed minimal long-term disturbance of Class 4 geological units, impacts are not anticipated.

4.7.6 Pueblo de San Ildefonso Future Projects Alternatives

4.7.6.1 Alternative SI-A—No Action

Under Alternative SI-A, No Action, the Pueblo de San Ildefonso future projects would not be constructed, so there would be no direct or indirect impacts on paleontological resources.

Mitigation and Residual Impacts

No mitigation or residual impacts are anticipated under Alternative SI-A, No Action.

4.7.6.2 Alternative SI-B—Proposed Wastewater and Water Infrastructure

The proposed Pueblo de San Ildefonso preliminary wastewater system design has the potential to affect paleontological resources. Direct and indirect impacts on paleontological resources would be the same types as those described above for the RWS project; however, direct and indirect impacts would be on a smaller scale than for the RWS project. This is because the project's direct short-term impacts would occur on 59 acres only.

There are no Class 5, Very High Potential, geological units in the proposed disturbance area for the wastewater improvements. Short-term disturbance acreage mapped in Class 4, High Potential, geological units is 8 acres. Short-term disturbed acres in Class 2, Low Potential, geological units is 51 acres (BLM GIS 2014; Reclamation GIS 2017). Further assessment and screening would be needed to determine impacts on paleontological resources.

The tentative project footprint for other water-related infrastructure is 130 acres in PFYC Class 4, High Potential, geological units for significant paleontological resources. Further assessment and screening would be needed to determine impacts on paleontological resources based on refinement of the actual disturbance areas and the potential presence of high-potential units in those areas.

Mitigation and Residual Impacts

If significant fossils are anticipated in the project area, ground surveys may need to be conducted before the surface-disturbing action is authorized. Further, on-site monitoring or spot-checking may be necessary at certain locations during construction. If vertebrate fossils or unique or site-specific invertebrate or plant fossils were found and could not be avoided, work would stop to allow for adequate evaluation, preservation, and data recovery. The recovery and preservation of fossils as the result of paleontological mitigation would permanently preserve the scientific information that may otherwise never have been discovered and would make the fossils available for further research and education.

Mitigation considerations include assessing the disturbance, the potential for recovery of the fossils and for future accelerated erosion, or increasing the ease of access that could result in greater looting or unauthorized collecting (BLM 2007). There would be no residual impacts on paleontological resources by implementing the mitigation measures.

4.8 Air Quality

This section addresses potential impacts on air quality from actions associated with each alternative.

4.8.1 Impact Indicators

As described in **Table 3-1**, the acres of surface disturbance and the fuel use or hours of operation of on-road and off-road vehicles and equipment are used to analyze impacts on air quality.

4.8.2 Analysis Methods and Assumptions

Potential effects on air quality were evaluated by examining the types of air pollutant emissions that would be associated with construction and operation of the RWS and other proposed actions. The analysis includes a qualitative discussion of fugitive dust emissions from surface disturbance and a quantitative estimate of on-road and non-road equipment emissions. There are no federally designated nonattainment areas in the general project area; therefore, CAA conformity guidelines do not apply.

The following assumptions were used in this analysis:

- Short term is defined as intermittent actions that occur for less than a year in one location, and long term is defined as those actions that occur intermittently or continuously for more than a year in one location.
- The project construction activities are expected to occur from 2018 through 2024; model year 2021 combustion-related emission factors were used to estimate on-road and non-road equipment emissions.

- There would be additional vehicles on local roads during construction and operation of the RWS and other proposed actions. This would result in a short-term temporary increase and a minimal long-term increase in traffic on U.S. Highway 84/285 and SHs 502 and 503. During construction there would be lane closures that result in traffic delays and vehicle idling with accompanying short-term temporary increases in carbon monoxide, nitrogen dioxide, volatile organic compounds, sulfur dioxide, and small quantities of PM_{10}, $PM_{2.5}$, and hazardous air pollutants.
- The EPA has implemented vehicle emission standards for lighter and heavy vehicles; therefore, newer vehicles and equipment would release fewer pollutants per gallon of fuel combusted. As the vehicle fleet year modernizes, the future air pollutant emissions from highway vehicles are predicted to be much lower than the current emission rates (EPA 2016d).

4.8.3 RWS Alternatives

4.8.3.1 Alternative A—No Action

Under Alternative A, No Action, air pollutant emissions related to using groundwater as the primary source of drinking water would continue. These emission sources include non-electrical pumps and well drilling equipment for developing new wells or modifying existing wells.

Mitigation and Residual Impacts

Alternative A would not require any mitigation to air quality impacts and would have no residual impacts.

4.8.3.2 Impacts Common to All Action Alternatives

Construction

Constructing the components of the RWS under all of the action alternatives would have a direct impact on air quality by generating fugitive dust (PM_{10} and $PM_{2.5}$) from surface-disturbing activities and emitting criteria pollutants through the combustion of fuel in commute vehicles, trucks, and construction equipment; however, the increase in air pollutants, compared with present levels, would be negligible.

Sources of temporary and localized fugitive dust emissions would include the following:

- Direct impacts from soil excavation and site grading for the water treatment plant, short-term storage tanks, water transmission and distribution system, pipelines, electrical power lines, and access roads
- Direct impacts from travel on unpaved roads and surfaces by construction equipment, commute vehicles, delivery trucks, water trucks, and tractor trailers
- Indirect impacts from wind erosion of disturbed surfaces
- Indirect impacts from entrained dust caused by travel on paved roads by commute vehicles, delivery trucks, and tractor trailers

The emissions of fugitive dust would be greatest during site excavation and grading activities, and emissions would vary over the course of construction based on the level of activity during the construction phase. The amount of fugitive dust emissions would depend on the type of activity, type of equipment, age of equipment, number of hours operated, area disturbed, vehicle speed, and wind speed. Emissions would be localized to the area surrounding any given construction activity and would cease when construction ends and temporary disturbance areas are revegetated. As described in **Chapter 2**, standard construction and dust abatement BMPs would be implemented to minimize impacts.

In addition to fugitive dust, operation of construction equipment would produce combustion-related emissions, including carbon monoxide, nitrogen dioxide, volatile organic compounds, sulfur dioxide, and small quantities of PM_{10}, $PM_{2.5}$, and hazardous air pollutants (diesel particulate matter, acetaldehyde, benzene, and formaldehyde). Exhaust from construction equipment, tractor-trailers bringing in and moving equipment and materials, and construction workers' personal vehicles would generate temporary criteria air pollutant emissions. Sources of emissions would include the following:

- Gas- and diesel-powered construction equipment and power tools
- Generators
- Tractor trailers to bring in and move out materials and supplies
- Water trucks for dust suppression
- On-site light-duty trucks and commute vehicles for construction personnel

Operations

Air pollutant emissions associated with operating the RWS would be less than emissions from construction but would occur over the lifetime of the RWS.

The action alternatives would develop small sections of access roads to the water treatment site and locations with water tanks. There would be an increased number of vehicle trips upon project completion to inspect, maintain, and service the RWS water purification system and the associated water tanks. This would result in an incremental increase in vehicle traffic in the local area and would result in an increase in unpaved road dust. Indirect impacts would occur from wind erosion on areas that were not revegetated or stabilized with gravel or dust suppressants.

Operations-related combustion emission sources would include worker commute traffic, maintenance vehicles and equipment, and truck traffic for material deliveries and transporting solids to the municipal landfill from the water treatment plant. The number of vehicle trips resulting from operation of the RWS would be low and would not affect ambient air quality conditions over the long term. Electricity produced to operate RWS component equipment would be an indirect source of GHG emissions that would be partially offset over time as existing domestic and municipal well pump equipment is brought off line.

Backup generators to provide power in the case of an electrical outage would emit criteria air pollutants and small amounts of hazardous air pollutants during monthly testing and operation during outages. Backup generator specifications would be determined during

detailed design and engineering, and air permits would be obtained from NMED for each backup generator. The NMED air permits would indicate the allowable hours of operation and associated criteria pollutant emission limits for these sources.

Mitigation and Residual Impacts

As described in **Chapter 2**, standard construction and dust abatement BMPs would be implemented to minimize air quality impacts from construction. Construction contractors will submit a construction emissions mitigation plan to Reclamation, which will then submit it to the County and Settlement Pueblos for concurrence. The plan will reduce impacts associated with emissions of particulate matter and other pollutants from construction and may include the following measures:

- Fugitive dust source controls
    - Stabilize heavily used unpaved construction roads stabilized with water or a nontoxic soil stabilizer or soil weighting agent that would not result in loss of vegetation or increase other environmental impacts
    - During grading, use water, as necessary, on disturbed areas in construction sites to control visible plumes
    - Vehicle speed
        - Limit speeds to 25 miles per hour or less on stabilized unpaved roads, as long as such speeds do not create visible dust emissions
        - Limit speeds to 10 miles per hour or less on unpaved areas within construction sites on unstabilized (and unpaved) roads
        - Post visible speed limit signs at construction site entrances
    - Use sandbags or equivalent effective measures to prevent runoff to roadways in construction areas next to paved roadways; ensure consistency with the project's stormwater pollution prevention plan, if such a plan is required for the project
    - Stabilize disturbed soils (after active construction activities are completed) with a nontoxic soil stabilizer, soil weighting agent, or other approved soil stabilizing method
    - Cover or treat soil storage piles and disturbed areas that remain inactive for longer than 10 days with appropriate dust suppressant compounds; cover vehicles used to transport solid bulk material on public roadways and that could cause visible emissions
    - Use wind erosion control techniques, such as windbreaks, water, silt fences, chemical dust suppressants, or vegetation, where soils are disturbed in construction, access, and maintenance routes and on material stockpile areas; keep any related windbreaks in place until the soil is stabilized or permanently covered with vegetation
- Mobile and stationary source controls

  - Plan construction scheduling to minimize vehicle trips
  - Limit idling of heavy equipment to less than 5 minutes and verify through unscheduled inspections
- Administrative controls
  - Develop a construction traffic and parking management plan that maintains traffic flow, and plan construction to minimize vehicle trips
  - Identify any sensitive receptors in the project area, such as children, the elderly, and the infirm, and specify the means to minimize these impacts, such as locating construction equipment and staging zones away from sensitive receptors and building air intakes
  - Include provisions for monitoring fugitive dust in the fugitive dust control plan, and initiate increased mitigation measures to abate any visible dust plumes

Implementing appropriate fugitive dust control measures would minimize impacts on local air quality, particularly nuisance conditions on adjacent or nearby uses that would be sensitive to excessive dust, such as residences, agricultural areas (if present), or roadways. Residual impacts would be low.

Traffic congestion-related air pollutants would be mitigated by implementing proper traffic flow measurements during construction and limiting heavy equipment idling, where feasible. Combustion-related emissions would still occur, but localized impacts related to vehicle idling would be reduced.

4.8.3.3 Alternative B—HKM Implementable

Construction

The type and nature of construction-related impacts on air quality under Alternative B would be the same as described under **Section 4.8.3.2**, Impacts Common to All Action Alternatives. In addition to fugitive dust and combustion-related emissions from commute vehicles, trucks, and construction equipment, well drilling equipment for developing a backup water source would emit criteria pollutant emissions under this alternative.

Under Alternative B, approximately 1,203 acres would be disturbed temporarily and approximately 51 acres would be disturbed permanently. Earth-moving activities described under **Section 4.8.3.2** would create localized and temporary fugitive dust emissions. As described in **Chapter 2**, standard construction and dust abatement BMPs would be implemented to minimize impacts.

An estimate of mobile source-related direct criteria pollutant emissions by RWS work activity was prepared based on preliminary estimates of fuel use for on-road equipment and operational hours for non-road (construction) equipment that would be required to construct the various components of the RWS. These emissions are shown in **Table 4-24**, below. Emissions from worker commute vehicles or heavy truck traffic for materials deliveries were not included in this estimate but would be a temporary source of additional criteria pollutant emissions.

Table 4-24. Estimated Equipment-Related Criteria Pollutant Emissions by Proposed Work Component (Tons)

Proposed Work	VOC	CO	NOx	SOx	PM_{10}	$PM_{2.5}$
Riverside intake	0.604	3.687	4.734	0.016	0.170	0.162
Pumping plants	0.344	2.294	2.220	0.007	0.103	0.092
SCADA-control, monitoring	0.040	0.263	0.266	0.001	0.012	0.010
Distribution tanks	0.142	0.849	0.922	0.003	0.039	0.036
Transmission lines	0.801	6.201	5.069	0.016	0.239	0.230
ASR wells	0.659	4.516	4.529	0.013	0.200	0.187
Water treatment plant	0.567	3.131	3.616	0.010	0.162	0.150
Total (tons)	**3.158**	**20.941**	**21.356**	**0.066**	**0.925**	**0.867**

Source: Assumptions and source data are described in Appendix H, Air Technical Report
Notes: VOC – volatile organic compounds; CO – carbon monoxide; NOx – nitrogen oxides; SOx – sulfur oxides; PM_{10} – particulate matter less than 10 microns in diameter; $PM_{2.5}$ – particulate matter less than 2.5 microns in diameter

The emissions described in **Table 4-24** represent an estimate of total mobile source-related emissions (not tons per year) based on current estimates of equipment requirements for the construction of the RWS. The actual emissions may differ from those shown as more detailed construction plans are developed and finalized.

Operations

Long-term operational emissions would be the same as described under **Section 4.8.3.2**.

Mitigation and Residual Impacts

Mitigation and residual impacts would be the same as described under **Section 4.8.3.2**.

4.8.3.4 Alternative C

Construction

The type and nature of construction-related fugitive dust and combustion emissions under Alternative C would be the same as described under **Section 4.8.3.2**. Based on **Table 2-3**, Summary Comparison of RWS Action Alternatives, and **Table 2-4**, RWS Surface Disturbance Comparison, construction under Alternative C would likely result in fewer emissions of fugitive dust and combustion-related emissions than shown in **Table 4-24** under Alternative B. This is because there would be a lower level of surface disturbance (1,140 acres under Alternative C versus 1,203 acres under Alternative B) and because no well drilling would be performed to support the backup water supply.

Operations

Long-term operational emissions would be the same as described under **Section 4.8.3.2**.

Mitigation and Residual Impacts

Mitigation and residual impacts would be the same as described under **Section 4.8.3.2**.

4.8.3.5 Alternative D

Construction

The type and nature of construction-related fugitive dust and combustion emissions under Alternative D would be the same as described under **Section 4.8.3.2**. Based on **Table 2-3** and **Table 2-4,** construction under Alternative D would likely result in fewer emissions of fugitive dust and combustion-related emissions than shown in **Table 4-24** under Alternative B. This is because there would be a lower level of surface disturbance (1,146 acres under Alternative D versus 1,203 acres under Alternative B) and because no well drilling would be performed to support the backup water supply.

Operations

Long-term operational emissions would be the same as described under **Section 4.8.3.2**.

Mitigation and Residual Impacts

Mitigation and residual impacts would be the same as described under **Section 4.8.3.2**.

4.8.3.6 Alternative E (Preferred Alternative)

Construction

The type and nature of construction-related fugitive dust and combustion emissions under Alternative E would be the same as described under **Section 4.8.3.2**. Based on **Table 2-3** and **Table 2-4,** construction under Alternative E would likely result in fewer emissions of fugitive dust and combustion-related emissions than shown in **Table 4-24** under Alternative B. This is because there would be a lower level of surface disturbance (856 acres under Alternative E versus 1,203 acres under Alternative B) and because no well drilling would be performed to support the backup water supply.

Operations

Long-term operational emissions would be the same as described under **Section 4.8.3.2**.

Mitigation and Residual Impacts

Mitigation and residual impacts would be the same as described under **Section 4.8.3.2**.

4.8.3.7 Summary of Impacts

Short-term direct impacts of the RWS on air quality would occur through the emission of fugitive dust (PM_{10} and $PM_{2.5}$) from surface-disturbing activities and nitrogen dioxide, sulfur dioxide, carbon monoxide, volatile organic compounds, particulates, and small quantities of hazardous air pollutants (diesel particulate matter, acetaldehyde, benzene, and formaldehyde) from fuel-burning vehicle and equipment use. The greatest level of fugitive dust and criteria pollutant emissions would occur during construction, with

emissions under Alternative B likely to be slightly higher than under the other action alternatives. This is because of the greater area of surface disturbance and the development of wells for backup water under this alternative compared with the other action alternatives. Operational fugitive dust and criteria pollutant emissions would be low, as the RWS components would not emit pollutants except for the backup generators. Impacts are detailed below:

- The action alternatives would have similar short- and long-term air quality impacts. The differences in construction locations, area of disturbed land, drilling wells, constructing access roads, constructing an electrical power line, and the number of new water tanks proposed among the four alternatives are not anticipated to result in significant differences in short- and long-term air quality impacts.
- The action alternatives would result in direct short-term, intermittent, and temporary increases in fugitive dust emissions during soil disturbance, site excavation, and grading. The dust emissions would be localized to the disturbed, excavation, and grading areas. The short-term dust emissions would cease upon project completion.
- The RWS project activities would result in direct short-term and temporary impacts on air quality due to increases in air pollutants from fuel combustion during the operation of heavy equipment, other vehicles, and on-road traffic. The principal pollutants would include carbon monoxide, nitrogen dioxide, volatile organic compounds, and sulfur dioxide, with small quantities of PM_{10}, $PM_{2.5}$, and hazardous air pollutants.
- There would be a small increase in local vehicle traffic upon project completion to inspect, maintain, and service the RWS water treatment system and the associated water tanks. This would result in a small increase in combustion-related air pollution. There would be minimal long-term indirect impacts on local and regional ambient air quality.

4.8.4 Rio Pojoaque Irrigation Improvement Project

4.8.4.1 Alternative RP-A—No Action

Under Alternative RP-A, No Action, the Rio Pojoaque irrigation improvement project would not be undertaken. Thus, there would be no direct or indirect impacts on air quality from this activity. Emissions associated with operating the Rio Pojoaque Barrier Dam would continue.

Mitigation and Residual Impacts

There would be no mitigation or residual impacts associated with Alternative RP-A, No Action.

4.8.4.2 Impacts Common to All Action Alternatives

The Rio Pojoaque irrigation improvement project would have direct, localized, intermittent, and short-term air quality impacts during construction in areas where proposed irrigation improvements would occur. Construction would have a direct impact

on air quality by generating fugitive dust from surface-disturbing activities and emitting criteria pollutants through the combustion of fuel in commute vehicles, trucks, construction equipment, and generators. These emissions would be the same as those described for the RWS under **Section 4.8.3.2**, Impacts Common to All Action Alternatives, but on a smaller scale.

Operation of the improvements would have little to no direct or indirect impacts on air quality, because the improvements would not introduce new emission sources.

Mitigation and Residual Impacts

Dust control mitigations would be specified during the construction design phase and would be conducted according to County, Pueblo, and state ordinances for construction dust control. Implementing appropriate dust control measures would minimize impacts on local air quality, particularly nuisance conditions on adjacent or nearby uses that would be sensitive to excessive dust. Residual impacts would be low.

4.8.4.3 Alternative RP-B

The type and nature of construction-related impacts on air quality under Alternative RP-B would be the same as those described under **Section 4.8.4.2**, Impacts Common to All Action Alternatives.

Under Alternative RP-B, approximately <1 acre would be disturbed temporarily, and <1 acre would be disturbed permanently. Surface disturbance, and thus dust-related impacts, would be low. Emissions from construction equipment, worker vehicles, and truck traffic would be a short-term and temporary source of construction-related emissions.

Operation of the improvements would have little to no direct or indirect impacts on air quality, because the improvements would not introduce new emission sources.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.8.4.2**.

4.8.4.4 Alternative RP-C (Preferred Alternative)

The type and nature of construction-related impacts on air quality under Alternative RP-C would be the same as those described under **Section 4.8.4.2**. Under Alternative RP-C, approximately 11 acres would be disturbed temporarily and 5 acres would be disturbed permanently. Earth-moving activities associated with extending the conveyance system would create localized and temporary fugitive dust emissions during construction. Emissions from construction equipment, worker vehicles, and truck traffic also would be a short-term and temporary source of construction-related emissions.

Operation of the improvements would have little to no direct or indirect impacts on air quality, because the improvements would not introduce new emission sources.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.8.4.2**.

4.8.4.5 Alternative RP-D

The type and nature of construction-related impacts on air quality under Alternative RP-D would be the same as those described under **Section 4.8.4.2**. Alternative RP-D would replace a 15-inch-diameter pipe with a larger perforated pipe, resulting in very little surface disturbance or equipment use. Therefore, direct impacts on air quality would be low under this alternative.

Operation of the improvements would have little to no direct or indirect impacts on air quality, because the improvements would not introduce new emission sources.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.8.4.2**.

4.8.4.6 Alternative RP-E

The type and nature of construction-related impacts on air quality under Alternative RP-E would be the same as those described under **Section 4.8.4.2**. Under Alternative RP-E, approximately 38 acres would be disturbed temporarily and 2 acres would be disturbed permanently. Earth-moving activities associated with extending the conveyance pipes and the infiltration gallery would create localized and temporary fugitive dust emissions during construction. Emissions from construction equipment, worker vehicles, and truck traffic also would be a short-term and temporary source of construction-related emissions.

Operation of the improvements would have little to no direct or indirect impacts on air quality, because the improvements would not introduce new emission sources.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.8.4.2**.

4.8.4.7 Summary of Impacts

Short-term direct impacts of the Rio Pojoaque irrigation improvement project on air quality would come from fugitive dust emissions (PM_{10} and $PM_{2.5}$) and equipment emissions. The source of these emissions would be surface-disturbing activities and nitrogen dioxide, sulfur dioxide, carbon monoxide, volatile organic compounds, particulates, and small quantities of hazardous air pollutants (diesel particulate matter, acetaldehyde, benzene, and formaldehyde) from fuel-burning vehicles and equipment. These impacts would be short term, intermittent, and temporary under all alternatives.

Emissions under Alternative RP-E are likely to be higher than under the other action alternatives, due to the larger area disturbed and the greater extent of the proposed improvements. There would be little to no operational impacts on air quality, because the improvements would not introduce new emission sources.

4.8.5 Rio Tesuque Channel Modification Project

4.8.5.1 Alternative RT-A—No Action

Under Alternative RT-A, No Action, the Rio Tesuque channel modification project would not be undertaken; therefore, there would be no direct or indirect impacts on air quality from this activity. Emissions associated with maintaining the current channel operations, if any, would continue.

Mitigation and Residual Impacts

There would be no mitigation or residual impacts associated with Alternative RT-A, No Action.

4.8.5.2 Impacts Common to All Action Alternatives

The Rio Tesuque channel modification project would have direct, localized, intermittent, and short-term air quality impacts during construction in areas where proposed modifications would occur. Construction would have a direct impact on air quality by generating fugitive dust from surface-disturbing activities and emitting criteria pollutants through the combustion of fuel in commute vehicles, trucks, construction equipment, and generators. These emissions would be the same as those described for the RWS under **Section 4.8.3.2**, Impacts Common to All Action Alternatives, but on a smaller scale.

Sources of temporary and localized fugitive dust emissions are the following:

- Direct impacts from soil excavation and site grading
- Direct impacts from travel on unpaved roads and surfaces
- Indirect impacts from wind erosion of disturbed surfaces
- Indirect impacts from entrained dust caused by travel on paved roads

The emissions of fugitive dust would be greatest during site excavation and grading. Emissions would be specific to the disturbed area and would cease when construction ends and temporary disturbance areas are reclaimed.

Operation of construction equipment would produce combustion-related emissions, including carbon monoxide, nitrogen dioxide, volatile organic compounds, sulfur dioxide, and small quantities of PM_{10}, $PM_{2.5}$, and hazardous air pollutants (diesel particulate matter, acetaldehyde, benzene, and formaldehyde). Exhaust from construction equipment, tractor-trailers bringing in and moving equipment and materials, and construction workers' personal vehicles would generate temporary criteria air pollutant emissions.

Sources of emissions are the following:

- Gas- and diesel-powered construction equipment and power tools
- Generators
- Water trucks for dust suppression
- On-site light-duty trucks and commute vehicles for construction personnel

Operation of the improvements would have little to no direct or indirect impacts on air quality, because the improvements would not introduce new emission sources.

Mitigation and Residual Impacts

Dust control mitigations would be specified during the construction design phase and would be conducted according to County, Pueblo, and state ordinances for construction dust control. Implementing appropriate dust control measures would minimize impacts on local air quality, particularly nuisance conditions on adjacent or nearby uses that would be sensitive to excessive dust. Residual impacts would be low.

4.8.5.3 Alternative RT-B

The type and nature of construction-related impacts on air quality under Alternative RT-B would be the same as those described under **Section 4.8.5.2**, Impacts Common to All Action Alternatives.

Under Alternative RT-B, approximately 11 acres would be disturbed temporarily and 3 acres would be disturbed permanently, with 4,600 cubic yards of excavation. Earth-moving activities associated with clearing vegetation, destabilizing and excavating the bank, raising the main channel bed elevation, and installing grade control features and detention ponds would create localized and temporary fugitive dust emissions. Emissions from construction equipment, worker vehicles, and truck traffic, including hauling excess excavated material 0.5 mile to a stockpile site, also would be a short-term and temporary source of construction-related emissions.

Operation of the improvements would have little to no direct or indirect impacts on air quality, because the improvements would not introduce new emission sources.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.8.5.2**.

4.8.5.4 Alternative RT-C

The type and nature of construction-related impacts on air quality under Alternative RT-C would be the same as those described under **Section 4.8.5.2**.

Under Alternative RT-C, approximately 13 acres would be disturbed temporarily and 4 acres would be disturbed permanently, with 5,300 cubic yards of excavation. Earth-moving activities associated with excavating a new channel, partially filling the existing channel, and controlling the grade in the new channel would create localized and temporary fugitive dust emissions. Emissions from construction equipment, worker vehicles, and truck traffic, including hauling excess excavated material 0.5 mile to a stockpile site and hauling in riprap, also would be a short-term and temporary source of construction-related emissions.

Operation of the improvements would have little to no direct or indirect impacts on air quality, because the improvements would not introduce new emission sources.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.8.5.2**.

4.8.5.5 Alternative RT-D (Preferred Alternative)

The type and nature of construction-related impacts on air quality under Alternative RT-D would be the same as those described under **Section 4.8.5.2**.

Under Alternative RT-D, approximately 4 acres would be disturbed temporarily and <1 acre would be disturbed permanently, with 1,320 cubic yards of excavation. Earth-moving activities associated with removing a sediment spoil pile from the east side of the Rio Tesuque to increase the capacity of the river during high water flows would create localized and temporary fugitive dust emissions. Emissions from construction equipment, worker vehicles, and truck traffic, including hauling excavated material 3.5 miles to a stockpiling site, also would be a short-term and temporary source of construction-related emissions.

Operation of the improvements would have little to no direct or indirect impacts on air quality, because the improvements would not introduce new emission sources.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.8.5.2**.

4.8.5.6 Alternative RT-E

The type and nature of construction-related impacts on air quality under Alternative RT-E would be the same as those described under **Section 4.8.5.2**.

Under Alternative RT-E, approximately 5 acres would be disturbed temporarily and 1 acre would be disturbed permanently, with 2,700 cubic yards of excavation. Earth-moving activities associated with excavating and installing a main carrier pipe running parallel to the river, three perforated collector pipes running perpendicular to the river, and a gravel filter layer surrounding all pipes would create localized and temporary fugitive dust emissions. Emissions from construction equipment, worker vehicles, and truck traffic also would be a short-term and temporary source of construction-related emissions. Minimal hauling would be required under this alternative, because excavated material would be used on-site.

Operation of the improvements would have little to no direct or indirect impacts on air quality, because the improvements would not introduce new emission sources.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.8.5.2**.

4.8.5.7 Summary of Impacts

The Rio Tesuque channel modification project would have direct, localized, intermittent, and short-term air quality impacts during construction in areas where proposed modifications would occur. Short-term direct impacts on air quality would occur through

the emission of fugitive dust emissions (PM_{10} and $PM_{2.5}$) from surface-disturbing activities and nitrogen dioxide, sulfur dioxide, carbon monoxide, volatile organic compounds, particulates, and small quantities of hazardous air pollutants (diesel particulate matter, acetaldehyde, benzene, and formaldehyde) from fuel-burning vehicle and equipment use. These impacts would be short term, intermittent, and temporary under all alternatives. Emissions under Alternatives RT-B and RT-C are likely to be higher than under Alternatives RT-D and RT-E, due to the larger area disturbed and the greater extent of the proposed modifications. There would be little to no operational impacts on air quality, because the modifications would not introduce new emission sources.

4.8.6 Pueblo de San Ildefonso Future Projects Alternatives

4.8.6.1 Alternative SI-A—No Action Alternative

Under Alternative SI-A, No Action, the Pueblo de San Ildefonso future projects would not be constructed. Thus, there would be no direct or indirect impacts on air quality from this activity.

Mitigation and Residual Impacts

There would be no mitigation or residual impacts associated with Alternative SI-A, No Action.

4.8.6.2 Alternative SI-B—Proposed Wastewater and Water Infrastructure

The proposed Pueblo de San Ildefonso preliminary wastewater system design has the potential to affect air quality. Direct and indirect impacts on air quality would be the same as those described above for the RWS project; however, direct and indirect impacts would be on a smaller scale than for the RWS project. This is because the project's direct short-term impacts would occur on 59 acres only.

The Pueblo de San Ildefonso is also considering additional water-related infrastructure in a 680-acre area, near the northern boundary of the Pueblo, along with three potential new pipeline alignments. The project footprint includes an unknown number of acres in short-term and long-term disturbance areas, although construction techniques, vehicle use, and other elements common to the RWS action alternatives would apply. As such, the direct and indirect air quality impacts under Alternative SI-B are expected to be similar to those described in **Section 4.8.4** for the RWS, though at a smaller scale.

Mitigation and Residual Impacts

Dust control mitigations would be specified during the construction design phase and would be conducted according to County, Pueblo, and state ordinances for construction dust control. Traffic congestion-related air pollutants would be mitigated by not conducting construction during peak-hour traffic in the area and by implementing proper traffic flow measurements during the construction phase. Implementing appropriate dust control measures would minimize impacts on local air quality, particularly nuisance conditions on adjacent or nearby uses that would be sensitive to excessive dust. Residual impacts would be low.

4.9 Climate Change

This section addresses potential impacts on climate change from actions associated with each alternative. It also addresses potential effects of climate change on each analyzed alternative.

4.9.1 Impact Indicators

The following indicators, as described in **Table 3-1**, are used to analyze impacts on climate change:

- The level of GHG emissions resulting from construction of the RWS and other proposed actions
- The adequate availability of daily flows in the Rio Grande at Otowi for the RWS and other proposed actions under a range of 19 climate change scenarios

4.9.2 Analysis Methods and Assumptions

4.9.2.1 Impacts of RWS on Climate Change

There are no CAA significance thresholds for evaluating GHGs.

The following assumption was used in the analysis:

- While there is a correlation between global concentrations of GHGs and climate change, it is not currently possible to link projected GHG emissions associated with any particular activity to specific environmental impacts at a specific site or location.

4.9.2.2 Impacts of Climate Change on the RWS

Section 3.9, Climate Change, describes climate change modeling using downscaled climate model predictions for northern New Mexico. Climate scenarios ranged from least adverse (a relative small change for current climate conditions) to more adverse (more significant changes from current climate conditions). These scenarios represent the following changes from the existing climate conditions, including a group with the central tendency (effectively the average) for all four scenarios listed below:

- Warmer and drier conditions
- Warmer and wetter conditions
- Hotter and drier conditions
- Hotter and wetter conditions

Time frames ranged from short term (year 2020) to long term (year 2089). Modeled stream flows at the Rio Grande at Otowi Bridge were evaluated based on diversion needs of the RWS over time.

4.9.3 RWS Alternatives

4.9.3.1 Alternative A—No Action

Impacts of the RWS on Climate Change

Under Alternative A, No Action, GHG emissions related to using groundwater as the primary source of drinking water would continue. These emissions include non-electrical pumps and well drilling equipment for developing new wells or modifying existing wells.

Mitigation and Residual Impacts

Alternative A would not require any mitigation of GHGs and would result in no residual impacts.

Impacts of Climate Change on the RWS

Under Alternative A, No Action, water in the Pojoaque Basin would continue to be provided with groundwater. The climate change modeling did not evaluate future impacts on aquifer recharge or evapotranspiration. Generally, groundwater levels could decrease, driven by a reduction in natural groundwater recharge and increased pumping in the Santa Fe area (Reclamation 2013b).

Mitigation and Residual Impacts

Climate adaptation to future climate conditions could vary; no jurisdiction within the service area has, to date, developed a climate adaptation plan. Lewis et al. 2013 examined various adaptation strategies, with public participation, for the Santa Fe Basin. Adaptation strategies could include:

- ASR projects
- Additional surface storage
- Water banking, such as temporary transfers of agricultural water to municipal, domestic, or commercial uses
- Water conservation to reduce demand
- Water reclamation

Under Alternative A, the most likely form of adaptation would involve increasing or sustaining supplies with new wells or deeper wells. Water use may also be part of adaptation, with decreases in summer uses. Direct climate adaptation under Alternative A would most likely be undertaken by individual well owners or specific jurisdictions.

4.9.3.2 Impacts Common to All Action Alternatives

Impacts of the RWS on Climate Change

Constructing the components of the RWS under all of the action alternatives would have a direct impact on global GHG emission levels from emitting GHGs through the combustion of fuel in commuter vehicles, trucks, and construction equipment and through the release of carbon in soils and vegetation during surface-disturbing activities. These activities would be a short-term source of GHG emissions.

GHG emissions associated with operating the RWS would be lower than emissions from construction, but would occur over the lifetime of the RWS. GHG emission sources would include worker commuter traffic, maintenance vehicles and equipment, and truck traffic for material deliveries and transporting solids to the municipal landfill from the water treatment plant.

Direct GHG emissions from operating the RWS components would be minimal, as equipment would run on electricity; however, indirect GHG emissions would occur from producing the electricity needed to operate the components. These indirect GHG emissions would be offset by removing existing domestic and municipal well pump equipment. The degree of offset would depend upon the size, rate of use, and efficiency of the new equipment compared with the removed equipment. Some electrical needs may also be offset by installing solar panels on some RWS facilities to provide electricity for nonessential functions such as lighting. Backup generators to provide power in the case of an electrical outage would emit GHGs directly during monthly testing and operation during outages.

Mitigation and Residual Impacts

No mitigation is required to reduce construction-related or operation-related GHGs; therefore, residual impacts would be the same as the direct and indirect impacts described above. However, any measures that reduce exhaust-related emissions to minimize impacts on air quality, discussed in **Section 4.8**, Air Quality, also would reduce GHG emissions. Similarly, any measures to reduce construction-related traffic, if included in traffic control and safety plans, would likewise reduce construction-related GHG emissions from these sources.

Impacts of Climate Change on the RWS

Climate scenarios showed the potential for reduced flows in the Rio Grande at Otowi Bridge from current climate conditions. Long-term climate projections indicate a potential for reduced low flows from current conditions by 0 percent to more than 39 percent in drought years by 2089 (Reclamation 2015c).

All the climate scenarios evaluated indicated that some flow would be available in the Rio Grande, although the diversion efficiency of the RWS could be affected. For the side channel surface diversion (Alternative B), there would be no additional potential for shortages from existing conditions, based on a least adverse, warmer, wetter 2089 climate scenario. The most adverse climate scenario—a hotter, drier 2089—could mean an additional 250.5 af of shortages during the worst drought year. The change in suspended sediment concentrations in the Rio Grande under climate change was not determined. Suspended sediment is not directly correlated with flows, but increased suspended sediment concentrations could also limit the ability to collect water for the RWS.

Mitigation and Residual Impacts

Climate adaptation to future climate conditions could vary. No jurisdiction in the service area has, to date, developed a climate adaptation plan. However, the jurisdictions have preliminarily assessed current and future climate adaptation strategies (Lewis et al. 2013).

The range of adaptation strategies described under Alternative A could apply to the various RWS action alternatives. The Regional Water Authority would have specific

opportunities for projects that directly benefited the service area. ASR or water banking could be specifically undertaken for the benefit of the service area customers. Additionally, the County and the Pueblos have the ability to set policies throughout the service area to encourage water conservation. These policies could include incentive programs to adopt low flow or best water use practices for customers. The Regional Water Authority could also implement maintenance and leak detection programs.

4.9.3.3 Alternative B—HKM Implementable

Impacts of the RWS on Climate Change

The type and nature of short-term GHG construction emissions under Alternative B would be the same as described under **Section 4.9.3.2**, Impacts Common to All Action Alternatives. In addition to the construction-related GHG emission sources described in that section, backup well drilling equipment would emit GHGs under Alternative B.

An estimate of direct GHG emissions from RWS construction activity was prepared based on estimated fuel use of on-road and non-road equipment that would be required to construct the various components of the RWS. These emissions are shown in **Table 4-25**, below. Emissions from worker commuter vehicles or heavy truck traffic for materials deliveries were not included in this estimate.

Table 4-25. Estimated GHG Emissions by Proposed Component

Proposed Work Activity	GHG Emissions (Metric Ton)			CO_{2e} (Metric Ton)
	CO_2	CH_4	N_2O	All GHGs
Side channel surface diversion	1904.84	0.9809	0.0480	1943.66
Pumping plants	576.30	0.2014	0.0145	585.66
SCADA-control, monitoring	44.39	0.0025	0.0011	44.79
Short-term storage tanks	262.56	0.1206	0.0066	267.55
Transmission lines	1,434.66	0.7977	0.0361	1,465.37
ASR wells	1,286.70	0.6331	0.0305	1,311.62
Water treatment plant	902.06	0.2037	0.0145	911.48
Total estimate-gasoline	**6,411.51**	**2.9399**	**0.1513**	**6,530.13**

Source: Assumptions and source data are described in Appendix H, Air Technical Report
Notes: CO_2 – carbon dioxide; CH_4 – methane; N_2O – nitrous oxide; CO_{2e} – carbon dioxide equivalents

As shown in **Table 4-25**, estimated GHG emissions represent less than 0.1 percent of total state GHG emissions in 2007, the most recently available statewide inventory of GHG emissions (NMED 2010).

Long-term operational GHG emissions would be the same as those described under **Section 4.9.3.2**, Impacts Common to All Action Alternatives. Estimated electricity

demand under Alternative B is projected to be 4,215 kVA. Electricity produced to operate RWS component equipment would be an indirect source of GHG emissions that would be partially offset over time as existing domestic and municipal well pump equipment is brought off line. The degree of offset would depend on the factors discussed under **Section 4.9.3.2**.

Mitigation and Residual Impacts

Mitigation and residual impacts would be the same as described under **Section 4.9.3.2**, Impacts Common to All Action Alternatives.

Impacts of Climate Change on the RWS

Under Alternative B, the ability to divert surface water from the Rio Grande via the side channel surface diversion would be reduced as river flows drop below 250 cfs. During these events, the RWS would be supplied by San Juan-Chama water operations or from a backup water source. The average number of days per year when backup water is used would not change for the least adverse climate scenario. However, in a more adverse climate scenario, it could increase by 4 days by 2089. This would increase the amount of backup supply required, by up to 250 afy. This backup supply amount does not include needs during high-suspended sediment events, which were not evaluated under future climate change scenarios.

Mitigation and Residual Impacts

Mitigation and residual impacts would be the same as described in **Section 4.9.3.2**, Impacts Common to All Action Alternatives.

4.9.3.4 Alternative C

Impacts of the RWS on Climate Change

The type and nature of short-term GHG construction-related emissions under Alternative C would be the same as described under **Section 4.9.3.2**, Impacts Common to All Action Alternatives. Based on **Table 2-3**, Summary Comparison of RWS Action Alternatives, and **Table 2-4**, RWS Surface Disturbance Comparison, construction under Alternative C would likely result in fewer emissions of GHGs than shown in **Table 4-25**. This is because no well drilling would be performed to support the backup water supply and because there would be a lower level of surface disturbance (1,140 acres under Alternative C versus 1,203 acres under Alternative B).

This lower level of disturbance would require less heavy equipment use for earth-moving activity and would release less carbon from vegetation removal and soil disturbance.

Long-term operational GHG emissions would be similar to those described under **Section 4.9.3.2**, Impacts Common to All Action Alternatives. Estimated electricity demand under Alternative C is projected to be 2,995 kVA. Electricity produced to operate RWS component equipment would be an indirect source of GHG emissions that would be partially offset over time as existing domestic and municipal well pump equipment is brought off line. The degree of offset would depend on the factors discussed under **Section 4.9.3.2**.

Mitigation and Residual Impacts

Mitigation and residual impacts would be the same as described under **Section 4.9.3.2**, Impacts Common to All Action Alternatives.

Impacts of Climate Change on the RWS

Existing modeling indicates that the yield of the parallel river interceptor drain depends on hydraulic conductivity of the river alluvium and the surface water stage in the Rio Grande (INTERA 2016a). At present, the potential yields of the parallel river interceptor drain are assumed to be between 3.6 and 4.8 mgd. Future climate change impacts on Rio Grande flows may affect the river flows and these yields. During times of modeled very low flows (less than 200 cfs), yields could drop to between 1.7 and 2.0 mgd. San Juan-Chama waters could be used to supplement flows.

Mitigation and Residual Impacts

Mitigation and residual impacts would be the same as described in **Section 4.9.3.2**, Impacts Common to All Action Alternatives.

4.9.3.5 Alternative D

Impacts of the RWS on Climate Change

The type and nature of GHG construction-related emissions under Alternative D would be the same as described under **Section 4.9.3.2**, Impacts Common to All Action Alternatives. Based on **Table 2-3** and **Table 2-4**, construction under Alternative D would likely result in fewer emissions of GHGs than shown in **Table 4-25**. This is because no well drilling would be performed to support the backup water supply and because there would be a lower level of surface disturbance (1,146 acres under Alternative D versus 1,203 acres under Alternative B). This lower level of disturbance would require less heavy equipment use for earth-moving activity and would release less carbon from vegetation removal and soil disturbance.

Long-term operational GHG emissions would be the same as described under **Section 4.9.3.2**, Impacts Common to All Action Alternatives. Estimated electricity demand under Alternative D is projected to be 2,875 kVA. Electricity produced to operate RWS component equipment would be an indirect source of GHG emissions that would be partially offset over time as existing domestic and municipal well pump equipment is brought off line. The degree of offset would depend on the factors discussed under **Section 4.9.3.2**.

Mitigation and Residual Impacts

Mitigation and residual impacts would be the same as described in **Section 4.9.3.2**, Impacts Common to All Action Alternatives.

Impacts of Climate Change on the RWS

Existing modeling indicates that the yield of the infiltration gallery depends on hydraulic conductivity of the river alluvium and the surface water stage in the Rio Grande (INTERA 2016a). At present, the potential yields of the infiltration gallery are assumed to be between 1.2 and 3.1 mgd. Future climate change impacts on Rio Grande flows may

affect the river flows and these yields. During times of modeled very low flows (less than 200 cfs), yields could drop to approximately 1.0 mgd. San Juan-Chama waters could be used to supplement flows.

Mitigation and Residual Impacts

Mitigation and residual impacts would be the same as described in **Section 4.9.3.2**, Impacts Common to All Action Alternatives.

4.9.3.6 Alternative E (Preferred Alternative)

Impacts of the RWS on Climate Change

The type and nature of GHG construction-related emissions under Alternative E would be the same as described under **Section 4.9.3.2**, Impacts Common to All Action Alternatives. Based on **Table 2-3** and **Table 2-4**, construction under Alternative E would likely result in fewer emissions of GHGs than shown in **Table 4-25**.

Reclamation would use existing emergency use wells to provide a supplemental water supply. There would be no well drilling for ASR wells to support the backup water supply and a lower level of surface disturbance (856 acres under Alternative E versus 1,203 acres under Alternative B). This lower level of disturbance would require less heavy equipment use for earth-moving activity and would release less carbon from vegetation removal and soil disturbance.

Long-term operational GHG emissions would be the same as described under **Section 4.9.3.2**, Impacts Common to All Action Alternatives. Estimated electricity demand under Alternative E is projected to be 2,865 kVA. Electricity produced to operate RWS component equipment would be an indirect source of GHG emissions that would be partially offset over time as existing domestic and municipal well pump equipment is brought off line. The degree of offset would depend on the factors discussed under **Section 4.9.3.2**.

Mitigation and Residual Impacts

Mitigation and residual impacts would be the same as described under **Section 4.9.3.2**, Impacts Common to All Action Alternatives.

Impacts of Climate Change on the RWS

Existing modeling indicates that the yield of the horizontal radial well collectors depends on hydraulic conductivity of the river alluvium and the surface water stage in the Rio Grande (INTERA 2016a). At present, the potential yields of the horizontal radial well collectors are assumed to be between 3.6 and 4.8 mgd. Future climate change impacts on Rio Grande flows may affect the river flows and these yields. During times of modeled very low flows (less than 200 cfs), yields could drop to between 1.7 and 2.0 mgd. San Juan-Chama waters and emergency use wells would be used to supplement flows.

Mitigation and Residual Impacts

Mitigation and residual impacts would be the same as described in **Section 4.9.3.2**, Impacts Common to All Action Alternatives.

4.9.3.7 Summary of Impacts

Impacts of the RWS on Climate Change

Impacts of the RWS on climate change would occur through the emission of GHGs from fuel-burning vehicles and equipment use and release of sequestered carbon in soils and vegetation resulting from surface disturbance. The greatest level of GHG emissions would occur during construction, with GHG emissions under Alternative B likely to be slightly higher than under the other action alternatives. This is because of the greater area of surface disturbance and the development of ASR wells for backup water supply under this alternative compared with the other action alternatives.

Operational direct emissions of GHGs would be low, as the RWS components would run on electricity and would not emit GHGs. Electricity to operate RWS component equipment would be an indirect source of GHG emissions that would be partially offset over time as existing domestic and municipal well pump equipment is brought off line. Estimated electricity demand would be similar under Alternatives C through E (2,995, 2,875, and 2,865 kVA, respectively) and highest under Alternative B (4,215 kVA).

Impacts of Climate Change on the RWS

Climate scenarios show the potential for reduced flows in the Rio Grande at Otowi Bridge compared with current climate conditions. Long-term climate projections indicate a potential for reduced low flows from current conditions by 0 percent to more than 39 percent during drought years. The climate scenarios evaluated all indicate that some flow would be available in the Rio Grande over the long term (2089); however, this may still affect the reliability of the water supply over time, given these climate scenarios.

Under Alternative B, the RWS would be supplied from a backup groundwater source (ASR wells) while the other action alternatives would use San Juan-Chama waters to provide supply during inadequate native Rio Grande flows. Under Alternative E, existing emergency use wells would provide a supplemental water supply. The impacts of climate change on the risk of water shortages for the RWS would be planned for in its design under all alternatives. Climate adaption strategies, if developed and implemented by jurisdictions within the service area, would improve the resiliency of the RWS to climate change through mechanisms to store, bank, conserve, and reclaim water in the service area.

4.9.4 Rio Pojoaque Irrigation Improvement Project

4.9.4.1 Alternative RP-A—No Action

Impacts of the Rio Pojoaque Irrigation Improvement Project on Climate Change

Under Alternative RP-A, No Action, the Rio Pojoaque irrigation improvement project would not be completed. There would be no GHG emissions.

Mitigation and Residual Impacts

There would be no mitigation or residual impacts associated with Alternative RP-A, No Action.

Impacts of Climate Change on the Rio Pojoaque Irrigation Improvement Project

While Reclamation did not model specific settlement-related climate change scenarios on Rio Pojoaque flows, a regional study estimated that runoff to Rio Grande tributaries could be reduced by one-third by 2100 (Reclamation 2013b). If flows were reduced, the existing Rio Pojoaque Barrier Dam and Ortiz Ditch infiltration gallery could have reduced capability in diverting water for irrigation.

Mitigation and Residual Impacts

Climate adaptation measures, such as conservation, adjusting irrigation cropping patterns and acreages, the future supply availability, and other water rights projects, could be implemented to offset any climate-induced reduction in flows. No climate adaptation plans have been adopted for the Rio Pojoaque. The potential for specific adaptation measures to offset future climate change on Rio Pojoaque irrigation is not known.

4.9.4.2 Impacts Common to All Action Alternatives

Impacts of the Rio Pojoaque Irrigation Improvement Project on Climate Change

Constructing the Rio Pojoaque irrigation improvement project under all of the action alternatives would have a direct impact on global GHG emission levels. Impacts would be from two sources: GHGs emitted through the combustion of fuel in commuter vehicles, trucks, and construction equipment and the release of carbon in soils and vegetation during surface-disturbing activities. These emissions would be similar to those described for the RWS under **Section 4.9.3.2**, Impacts Common to All Action Alternatives, but at a smaller scale.

Operation of the improvements would not introduce new GHG emission sources.

Mitigation and Residual Impacts

No mitigation is required to reduce construction- or operation-related GHGs; therefore, residual impacts would be the same as the direct and indirect impacts described above.

Impacts of Climate Change on the Rio Pojoaque Irrigation Improvement Project

The goal of the Rio Pojoaque irrigation improvement project is to improve the ability to divert water for irrigation from the Ortiz Ditch. This goal could offset climate-induced flow changes on the Rio Pojoaque. The potential for the Rio Pojoaque irrigation improvement project or the RWS-related reduced groundwater pumping to offset future climate change on Rio Pojoaque irrigation is not known.

Mitigation and Residual Impacts

Even with the Rio Pojoaque irrigation improvement project, other climate adaptation measures may be required in the future to offset reduced Rio Pojoaque flows.

4.9.4.3 Alternative RP-B

Impacts of the Rio Pojoaque Irrigation Improvement Project on Climate Change

The type and nature of construction-related impacts of GHG emissions under Alternative RP-B would be the same as described under **Section 4.9.4.2**, Impacts Common to All Action Alternatives.

Under Alternative RP-B, approximately <1 acre would be disturbed temporarily and <1 acre would be disturbed permanently. This would result in a low level of equipment-related GHG emissions and low carbon release by removing vegetation and disturbing soil.

Operating the improvements would not introduce new GHG emission sources.

Mitigation and Residual Impacts

No mitigation is required to reduce construction- or operation-related GHGs; therefore, residual impacts would be the same as the direct and indirect impacts described above.

Impacts of Climate Change on the Rio Pojoaque Irrigation Improvement Project

The potential climate impacts for Alternative RP-B would be the same as in the **Section 4.9.4.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

The potential for climate adaptation under Alternative RP-B is the same as in the **Section 4.9.4.2**, Impacts Common to All Action Alternatives.

4.9.4.4 Alternative RP-C (Preferred Alternative)

Impacts of the Rio Pojoaque Irrigation Improvement Project on Climate Change

The type and nature of construction-related impacts GHG emissions under Alternative RP-C would be the same as those described under **Section 4.9.4.2**, Impacts Common to All Action Alternatives.

Under Alternative RP-C, approximately 11 acres would be disturbed temporarily and 5 acres would be disturbed permanently. Activities associated with extending the conveyance system would emit fuel combustion-related GHGs from construction equipment, worker vehicles, and truck traffic. These activities would also release carbon by removing vegetation and disturbing soil.

Operation of the improvements would not introduce new GHG emission sources.

Mitigation and Residual Impacts

No mitigation is required to reduce construction-related or operation-related GHGs; therefore, residual impacts would be the same as the direct and indirect impacts described above.

Impacts of Climate Change on the Rio Pojoaque Irrigation Improvement Project

The potential climate impacts for Alternative RP-C are the same as in the **Section 4.9.4.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

The potential for climate adaptation under Alternative RP-C is the same as in the **Section 4.9.4.2**, Impacts Common to All Action Alternatives.

4.9.4.5 Alternative RP-D

Impacts of the Rio Pojoaque Irrigation Improvement Project on Climate Change

The type and nature of construction-related impacts GHG emissions under Alternative RP-D would be the same as described under **Section 4.9.4.2**, Impacts Common to All Action Alternatives, above. GHG emissions under Alternative RP-D would be very low, given that this alternative would replace an existing 15-inch-diameter pipe with a larger perforated pipe, resulting in very little surface disturbance or equipment use.

Operation of the improvements would not introduce new GHG emission sources.

Mitigation and Residual Impacts

No mitigation is required to reduce construction-related or operation-related GHGs; therefore, residual impacts would be the same as the direct and indirect impacts described above.

Impacts of Climate Change on the Rio Pojoaque Irrigation Improvement Project

The potential climate impacts for Alternative RP-D would be the same as in the **Section 4.9.4.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

The potential for climate adaptation under Alternative RP-D is the same as in the **Section 4.9.4.2**, Impacts Common to All Action Alternatives.

4.9.4.6 Alternative RP-E

Impacts of the Rio Pojoaque Irrigation Improvement Project on Climate Change

The type and nature of construction-related impacts GHG emissions under Alternative RP-E would be the same as described under **Section 4.9.4.2**, Impacts Common to All Action Alternatives, above.

Under Alternative RP-E, approximately 38 acres would be disturbed temporarily and 2 acres would be disturbed permanently. Activities associated with extending the conveyance pipes and the infiltration gallery would emit fuel combustion-related GHGs from construction equipment, worker vehicles, and truck traffic and would release carbon from removing vegetation and disturbing soil.

Operation of the improvements would not introduce new GHG emission sources.

Mitigation and Residual Impacts

No mitigation is required to reduce construction-related or operation-related GHGs; therefore, residual impacts would be the same as the direct and indirect impacts described above.

Impacts of Climate Change on the Rio Pojoaque Irrigation Improvement Project

The potential climate impacts for Alternative RP-E would be the same as in the **Section 4.9.4.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

The potential for climate adaptation under Alternative RP-E is the same as in the **Section 4.9.4.2**, Impacts Common to All Action Alternatives.

4.9.4.7 Summary of Impacts

Impacts of the Rio Pojoaque Irrigation Improvement Project on Climate Change

There would be impacts of the Rio Pojoaque irrigation improvement project on climate change. This would be the result of the emission of GHGs from fuel-burning vehicles and equipment and the release of sequestered carbon in soils and vegetation. The most GHGs would be emitted during construction; GHG emissions under Alternative RP-E would likely be slightly higher than under the other action alternatives. This is because of the greater area of surface disturbance under Alternative RP-E. Long-term emissions of GHGs would be low under all alternatives, because the improvements would not introduce new GHG emission sources.

Impacts of Climate Change on the Rio Pojoaque Irrigation Improvement Project

A reduced water supply from future climate change could reduce the effectiveness of the Rio Pojoaque irrigation improvement project from historic climate conditions; project

operation may serve to offset the impacts of reduced flows. Climate adaptation may be needed, in addition to the project.

4.9.5 Rio Tesuque Channel Modification Project

4.9.5.1 Alternative RT-A—No Action

Impacts of the Rio Tesuque Channel Modification Project on Climate Change

Under Alternative RT-A, No Action, the Rio Tesuque channel modification project would not be completed. There would be no emissions of GHGs from this activity.

Mitigation and Residual Impacts

There are no mitigation or residual impacts associated with Alternative RT-A, No Action.

Impacts of Climate Change on the Rio Tesuque Channel Modification Project

While Reclamation did not model specific settlement-related climate change scenarios on Rio Tesuque flows, a regional study estimated that runoff to Rio Grande tributaries could be reduced by one-third by 2100 (Reclamation 2013b). Under Alternative RT-A, No Action, the form and function of the Rio Tesuque reaches would continue. With reduced flow, the potential for encroaching vegetation could be enhanced. The vegetation could further stabilize banks, leading to continued incising of the Rio Tesuque.

Mitigation and Residual Impacts

No climate adaptation plans have been adopted for the Rio Tesuque. The potential of specific adaptation measures to offset future climate change on the Rio Tesuque channel and existing irrigation infrastructure is not known.

4.9.5.2 Impacts Common to All Action Alternatives

Impacts of the Rio Tesuque Channel Modification Project on Climate Change

Constructing the Rio Tesuque channel modification project under all of the action alternatives would have a direct impact on global GHG emission levels. The sources of the GHGs would be the combustion of fuel in commute vehicles, trucks, and construction equipment and the release of carbon in soils and vegetation during surface-disturbing activities. These emissions would be similar to those described for the RWS under **Section 4.9.3.2**, Impacts Common to All Action Alternatives, but at a smaller scale.

Operating the improvements would not introduce new GHG emission sources.

Mitigation and Residual Impacts

No mitigation is required to reduce construction-related or operation-related GHGs; therefore, residual impacts would be the same as the direct and indirect impacts described above.

Impacts of Climate Change on the Rio Tesuque Channel Modification Project

The goals of the Rio Tesuque channel modification project alternatives vary by alternative. Some alternatives relate to floodplain management, river restoration, or irrigation. Potential climate change impacts vary by alternative and are discussed separately.

Mitigation and Residual Impacts

No climate adaptation plans have been adopted for the Rio Tesuque. The potential of specific adaptation measures to offset future climate change on proposed Rio Tesuque channel restoration and irrigation infrastructure is not known.

4.9.5.3 Alternative RT-B

Impacts of the Rio Tesuque Channel Modification Project on Climate Change

The type and nature of construction-related impacts of GHG emissions under Alternative RT-B would be the same as described under **Section 4.9.5.2**, Impacts Common to All Action Alternatives, above.

Under Alternative RT-B, approximately 11 acres would be disturbed temporarily, and 3 acres would be disturbed permanently, with 4,600 cubic yards of excavation. Activities associated with the following activities would emit fuel combustion-related GHGs:

- Clearing vegetation
- Destabilizing and excavating the bank
- Raising the main channel bed elevation
- Installing grade control features and detention ponds

These GHGs would come from construction equipment, worker vehicles, and truck traffic and would release carbon by removing vegetation and disturbing soil.

Operating the improvements would not introduce new GHG emission sources.

Mitigation and Residual Impacts

No mitigation is required to reduce construction- or operation-related GHGs; therefore, residual impacts would be the same as the direct and indirect impacts described above.

Impacts of Climate Change on the Rio Tesuque Channel Modification Project

No climate adaptation plans have been adopted for the Rio Tesuque. The potential for specific adaptation measures to offset future climate change on proposed Rio Tesuque channel restoration and irrigation infrastructure is not known.

Mitigation and Residual Impacts

No mitigation is proposed for Alternative RT-B, although other climate adaptation measures may be needed based on the uncertainty in future climate change projections.

4.9.5.4 Alternative RT-C

Impacts of the Rio Tesuque Channel Modification Project on Climate Change

The type and nature of construction-related impacts from GHG emissions under Alternative RT-C would be the same as described under **Section 4.9.5.2**, Impacts Common to All Action Alternatives.

Under Alternative RT-C, approximately 13 acres would be disturbed temporarily, and 4 acres would be disturbed permanently, with 5,300 cubic yards of excavation. Activities associated with excavating a new channel for an infiltration gallery and intake system, partially filling the existing channel, and controlling the grade in the new channel would emit fuel combustion-related GHGs. These emissions would come from construction equipment, worker vehicles, and truck traffic. Moreover, these activities would release carbon by removing vegetation and disturbing soil.

Operation of the improvements would not introduce new GHG emission sources.

Mitigation and Residual Impacts

No mitigation is required to reduce construction- or operation-related GHGs; therefore, residual impacts would be the same as the direct and indirect impacts described above.

Impacts of Climate Change on the Rio Tesuque Channel Modification Project

The climate change impacts for Alternative RT-C would be the same as those under Alternative RT-B.

Mitigation and Residual Impacts

No mitigation would be required to reduce construction- or operation-related GHGs; therefore, residual impacts would be the same as the direct and indirect impacts described above.

Mitigation for Alternative RT-C would be the same as those under Alternative RT-B.

4.9.5.5 Alternative RT-D (Preferred Alternative)

Impacts of the Rio Tesuque Channel Modification Project on Climate Change

The type and nature of construction-related impacts of GHG emissions under Alternative RT-D would be the same as those described under **Section 4.9.5.2**, Impacts Common to All Action Alternatives.

Under Alternative RT-D, approximately 4 acres would be disturbed temporarily and 1> acre would be disturbed permanently, by excavating 1,320 cubic yards of soil. A sediment spoil pile would be removed from the east side of the Rio Tesuque. This would be done to increase the capacity of the river during a high water flows. Under this activity, combustion-related GHGs would be emitted from construction equipment, worker vehicles, and truck traffic. Further, carbon would be released by removing vegetation and disturbing soil.

Operating the improvements would not introduce new GHG emission sources.

Mitigation and Residual Impacts

No mitigation would be required to reduce construction- or operation-related GHGs; therefore, residual impacts would be the same as the direct and indirect impacts described above.

Impacts of Climate Change on the Rio Tesuque Channel Modification Project

The climate change impacts for Alternative RT-D would be the same as those under Alternative RT-B. While some project benefit in the 500-year floodplain was noted for Alternative RT-D (**Section 4.11**, Wetlands, Non-wetland Waters, and Floodplains), the benefit was less pronounced than that for the 100-year floodplain. Alternative RT-D may be less effective, although still beneficial, under future climate change. Additionally, Alternative RT-D is considered to have short-term impacts. The form and function of the Rio Tesuque in this reach may recreate the sediment conditions that Alternative RT-D seeks to correct. As a result, Alternative RT-D may not extend far enough into the future to be affected by future climate change conditions.

Mitigation and Residual Impacts

Mitigation for Alternative RT-D would be the same as that under Alternative RT-B.

4.9.5.6 Alternative RT-E

Impacts of the Rio Tesuque Channel Modification Project on Climate Change

The type and nature of construction-related impacts of GHG emissions under Alternative RT-E would be the same as those described under **Section 4.9.5.2**, Impacts Common to All Action Alternatives, above.

Under Alternative RT-E, approximately 5 acres would be disturbed temporarily and 1 acre would be disturbed permanently, with 2,700 cubic yards of excavation. Activities associated with excavating and installing a main carrier pipe running parallel to the river, three perforated collector pipes running perpendicular to the river, and a gravel filter layer surrounding all pipes would emit fuel combustion-related GHGs. Sources of the GHGs would be construction equipment, worker vehicles, and truck traffic. Excavation also would release carbon by removing vegetation and disturbing soil.

Operation of the improvements would not introduce new GHG emission sources.

Mitigation and Residual Impacts

No mitigation would be required to reduce construction- or operation-related GHGs; therefore, residual impacts would be the same as the direct and indirect impacts described above.

Impacts of Climate Change on the Rio Tesuque Channel Modification Project

Reduced flows on the Rio Tesuque induced by changing climate would offset improvements in irrigation diversions under Alternative RT-E. Because the primary goal of Alternative RT-E is filtering sediment, it is possible that longer times of operation of the infiltration gallery may be needed under reduced river flows. The extent that Alternative RT-E could offset the impacts of future climate-induced reduced river flows is not known.

Mitigation and Residual Impacts

No climate adaptation plans have been adopted for the Rio Tesuque. The potential of specific adaptation measures to offset future climate change on the Rio Tesuque channel and Alternative RT-E irrigation infrastructure is not known.

4.9.5.7 Summary of Impacts

Impacts of the Rio Tesuque Channel Modification Project on Climate Change

There would be impacts from the Rio Tesuque channel modification project on climate change. They would come from fuel-burning vehicles and equipment emitting GHGs and sequestered carbon being released from soils and vegetation. Emissions under Alternatives RT-B and RT-C are likely to be higher than under Alternatives RT-D and RT-E. This would be due to the larger amount of area disturbed and the greater extent of the proposed modifications. Operation would emit little to no GHGs, because the modifications would not introduce new emission sources.

Impacts of Climate Change on the Rio Tesuque Channel Modification Project

Alternatives RT-B, RT-C, and RT-D are related to stream restoration and floodplain management. They would likely continue to function under future climate change. The potential for future reduced stream flows could affect the water diversion for irrigation under Alternative RT-E; it may offset impacts of reduced flows. Additional climate adaptation may be needed, in addition to the project.

4.9.6 Pueblo de San Ildefonso Future Projects Alternatives

4.9.6.1 Alternative SI-A—No Action

Impacts of the Pueblo de San Ildefonso Future Projects Alternatives on Climate Change

Under Alternative SI-A, No Action, the Pueblo de San Ildefonso future projects would not be constructed, and there would be no GHG emissions from the construction or operation of the projects. Continued use of existing infrastructure is a minimal source of GHG emissions.

Mitigation and Residual Impacts

There would be no mitigation or residual impacts associated with Alternative SI-A, No Action.

Impacts of Climate Change on the Pueblo de San Ildefonso Future Projects Alternatives

Under Alternative SI-A, No Action, the Pueblo de San Ildefonso future projects would not be constructed. There would continue to be no climate change impacts on existing water and wastewater infrastructure systems.

Mitigation and Residual Impacts

No mitigation is proposed under Alternative SI-A, No Action. No climate adaptation plans have been adopted for the Rio Pojoaque Basin.

4.9.6.2 Alternative SI-B—Proposed Wastewater and Water Infrastructure

Impacts of the Pueblo de San Ildefonso Future Projects Alternatives on Climate Change

Constructing the wastewater improvements and other future water-related infrastructure would have a direct impact on global GHG emission levels from emitting GHGs through the combustion of fuel in worker commute vehicles, delivery trucks, and construction equipment and through the release of carbon in soils and vegetation during surface-disturbing activities. These activities would be a short-term source of GHG emissions. GHG emissions associated with operating the infrastructure would be minimal.

Mitigation and Residual Impacts

No mitigation is required to reduce construction-related or operation-related GHGs; therefore, residual impacts would be the same as the direct and indirect impacts described above.

Impacts of Climate Change on the Pueblo de San Ildefonso Future Projects Alternatives

The wastewater system improvements would not be affected by climate change, because this project addresses wastewater treatment; not the source of water. Impacts for the other proposed future water-related infrastructure projects would depend on the source of water proposed to be distributed and could be similar to the impacts on the RWS.

Mitigation and Residual Impacts

No mitigation is proposed for Alternative SI-B.

4.10 Vegetation

This section addresses potential impacts on vegetation (including special status plants) from actions associated with each alternative.

4.10.1 Impact Indicators

The following indicators, as described in **Table 3-1**, are used to analyze impacts on vegetation:

- Acres and location of different vegetation communities that could be disturbed
- Loss of special status plant species
- Estimated number of cottonwood trees removed per acre
- Potential for the spread of noxious weeds

4.10.2 Analysis Methods and Assumptions

In order to assess the impacts of the RWS, Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and Pueblo de San Ildefonso future projects alternatives on vegetation, Reclamation, in consultation with other agencies, defined the biological resources area of analysis around the proposed RWS infrastructure and other connected actions. This area was subject to preliminary review by aerial imagery, followed by field surveys to verify potential habitat that could support listed plant species. Pedestrian surveys were conducted to identify all plants, including noxious weeds, in the approximately 5,900-acre biological resources area of analysis (**Figure 3-8**, Biological Resources Area of Analysis). The biological resources area of analysis includes lands where the native vegetation has been previously disturbed, unvegetated areas, and developed lands.

4.10.2.1 Vegetation Communities

Spatial data from the Southwest Regional Gap Analysis Project (SWReGAP 2014) provides a detailed description of the vegetation communities in the general project area as shown in **Figure 3-10**, SWReGAP Vegetation Communities, and **Table 3-13**, Vegetation Communities in the Pojoaque Basin General Project Area. The SWReGAP data were used to compare areas of various vegetation communities that would be disturbed by each of the alternatives. The impact analysis focuses on those SWReGAP vegetation communities that have the potential to support special status plant species (**Table 4-26**, below).

4.10.2.2 Special Status Species

Habitats where special plant status species could occur are found in the 30,400-acre general project area. Two state endangered plant species, the Santa Fe cholla and the Great Plains lady tresses orchid have the potential to be in the general project area. In addition, three New Mexico rare plant species, Cyanic milkvetch, Santa Fe milkvetch, and Springer's blazing star, also have the potential to occur within the general project area (**Section 3.10.3**, Special Status Plant Species).

One Santa Fe cholla was identified in the biological resources area of analysis. Another three Santa Fe chollas were documented outside the biological resources area of analysis but in the general project area, near the Cities of Gold Casino. One potential Santa Fe cholla was identified outside the biological resources area of analysis but in the general project area, to the east of the Cities of Gold Casino. No other rare plants were identified

Table 4-26. Special Status Species and Associated Vegetation Communities

Vegetation Communities Associated with Special Status Plant Species	Cyanic Milkvetch	Santa Fe Milkvetch[1]	Santa Fe Cholla[2]	Springer's Blazing Star[1]	Great Plains Lady Tresses Orchid[2]
Intermountain Basins Semi-Desert Grassland		X	X		
Southern Rocky Mountain Piñon-Juniper Woodland	X			X	
Southern Rocky Mountain Juniper Woodland Savanna	X	X	X		
Rocky Mountain Ponderosa Pine Woodland				X	
Western Great Plains Foothill and Piedmont Grassland			X		
Riparian Wet Meadows[3]					X

Source: SWReGAP 2014
[1] New Mexico sensitive and New Mexico rare plant
[2] State-listed endangered species
[3] This riparian habitat is not a category under the vegetation communities; however, it is important in describing potential areas for the Great Plains lady tresses orchid, which could occur at any of the wetlands in the general project area.

in the general project area. No other special status species would likely be disturbed by the RWS, Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, or Pueblo de San Ildefonso future projects alternatives.

Springer's blazing star was found in the general project area. This species was located just beyond the western edge of the Pueblo de San de Ildefonso, outside of the biological resources area of analysis.

4.10.2.3 Cottonwood Galleries

Cottonwood galleries are found within riparian-related vegetation communities in the general project area and provide a key component to the high canopies of riparian areas. In addition, cottonwoods are an important resource as they provide forage, shelter, nesting, and denning sites for wildlife. Their roots also aid in erosion control. Cottonwood gallery landscapes are sensitive to excessive groundwater depletion and changes in surface water availability. Anthropogenic and climate variability have altered hydrologic regimes and associated fluvial processes, resulting in diminished ecosystem

viability within the general project area. Therefore, consideration of potential impacts on cottonwoods is included in this section.

Existing aerial imagery was compared with proposed RWS facilities and disturbance areas along with areas on the Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and Pueblo de San Ildefonso future projects alternatives. This analysis revealed that most of the potential for impacts on established cottonwood trees would be related to the placement of water distribution lines associated with the RWS. Installation of water pipelines would require a maximum disturbance width of 50 feet.

The estimated number of cottonwood trees that could be affected by removal or root damage was calculated by multiplying the width of disturbance (50 feet) by the estimated number of mature cottonwoods per acre (45). This estimation was based on a sample of known cottonwood galleries within the biological resources area of analysis (**Figure 3-8**, Biological Resources Area of Analysis). Refinement of the final project design, BMPs, and modification of construction practices would be considered to avoid affecting mature cottonwoods when feasible.

Maximum longevity of mature cottonwoods is estimated at approximately 150 years (Rood and Polzin 2003). The age classes of cottonwoods in the RWS diversion area are relatively similar, and indicates the lifespan of the present mature trees observed in the field would die off before modeled drawdown scenarios reach peak level. Modeled drawdowns are described in the Hydrologic Modeling and Analyses Associated with a Proposed Regional Water System in the Pojoaque River Basin (INTERA 2016a).

Projected impacts of drawdown on cottonwoods were used to estimate the potential total loss of cottonwoods in the project area. Estimates regarding mature cottonwood mortality under groundwater drawdown were calculated from the remaining areas outside of short-term construction impacts that could be affected under groundwater depletion scenarios.

4.10.2.4 Noxious Weeds

Eighteen species of noxious weeds were identified during field surveys (**Section 3.10.6**, Noxious Weed Species). Disturbance of existing vegetation and ground surface can potentially encourage the spread of weeds. Standard construction BMPs would be implemented during construction activities to reduce the potential spread of these weeds.

4.10.3 RWS Alternatives

4.10.3.1 Alternative A—No Action

Under Alternative A, no construction, operation, or maintenance of the RWS would occur (**Section 2.6.1**, Alternative A, No Action). Therefore, there would be no impacts on vegetation due to these actions. However, groundwater levels would continue to diminish over time as a result of continued pumping of groundwater as the primary water source in the general project area. This could limit growth of plants within the biological resources area of analysis (**Figure 3-8**, Biological Resources Area of Analysis) and the general project area. Lowering the water table could also increase the spread of noxious weeds due to changed hydrology. All plants, including upland and riparian vegetation, could be affected by diminished groundwater over time.

Mitigation and Residual Impacts

Under Alternative A, no mitigation is proposed, and no residual impacts would occur.

4.10.3.2 Impacts Common to All Action Alternatives

Long- and short-term surface disturbance acreage due to construction and operations is anticipated to be similar across the action alternatives. Likewise the acres and locations of disturbance of vegetation communities that include potential habitat for special status plant species is anticipated to be similar across the action alternatives.

A variety of land cover types are anticipated to be disturbed. They include unvegetated, previously disturbed, and developed lands. However, there would be direct impacts from the removal of native vegetation and loss of vegetation that may provide habitat for special status plant species.

Short-term vegetation removal would expose soils to compaction from equipment use, erosion, loss of topsoil, and spread of weeds. Once disturbed, native vegetation reestablishment is difficult. As a result, native plant communities supporting special status plant species may not be restored. Loss of native vegetation at facility locations and access roads would be permanent, and indirect impacts may occur to adjacent vegetation from vehicle use, erosion, and the spread of weedy species in the long-term from operations.

Based on available survey information, the known locations of special status plant species are isolated and may be avoided under all of the action alternatives. Therefore, no direct impacts on special status plant species are expected within the biological resources area of analysis. Indirect impacts from the loss of potential habitat however, may occur.

Direct impacts from the removal of young and mature established cottonwoods are anticipated under all of the action alternatives. An estimate of the number of mature cottonwoods that could be affected by ground-disturbing construction activities for the RWS would be determined closer to the date of construction, and may be reduced by site-specific efforts to avoid impacts.

All of the action alternatives have a similar potential to increase the spread of weeds in the short and the long term from ground disturbance, loss of native vegetation, and equipment and vehicle use. Disturbed lands are often colonized by weedy species that can replace native plants and vegetation communities.

Operation of the RWS over the long-term would reduce dependence on groundwater pumping within the general project area. This may lead to stable or higher groundwater levels supporting native vegetation and vegetation communities.

Mitigation and Residual Impacts

The following mitigation measures would be implemented under all action alternatives:

- Prior to construction, current special status plant data and the adequacy of historic surveys would be reviewed, due to construction being conducted in phases.
- Construction would be limited to the smallest (narrowest) possible footprint.

- Special status plant species identified in the general project area would be mapped or flagged to protect individual plants from being destroyed during construction.
- Native vegetation at work sites would be avoided to the extent possible. If large, native, woody vegetation (primarily cottonwood) needs to be trimmed or removed, it would be replaced at a ratio of 10:1 for every healthy, mature tree and 5:1 for every young or diseased cottonwood removed.
- When and where possible, small, native, woody vegetation would be removed or harvested at the appropriate season to use for revegetating another location in the project area or another project site. Native vegetation that cannot be replanted may be mulched; mulch would be removed or spread on the site, at a depth of 3 inches or less. Alternatively, the mulch would be temporarily stockpiled and used to create dead tree snags or brush piles in the project area on completion.
- Disturbed areas would be reseeded with an appropriate native seed mix as soon as possible after construction to limit the spread of noxious weeds. Disturbed sites would be monitored to help establish desirable species and remove noxious weeds. Standard BMPs would be used to reduce the spread of weeds, including washing all equipment before it is brought onsite. In some portions of revegetated areas, such as along the riverbank near the primary source water collection facility, trees would not be allowed to grow, but grass and shrubs would be allowed.
- Riparian areas would be replanted with such vegetation as willows, as appropriate, and would subject to landowner approval.

Although mitigation efforts would help reduce impacts related to the proposed RWS, residual impacts would include loss of vegetation communities that could support special status plant species during project construction. Loss of mature cottonwood trees may remove potential future nesting and perching sites for wildlife as well as roots that limit erosion. In addition, although BMPs would be employed during construction, noxious weeds would likely continue to spread and replace existing wildlife habitat.

4.10.3.3 Alternative B—HKM Implementable

Direct and indirect impacts associated with Alternative B are the same as those described under **Section 4.10.3.2**, Impacts Common to All Action Alternatives.

Table 4-27, below, outlines the total short- and long-term disturbance anticipated under Alternative B and the breakdown of disturbance, focusing only on those vegetative communities that may provide special status plant species habitat. Anticipated disturbance acreage includes a variety of land cover types, including unvegetated, previously disturbed, and developed lands. No Riparian Wet Meadows occur within the footprint of this alternative, but approximately 1.24 acres (or approximately 55 cottonwood trees) may be affected during construction under Alternative B. No additional cottonwoods would be lost due to drawdown impacts from this alternative.

Table 4-27. Alternative B Disturbance of Vegetation Communities Associated with Special Status Plant Species

Vegetation Communities Associated with Special Status Plant Species	Short-Term Disturbance (Acres)	Long-Term Disturbance (Acres)
Intermountain Basins Semi-Desert Grassland	442	13
Southern Rocky Mountain Piñon-Juniper Woodland	155	8
Southern Rocky Mountain Juniper Woodland Savanna	309	27
Rocky Mountain Ponderosa Pine Woodland	7	0
Western Great Plains Foothill and Piedmont Grassland	13	0
Riparian Wet Meadows	1	0
Total estimated disturbance in all areas	**927**	**48**

Sources: Reclamation GIS 2017; SWReGAP 2014
Note: Since only selected vegetation communities are listed above, the total estimated disturbance is greater than the total disturbance of vegetation communities associated with special status plant species in this table.

Mitigation and Residual Impacts

Mitigation and residual impacts on vegetation communities (including cottonwood trees), special status plant species, and noxious weeds under Alternative B would be the same as those discussed under **Section 4.10.3.2**, Impacts Common to All Action Alternatives.

4.10.3.4 Alternative C

Direct and indirect impacts associated with Alternative C are the same as those described under **Section 4.10.3.2**, Impacts Common to All Action Alternatives**. Table 4-28**, below, outlines the total short- and long-term disturbance anticipated under Alternative C and the breakdown of disturbance focusing on only those vegetative communities that may provide special status plant species habitat. Anticipated disturbance acreage includes a variety of land cover types, including unvegetated, previously disturbed, and developed lands.

No Riparian Wet Meadows occur within the footprint of this alternative; however, cottonwood trees near the intake system may be affected long term. Approximately 3 acres (or approximately 142 cottonwood trees) could be affected under Alternative C. No additional cottonwoods would be lost due to drawdown.

Mitigation and Residual Impacts

Mitigation and residual impacts on vegetation communities (including cottonwood trees), special status plant species, and noxious weeds under Alternative C would be the same as those discussed under **Section 4.10.3.2**, Impacts Common to All Action Alternatives.

4.10.3.5 Alternative D

Direct and indirect impacts associated with Alternative D are the same as those described under **Section 4.10.3.2**, Impacts Common to All Action Alternatives. **Table 4-29**, below, outlines the total short- and long-term disturbance anticipated under Alternative D and the breakdown of disturbance, focusing only on those vegetative communities that may

Table 4-28. Alternative C – Disturbance of Vegetation Communities Associated with Special Status Plant Species

Vegetation Communities Associated with Special Status Plant Species	Short-Term Disturbance (Acres)	Long-Term Disturbance (Acres)
Intermountain Basins Semi-Desert Grassland	421	8
Southern Rocky Mountain Piñon-Juniper Woodland	152	6
Southern Rocky Mountain Juniper Woodland Savanna	268	9
Rocky Mountain Ponderosa Pine Woodland	9	1
Western Great Plains Foothill and Piedmont Grassland	12	0
Riparian Wet Meadows	1	0
Total estimated disturbance in all areas	**863**	**24**

Sources: Reclamation GIS 2017; SWReGAP 2014
Note: Since only selected vegetation communities are listed above, the total estimated disturbance is greater than the total disturbance of vegetation communities associated with special status plant species in this table.

Table 4-29. Alternative D – Disturbance of Vegetation Communities Associated with Special Status Plant Species

Vegetation Communities Associated with Special Status Plant Species	Short-Term Disturbance (Acres)	Long-Term Disturbance (Acres)
Intermountain Basins Semi-Desert Grassland	421	8
Southern Rocky Mountain Piñon-Juniper Woodland	147	8
Southern Rocky Mountain Juniper Woodland Savanna	262	8
Rocky Mountain Ponderosa Pine Woodland	7	0
Western Great Plains Foothill and Piedmont Grassland	11	0
Riparian Wet Meadows	1	0
Total estimated disturbance in all areas	**849**	**24**

Sources: Reclamation GIS 2017; SWReGAP 2014
Note: Since only selected vegetation communities are listed above, the total estimated disturbance is greater than the total disturbance of vegetation communities associated with special status plant species in this table.

provide special status plant species habitat. Anticipated disturbance acreage includes a variety of land cover types, including unvegetated, previously disturbed, and developed lands.

Approximately 10 acres (or approximately 455 cottonwoods) may be affected under Alternative D. In addition, 0.05 acres (or approximately two more cottonwoods) could be affected, based on the modeled drawdown data for this project area (INTERA 2016a).

Mitigation and Residual Impacts

Mitigation and residual impacts on vegetation communities (including cottonwood trees), special status plant species, and noxious weeds under Alternative D would be the same as those discussed under **Section 4.10.3.2**, Impacts Common to All Action Alternatives.

4.10.3.6 Alternative E (Preferred Alternative)

Direct and indirect impacts associated with Alternative E are the same as those described under **Section 4.10.3.2**, Impacts Common to All Action Alternatives. **Table 4-30**, below, outlines the total short- and long-term disturbance anticipated under Alternative E and the breakdown of disturbance, focusing only on those vegetative communities that may provide special status plant species habitat.

Anticipated disturbance acreage includes a variety of land cover types, including unvegetated, previously disturbed, and developed lands. No Riparian Wet Meadows occur within the footprint of this alternative, but approximately 1.26 acres (or approximately 57 cottonwood trees) may be affected under Alternative. E. In addition, 0.98 acres (or approximately 44 additional cottonwoods) could be affected, based on the modeled drawdown data for this project area (INTERA 2016a).

Table 4-30. Alternative E – Disturbance of Vegetation Communities Associated with Special Status Plant Species

Vegetation Communities Associated with Special Status Plant Species	Short-Term Disturbance (Acres)	Long-Term Disturbance (Acres)
Intermountain Basins Semi-Desert Grassland	362	4
Southern Rocky Mountain Piñon-Juniper Woodland	104	6
Southern Rocky Mountain Juniper Woodland Savanna	224	7
Rocky Mountain Ponderosa Pine Woodland	6	0
Western Great Plains Foothill and Piedmont Grassland	4	0
Riparian Wet Meadows	1	0
Total estimated disturbance in all areas	**701**	**17**

Sources: Reclamation GIS 2017; SWReGAP 2014
Note: Since only selected vegetation communities are listed above, the total estimated disturbance is greater than the total disturbance of vegetation communities associated with special status plant species in this table.

Mitigation and Residual Impacts

Mitigation and residual impacts on vegetation communities (including cottonwood trees), special status species, and noxious weeds under Alternative E would be the same as those discussed under **Section 4.10.3.2**, Impacts Common to All Action Alternatives.

4.10.3.7 Summary of Impacts

- Construction of the RWS would result in short-term disturbance of between 856 and 1,203 acres in the vegetation communities under each action alternative. Disturbed acres include habitats where special status plant species could occur. There would be direct impacts from construction on vegetation communities that may be difficult to mitigate and restore.
- Constructed facilities would permanently disturb between 26 and 51 acres of vegetation communities; here, special status plant species could occur under each action alternative.
- Few special status plants have been located so far in surveys, and the ones that have been identified may be avoided with no direct impacts; however, indirect impacts would occur due to habitat loss.
- Native vegetation at work sites would be avoided to the extent possible. If large, native, woody vegetation (primarily cottonwood) needs to be trimmed or removed, it would be replaced at a ratio of 10:1 for every healthy, mature tree and 5:1 for every young or diseased cottonwood removed. In such cases, and where possible, it would be removed or harvested at the appropriate season to use for revegetating another location in the project area or at another project site. Native vegetation that cannot be replanted may be mulched; mulch would be removed or spread on the site, at a depth of 3 inches or less. Alternatively, the mulch would be temporarily stockpiled and used to create dead tree snags or brush piles in the project area on completion.
- Soils disturbance during and immediately after construction would potentially lead to an increase in noxious weeds in disturbed areas. Ongoing operation of facilities may also increase the spread of weeds in existing habitats.

4.10.4 Rio Pojoaque Irrigation Improvement Project

4.10.4.1 Alternative RP-A—No Action

Under Alternative RP-A, No Action, the Rio Pojoaque irrigation improvement project would not be completed (**Section 2.7**, Rio Pojoaque Irrigation Improvement Project Alternatives). The existing Rio Pojoaque Barrier Dam would continue operating with its current design. Because of the limited recharge of the alluvium and a lower groundwater table, vegetation growth may be hindered.

Mitigation and Residual Impacts

Under Alternative RP-A, no mitigation is proposed and therefore no residual impacts would occur.

4.10.4.2 Impacts Common to All Action Alternatives

Under the action alternatives, the anticipated long-term surface disturbance would be very minor (5 acres or less), and would not vary greatly between alternatives. Short-term construction disturbance would vary between the alternatives from <1 acre to 38 acres. The proposed project is in and adjacent to the river. There is little undisturbed land or

vegetated land that would be affected by alternatives. No direct or indirect impacts on existing vegetation communities are anticipated.

To date, no special status plant species have been identified within the Rio Pojoaque irrigation improvement project area. Therefore, no direct or indirect impacts on special status plants are anticipated under the action alternatives.

No cottonwood galleries or individual trees would be affected by the Rio Pojoaque irrigation improvement project. This project area consists of mainly coyote willow and large Siberian elm trees. Construction of the infrastructure would disturb soils and potentially increase the spread of weeds in the project area and adjacent vegetation communities.

Mitigation and Residual Impacts

The following mitigation measures would be implemented:

- Construction areas would be limited to the smallest (narrowest) possible footprint.
- Native vegetation at work sites would be avoided to the extent possible. If large, native, woody vegetation (primarily cottonwood) needs to be trimmed or removed, it would be replaced at a ratio of 10:1 for every healthy, mature tree and 5:1 for every young or diseased cottonwood removed. In such cases, and where possible, it would be removed or harvested at the appropriate season to use for revegetating another location in the project area or at another project site. Native vegetation that cannot be replanted may be mulched; mulch would be removed or spread on the site, at a depth of 3 inches or less. Alternatively, the mulch would be temporarily stockpiled and used to create dead tree snags or brush piles in the project area on completion.
- Disturbed areas would be reseeded with an appropriate native seed mix as soon as possible after construction to limit the spread of noxious weeds. Disturbed sites would be monitored to help establish desirable species and remove noxious weeds. Standard BMPs would be used to reduce the spread of weeds, including washing all equipment before it is brought onsite.
- Riparian areas would be replanted with such vegetation as willows, as appropriate and subject to landowner approval.

4.10.4.3 Alternative RP-B

Under Alternative RP-B, the existing Rio Pojoaque Barrier Dam would be extended from the north edge of the existing dam, across the Rio Pojoaque, to its north bank. The extended barrier dam would improve the effectiveness of the barrier dam in recharging the alluvium and diverting alluvial flows to the Rio Pojoaque infiltration gallery under drought conditions.

Potential direct and indirect impacts would be the same as those discussed under **Section 4.10.4.2**, Impacts Common to All Action Alternatives. Alternative RP-B would have a short-term disturbance of <1 acre, and there would be no long-term disturbance. Due to the minimal surface disturbance, impacts on vegetation are not anticipated. Better recharge may provide a higher water table locally for vegetation.

Mitigation and Residual Impacts

Mitigation and residual impacts are the same as those discussed for **Section 4.10.4.2**, Impacts Common to All Action Alternatives.

4.10.4.4 Alternative RP-C (Preferred Alternative)

Under Alternative RP-C (Preferred Alternative), Rio Pojoaque water would be diverted into a conveyance system that would tie into the existing Pueblo de San Ildefonso irrigation system.

Potential direct and indirect impacts would be the same as those discussed under **Section 4.10.4.2**, Impacts Common to All Action Alternatives. Direct impacts associated with Alternative RP-C would be limited to any disturbance of vegetated areas. No cottonwood galleries are present within this reach of the Rio Pojoaque. Russian olive, Siberian elm, and coyote willow trees are present along the riverbank in this area. Alternative RP-C would have a short-term disturbance of 11 acres and long-term disturbance of 5 acres.

Mitigation and Residual Impacts

Mitigation and residual impacts are the same as those discussed for **Section 4.10.4.2**, Impacts Common to All Action Alternatives.

4.10.4.5 Alternative RP-D

Under Alternative RP-D, Reclamation would analyze the working condition of the existing infiltration gallery within the context of the surrounding stratigraphy. Based on this analysis, Reclamation would identify operational issues that could be addressed to improve infiltration to the Pueblo de San Ildefonso irrigation system. Work would be conducted within the river channel. Potential direct and indirect impacts would be the same as those discussed under **Section 4.10.4.2**, Impacts Common to All Action Alternatives. Impacts on vegetation are not anticipated.

Mitigation and Residual Impacts

Mitigation and residual impacts are the same as those discussed for **Section 4.10.4.2**, Impacts Common to All Action Alternatives.

4.10.4.6 Alternative RP-E

Under Alternative RP-E, Reclamation would add approximately 2,543 feet of perforated pipe to the existing Rio Pojoaque infiltration gallery to deliver more water to the Pueblo de San Ildefonso irrigation system. Eighteen-inch perforated pipe would be installed, with a bed of engineered gravel for the infiltration gallery extension. Potential direct and indirect impacts on vegetation would be the same as those discussed under **Section 4.10.4.2**, Impacts Common to All Action Alternatives.

Direct impacts associated with Alternative RP-E would be limited to any disturbance of vegetated areas. No cottonwood galleries are present within this reach of the Rio Pojoaque. Alternative RP-E would have a short-term disturbance of 38 acres and long-term disturbance of 2 acres. Better recharge may provide a higher water table locally for vegetation.

Mitigation and Residual Impacts

Mitigation and residual impacts are the same as those discussed for **Section 4.10.4.2**, Impacts Common to All Action Alternatives.

4.10.4.7 Summary of Impacts

Under the action alternatives, the anticipated long-term surface disturbance would be very minor and would not vary greatly between alternatives. Short-term construction disturbance would vary between the alternatives, from <1 acre to 38 acres. There would be between <1 and 5 acres of long-term impacts. There is little undisturbed land or vegetated land that would be affected by the action alternatives. No direct or indirect impacts on existing vegetation communities are anticipated.

No special status plant species were identified in this area during field surveys. Construction activities for the Rio Pojoaque irrigation improvement project would not directly or indirectly impact special status plant species.

Cottonwood trees or cottonwood galleries would not be affected during the implementation of any of the action alternatives. Construction could, however, potentially result in the spread of noxious weeds.

4.10.5 Rio Tesuque Channel Modification Project

4.10.5.1 Alternative RT-A—No Action

Under Alternative RT-A, the Rio Tesuque channel modification project would not be completed. Because of the limited recharge of the alluvium and a lower groundwater table, riparian vegetation growth may be hindered.

Mitigation and Residual Impacts

Under Alternative RT-A, no mitigation is proposed, and therefore no residual impacts would occur.

4.10.5.2 Impacts Common to All Action Alternatives

Under the action alternatives, the anticipated long-term surface disturbance would be very minor, and would not vary greatly between alternatives. Short-term construction disturbance would vary between the alternatives from 4 acres to 13 acres. Long-term construction disturbance would vary between the alternatives, from <1 acres to 4 acres.

The proposed project is in and adjacent to the river. There is little undisturbed land or vegetated land that would be affected by alternatives. No direct or indirect impacts on existing vegetation communities are anticipated.

No special status plant species have been identified within the Rio Tesuque channel modification project area. Therefore, no direct or indirect impacts on special status plants are anticipated under the action alternatives.

Approximately 0.6 acres of cottonwood galleries are present on the north side of the channel and may be affected by the project. The number of cottonwood trees (if any), that could be affected under each alternative has not been determined.

Construction of the infrastructure would disturb soils and potentially increase the spread of weeds in the project area and adjacent vegetation communities.

Mitigation and Residual Impacts

The following mitigation measures would be implemented for the Rio Tesuque channel modification project:

- Construction areas would be limited to the smallest (narrowest) possible footprint.
- Native vegetation at work sites would be avoided to the extent possible. If large, native, woody vegetation (primarily cottonwood) needs to be trimmed or removed, it would be replaced at a ratio of 10:1. In such cases, and where possible, it would be removed or harvested at the appropriate season to use for revegetating another location in the project area or at another project site. Native vegetation that cannot be replanted may be mulched; mulch would be removed or spread on the site, at a depth of 3 inches or less. Alternatively, the mulch would be temporarily stockpiled and used to create dead tree snags or brush piles in the project area on completion.
- Disturbed areas would be reseeded with an appropriate native seed mix as soon as possible after construction to limit the spread of noxious weeds. Disturbed areas would be monitored to help establish desirable species and remove noxious weeds. Standard BMPs would be used to reduce the spread of weeds, including washing all equipment before it is brought onsite.
- Riparian areas would be replanted with such vegetation as willows, as appropriate and subject to landowner approval.

4.10.5.3 Alternative RT-B

Under Alternative RT-B, the Rio Tesuque channel modification project would restore the existing incised channel between the Upper Ponds Diversion Dam and the U.S. Highway 84/285 bridge. This restoration would aim to reconnect the channel with its floodplain, allowing excess water to spill over the channel banks and into the floodplain.

Potential direct and indirect impacts would be the same as those discussed under **Section 4.10.5.2**, Impacts Common to All Action Alternatives. Alternative RT-B would have a short-term disturbance of 11 acres and long-term disturbance of 3 acres. Due to the minimal surface disturbance, impacts on vegetation are not anticipated. Channel restoration and a higher water table may enhance riparian vegetation.

Mitigation and Residual Impacts

Mitigation and residual impacts are the same as those discussed for **Section 4.10.5.2**, Impacts Common to All Action Alternatives.

4.10.5.4 Alternative RT-C

Alternative RT-C would be similar to Alternative RT-B and would be constructed along the same sub-reach discussed under that alternative. The major difference under Alternative RT-C is that, rather than encouraging the channel to follow the channel

evolution processes, a new channel would be excavated within the existing floodplain to the east of the current channel alignment. This alternative is still intended to restore natural geomorphic processes, improve floodplain connection, reduce main channel velocities during high flow events, and to reduce risk of damage to the irrigation ponds.

Potential direct and indirect impacts would be the same as those discussed under **Section 4.10.5.2**, Impacts Common to All Action Alternatives. Alternative RT-C would have a short-term disturbance of 13 acres and long-term disturbance of 4 acres. Due to the minimal surface disturbance, significant impacts on vegetation are not anticipated. The creation of the new channel and floodplain restoration with a higher water table may enhance riparian vegetation.

Mitigation and Residual Impacts

Mitigation and residual impacts are the same as those discussed for **Section 4.10.5.2**, Impacts Common to All Action Alternatives.

4.10.5.5 Alternative RT-D (Preferred Alternative)

Under Alternative RT-D, the Rio Tesuque channel modification project would remove a sediment spoil pile from the east side of the Rio Tesuque, just upstream of the TP-806 Bridge. No vegetation is expected to be directly or indirectly affected by the removal of the spoil pile. Potential direct and indirect impacts would be the same as those discussed under **Section 4.10.5.2**, Impacts Common to All Action Alternatives. Alternative RT-D would have a short-term disturbance of 4 acres. Long-term disturbance would be <1 acres.

Mitigation and Residual Impacts

Mitigation and residual impacts are the same as those discussed for **Section 4.10.5.2**, Impacts Common to All Action Alternatives.

4.10.5.6 Alternative RT-E

Under Alternative RT-E, the Rio Tesuque channel modification project would involve construction of an infiltration gallery upstream of the Upper Ponds Diversion Dam to collect water from the Rio Tesuque and transmit the water to the Pueblo of Tesuque irrigation system.

Potential direct and indirect impacts would be the same as those discussed under **Section 4.10.5.2**, Impacts Common to All Action Alternatives. Alternative RT-E would have a short-term disturbance of 5 acres and long-term disturbance of 1 acre. Due to the minimal surface disturbance, impacts on vegetation are not anticipated. The creation of the new infiltration gallery may raise the water table and enhance riparian vegetation.

Mitigation and Residual Impacts

Mitigation and residual impacts are the same as those discussed for **Section 4.10.5.2**, Impacts Common to All Action Alternatives.

4.10.5.7 Summary of Impacts

Under the action alternatives, the anticipated long-term surface disturbance would be very minor (4 acres or less), and would not vary greatly between alternatives. Short-term construction disturbance would vary between the alternatives from 4 acres to 13 acres. Long-term disturbance would vary between alternatives, from <1 acre to 4 acres. The proposed project is in and adjacent to the river. There is little undisturbed land or vegetated land that would be affected by the action alternatives. No direct or indirect impacts on existing vegetation communities are anticipated.

No special status plant species were identified in this area during field surveys. Construction activities for the Rio Tesuque channel modification project would not directly or indirectly impact special status plant species.

Approximately 0.6 acres of cottonwood galleries are present on the north side of the channel and may be affected by the project. The number of cottonwood trees (if any), that could be affected under each alternative is approximately 45 mature cottonwoods per acre.

Construction would potentially result in the spread of noxious weeds.

4.10.6 Pueblo de San Ildefonso Future Projects Alternatives

4.10.6.1 Alternative SI-A—No Action

Under Alternative SI-A, No Action, the Pueblo de San Ildefonso future projects alternative would not be constructed. The objectives of the project described in **Section 1.4** would not be realized. There would be no construction of facilities and no resultant potential direct or indirect effects on vegetation.

Mitigation and Residual Impacts

There would be no mitigation and residual impacts under the No Action Alternative for this project area.

4.10.6.2 Alternative SI-B—Proposed Wastewater and Water Infrastructure

The proposed Pueblo de San Ildefonso preliminary wastewater system design could affect vegetation. Direct and indirect impacts on vegetation would be the same types as those described above for the RWS project; however, direct and indirect impacts would be on a smaller scale than for the RWS project. This is because the project's direct short-term impacts would be on only 59 acres.

Table 4-31, below, outlines the total short-term disturbance from the proposed wastewater system improvements anticipated under Alternative SI-B and the breakdown of disturbance. It focuses only on those vegetation communities that may provide special status plant species habitat. Anticipated disturbance acreage includes a variety of land cover types, such as unvegetated, previously disturbed, and developed lands.

Table 4-31. Alternative SI-B Disturbance of Vegetation Communities Associated with Special Status Plant Species

Vegetation Communities Associated with Special Status Plant Species	Long-Term Disturbance (Acres)	Short-Term Disturbance (Acres)
Intermountain Basins Semidesert Grassland	0	37
Southern Rocky Mountain Piñon-Juniper Woodland	2	0
Southern Rocky Mountain Juniper Woodland Savanna	0	7
Rocky Mountain Ponderosa Pine Woodland	0	0
Western Great Plains Foothill and Piedmont Grassland	0	2
Riparian Wet Meadows	0	0
Total estimated disturbance in all areas	**2**	**46**

Sources: Reclamation GIS 2017; SWReGAP 2014
Note: Since only selected vegetation communities are listed above, the actual total estimated disturbance is greater than the total disturbance of vegetation communities associated with special status plant species.

Under Alternative SI-B, there would be long-term disturbance of 2 acres of vegetation communities that may provide special status plant species habitat, and there would be short-term construction disturbance of 46 acres. Direct impacts related to this project would result from removing vegetation from the construction footprint. Indirect impacts would be associated with the potential spread of noxious weeds in the disturbed areas. No special status plant species were identified in this area during field surveys; therefore, construction for Alternative SI-B would not directly or indirectly impact special status plant species.

In addition to, and separate from, the wastewater system improvements, the Pueblo de San Ildefonso is considering water-related infrastructure in a 680-acre area, near the northern boundary of the Pueblo, along with three potential new pipeline alignments. The other water-related infrastructure projects could result in vegetation removal and the spread of noxious weeds within the 680-acre area analyzed.

No cottonwood galleries are present under Alternative SI-B, so no cottonwoods would be affected by the project.

Mitigation and Residual Impacts

The following mitigation measures would be implemented under Alternative SI-B:

- Construction areas would be limited to the smallest (narrowest) possible footprint.
- Disturbed areas would be reseeded with an appropriate native seed mix as soon as possible after construction to limit the spread of noxious weeds. Disturbed areas would be monitored to help establish desirable species and remove noxious weeds. To reduce the spread of weeds, standard BMPs would be used, including washing all equipment before it is brought on-site.

4.11 Wetlands, Non-wetland Waters, and Floodplains

This section addresses potential impacts on aquatic resources regulated under Sections 404 and 401 of the CWA, including wetlands, non-wetland waters, and floodplains, from actions associated with each alternative. Waterways were identified on four settlement Pueblos and on non-Pueblo lands, and each identified OHWM was delineated. The results are documented in the Pojoaque Basin Regional Water System Wetland and Non-wetland Waters Delineation Report (Parametrix 2017).

4.11.1 Impact Indicators

The following indicators, as described in **Table 3-1**, were used to analyze impacts on wetlands, non-wetland waters, and floodplains:

- Wetlands—Acres and locations of wetlands that would be disturbed during construction
- Non-wetland waters—Changes to the OHWM
- Floodplains—Change in flooded areas within the FEMA-designated special flood hazard zones

In addition, because projects discussed in this section could change groundwater elevations, the following additional indicator was used to analyze indirect impacts on wetlands:

- Acres and locations of wetlands that could be affected by changes in hydrology

4.11.2 Analysis Methods and Assumptions

Wetland impacts were assessed by determining areas where proposed facilities would directly intersect with potential wetlands. The area of analysis for determining direct wetland impacts was the biological resources area of analysis. The area of analysis for determining indirect wetland impacts was the general project area.

The following assumptions were used in analyzing wetland and non-wetland impacts on all areas affected by the project:

- The Pojoaque Basin Regional Water System Wetland and Non-wetland Waters Delineation Report (Parametrix 2017) was prepared for this project. The report addresses wetlands and non-wetland waters in the area of analysis, including any associated short-term and long-term impacts.
- Once the USACE has reviewed the report, it will coordinate with Reclamation and the Settlement Pueblos regarding its findings.

For floodplains, the Rio Grande and Pojoaque Basins comprise the area of analysis. The general project area is found within part of this area of analysis. Potential flood impacts of alternative infrastructure and channel modifications were evaluated by conducting hydraulic modeling using the USACE's River Analysis System (**Appendix I**). The intent of this modeling was to provide an estimate of potential floodplain impacts, based on the

level of design detail that is available. Estimates of flows for various flood risks were generated using the USGS (2008) regional regression equations.

4.11.3 RWS Alternatives

4.11.3.1 Alternative A—No Action

Under Alternative A, no RWS construction, operation, or maintenance would occur; therefore, Alternative A would have no direct impacts on wetlands or non-wetland waters in the biological resources area of analysis (**Figure 3-8**, Biological Resources Area of Analysis) or the general project area.

However, the continuing depletion of groundwater could limit plant growth within the biological resources area of analysis and the general project area. Lowering the water table could also increase the spread of noxious weeds due to changed hydrology. All plants, including upland and riparian vegetation, could be affected by diminished groundwater over time; therefore, gradual drawdown of the water table could have a direct and an indirect impact on wetlands and non-wetland waters over time.

Reduced groundwater and surface flows could result in less water availability, which may affect wetland function and sustainability in the future.

There would be no impacts on wetland or non-wetland waters associated with distribution lines and pipeline installation or other additional infrastructure.

For floodplains, flood risk in the area of analysis in the short-term would not change. Future development in the basin may affect flood risk, although it would be regulated under the respective jurisdictional flood ordinances and the FEMA National Flood Insurance Program, as applicable.

Reclamation evaluated future climate change scenarios (see **Section 3.9**, Climate Change), up to year 2100. In general, Reclamation's evaluation of various climate change scenarios indicates the potential for drier conditions overall. Flood risk, conversely, may increase, due to higher potential for faster snow melt.

Mitigation and Residual Impacts

Under Alternative A, no mitigation is proposed and no residual impacts would occur.

4.11.3.2 Impacts Common to All Action Alternatives

For wetlands, the following impacts would occur for all of the action alternatives:

- Under each action alternative, direct impacts on wetlands and non-wetland waters would vary, based on the location and acreage of ground disturbance necessary to accommodate each infrastructure component. Most wetlands would be avoided by boring under arroyos and rerouting pipelines and facilities. There would be <1 to 3 acres of wetlands in the project area that would be directly affected by pipelines and other facilities, depending on the alternative.
- Where all pipeline and related transportation crossings occur, delineated wetlands and non-wetland water crossings exhibiting an OHWM were documented. Reference guides used in conducting delineations included

USACE Arid West Regional Supplements (Curtis and Lichvar 2010; Lichvar and McColley 2008; USACE 2008).

- There would be 15 to 20 acres of non-wetland waters directly affected by pipelines and other facilities, depending on the alternative.
- Site evaluations determined the potential temporary and permanent impacts at each non-wetland water. Specific project-related impacts on wetlands and non-wetland water are identified in the Pojoaque Basin Regional Water System Wetland and Non-wetland Waters Delineation Report (Parametrix 2017).
- In some cases, the action alternatives may increase tributary flows, resulting in improved conditions for wetlands. There is potential for the water table to rise, allowing more water to be available for some wetlands that are dependent on groundwater (i.e., those wetlands not associated with waterways). Increased water could result in increased wetlands, counteracting any short-term construction impacts.
- Indirect impacts on wetlands associated with the recharging alluvium along the Rio Pojoaque and the Rio Tesuque banks could be indirectly affected by increased water availability.
- The action alternatives could increase groundwater resources within the general project area. The alternatives would reduce pumping from some existing wells and could allow water levels and wetlands to recover over time.

For floodplains, the presence of various transmission and distribution pipes would vary by project alternative, but the locations of proposed pipelines in the delineated floodplain would not change.

Table 4-32, Transmission and Distribution Pipelines in the 100-Year Floodplain, lists the maximum miles of proposed pipelines in floodplains recognized by FEMA. The alternative with the maximum miles in each area may vary. The numbers shown in the table are the maximum miles under any alternative for each area. Pipelines are a combination of crossings and runs that are parallel to arroyos and rivers.

Table 4-32. Transmission and Distribution Pipelines in the 100-Year Floodplain

	Maximum Miles of Transmission and Distribution Pipelines		
Floodplain Location	Detailed Study Floodplains (Zone AE)	Approximate Study Floodplains (Zone A)	Total
Pueblo of Nambé	0	4	4
Pueblo of Pojoaque	1	8	9
Pueblo de San Ildefonso	4	4	8
Pueblo of Tesuque	0	2	2
Santa Fe County	2	2	4

Sources: Reclamation GIS 2017; FEMA 2012

All proposed pipelines would be buried. Pipelines built under major watercourses would be constructed by jack-and-bore technology, which does not include drilling or drilling mud. With no infrastructure aboveground to impede flow, the project would cause no long-term direct impacts on floodplains from pipeline infrastructure.

Some pipelines may be protected from scour using riprap (rock placed within the channel) or other means. **Section 2.6**, RWS Alternatives Considered in Detail, provides additional detail on pipeline crossings where this protection may occur. This protection is generally designed for floods generating scour, which are typically those that are more frequent than the 100-year flood. The locations of new electrical lines within floodplains would vary by alternative; these impacts are described within each alternative.

Mitigation and Residual Impacts

For delineated wetlands and non-wetland waters, mitigation and residual impacts for all action alternatives are summarized below:

- Waterline crossings may create temporary impacts, and bank stabilization and transportation crossings would be considered permanent impacts.
- Until Reclamation develops a mitigation plan and the USACE approves it, a determination of residual impacts cannot be made.
- Compensatory mitigation would be required for unavoidable impacts once avoidance and minimization measures have been demonstrated. The USACE may also require minimization measures for temporary impacts on wetlands and non-wetland riparian areas; this may include revegetation, with multi-year monitoring.

For floodplains, construction within delineated floodplains could cause short-term increases in flood risk. Such temporary impacts could arise due to coffer dams, construction activities, or stock-piled materials in the floodplain. This could be mitigated through scheduling construction during low-flow periods, when the historic chance of floods is reduced. **Table 4-33**, below, for example, provides the frequency of the floods on the Rio Grande at Otowi by month. Construction scheduled before April or after June would decrease the short-term flood risks. A recommended construction schedule for activities within floodplains is to avoid spring runoff and monsoons. Other considerations, such as MBTA obligations, would help determine the construction time frame. Temporary flood risks are described separately for each alternative. Project contractors would be required to assess and mitigate flood risk caused by temporary construction conditions.

Table 4-33. Frequency of Flooding on Rio Grande at Otowi Bridge

	Number of Times Flood Occurred in a Reoccurrence Interval					
Month	100-year	50-year	25-year	10-year	5-year	2-year
January	0	0	0	0	0	0
February	0	0	0	0	0	0
March	0	0	0	0	0	0
April	0	0	0	1	4	22
May	4	5	8	10	29	61
June	1	2	7	9	13	25
July	0	0	0	0	1	7
August	0	0	0	0	0	0
September	0	0	0	1	0	0
October	30	0	1	0	2	2
November	0	0	0	0	0	0
December	0	0	0	0	0	0

Sources: Reclamation 2015b; USGS 2008

4.11.3.3 Alternative B—HKM Implementable

Alternative B incorporates the RWS facilities and components analyzed in the 2008 report prepared by HKM Engineering, Inc. (**Section 2.6.2**, Alternative B: HKM Implementable Alternative).

For wetlands, direct and indirect effects would occur with Alternative B. In most cases, impacts on delineated wetlands would be avoided by boring under arroyos and rerouting pipelines and facilities. Facilities such as pipelines, transmission and distribution lines, and pumping plants related to the side channel surface diversion structure could directly impact delineated wetlands. Approximately <1 acre of wetlands would be directly affected by pipelines, transmission lines, and other project facilities, temporarily. No permanent impacts are expected from this alternative.

Site visits to delineate OHWM at waterways determined the potential temporary and permanent impacts at each site. There would be 16 acres of non-wetland waters directly impacted temporarily and 4 acres permanently impacted, for a total of 20 acres impacted.

Specific project-related impacts on wetlands and non-wetland waters are identified in the Pojoaque Basin Regional Water System Wetland and Non-wetland Waters Delineation Report (Parametrix 2017).

Other impacts on wetlands and non-wetland waters are the same as those described under **Section 4.11.3.2**, Impacts Common to All Action Alternatives, for the RWS alternatives.

For floodplains, infrastructure associated with the surface water diversion would be within the 100-year floodplain of the Rio Grande, which is an approximate study floodplain (Zone A). The design of the side channel surface diversion structure would allow it to be overtopped during a 100-year flood event. The diversion would continue when overtopped, as long as debris does not clog the intake structure itself. The pumping

plant would be elevated 1 foot above the 100-year floodplain. The surface water collection system would have no impact on water surface elevations during a 100-year flood event.

The extent to which water transmission and distribution pipelines are within the FEMA-designated 100-year floodplain is described in **Section 4.11.3.2**. The transmission and distribution pipelines would be buried and would not have a direct impact on floodplains. Riprap and other scour protection measures would be designed to not have an impact on the 100-year floodplain.

The extent to which electrical distribution lines would be constructed within the FEMA designated 100-year floodplain is provided in **Table 4-34**, below. Electrical distribution lines may be either overhead or buried, although most of the new lines would be overhead. The overhead poles would be placed outside of the floodplain when possible. If they were within the floodplain, the poles would be placed so they would not impact floodplains. Buried electrical lines could have similar scour protection measures as the buried water transmission and distribution pipelines. The scour protection measures would be designed to limit increases in flood risk and would comply with FEMA permitting requirements.

Table 4-34. Extent of Electrical Distribution Lines within Floodplains (Alternative B)

	Feet of Electrical Distribution Lines		
Floodplain Location	**Detailed Study Floodplains (Zone AE)**	**Approximate Study Floodplains (Zone A)**	**Total**
Pueblo of Nambé	0	0	0
Pueblo of Pojoaque	0	8,960	8,960
Pueblo de San Ildefonso	0	4,616	4,616
Pueblo of Tesuque	0	0	0
Santa Fe County	38	202	240
Total	**38**	**13,778**	**13,816**

Sources: Reclamation GIS 2017; FEMA 2012

The proposed water treatment plant would be near an unnamed arroyo south of SH 502. The water treatment plant would not be within a designated floodplain.

Mitigation and Residual Impacts

Wetlands and non-wetland waters mitigation and residual impacts would be the same as those listed under **Section 4.11.3.2**, Impacts Common to All Action Alternatives, for the RWS.

No mitigation is proposed for floodplain impacts since floodplain impacts associated with Alternative B are within the regulatory limits of floodplain changes.

4.11.3.4 Alternative C

Direct and indirect impacts could occur in delineated wetlands and in non-wetland waters under Alternative C. Transmission and distribution pipelines and pumps related to the parallel river interceptor drain infrastructure could directly or indirectly impact delineated wetlands by removing water. In most cases, impacts on wetlands would be avoided by boring under arroyos and rerouting pipelines and facilities. Approximately <1 acres of delineated wetlands would be temporarily impacted; however, no permanent impacts are expected from pipelines, distribution lines, and other project facilities.

Site visits to delineate OHWM at waterways determined the potential temporary and permanent impacts under this alternative. There would be a total of 16 acres impacted, including 16 acres of temporary disturbance and <1 acres of permanent disturbance. Other wetland impacts are the same as those described under **Section 4.11.3.2**, Impacts Common to All Action Alternatives, for the RWS. The extent to which electrical distribution lines would be constructed within the FEMA designated 100-year floodplain is provided in **Table 4-35**.

Table 4-35. Extent of Electrical Distribution Lines within Floodplains (Alternative C)

	Feet of Electrical Distribution Lines		
Floodplain Location	Detailed Study Floodplains (Zone AE)	Approximate Study Floodplains (Zone A)	Total
Pueblo of Nambé	0	0	0
Pueblo of Pojoaque	0	567	567
Pueblo de San Ildefonso	0	3,784	3,784
Pueblo of Tesuque	0	0	0
Santa Fe County	337	0	337
Total	**337**	**4,351**	**4,688**

Sources: Reclamation GIS 2017; FEMA 2012

The water treatment plant under Alternative C would be near the El Rancho substation, along the unnamed arroyo that crosses SH 502, described above. It is approximately 0.3 miles upstream of the Highway 101E Bridge over the Rio Pojoaque. Of the 4.3-acre footprint of the water treatment plant, approximately <1 acre would be in the designated Zone A floodplain. The site service yard elevation would be at least 3 feet above the 100-year floodplain (Reclamation 2015b), which may cause the 100-year water surface elevation to increase.

Mitigation and Residual Impacts

Wetlands and non-wetland waters mitigation and residual impacts would be the same as those listed under **Section 4.11.3.2**, Impacts Common to All Action Alternatives, for the RWS.

No floodplain mitigation is proposed for the water collection infrastructure under Alternative C. The floodplain impacts of the proposed water treatment plant would be

evaluated and mitigated if necessary based on final engineering design. There would be no residual impacts on floodplains from the primary source water collection infrastructure. Residual floodplain impacts from the water treatment plant would be determined based on final design.

4.11.3.5 Alternative D

Direct and indirect impacts could occur in delineated wetlands and non-wetland waters under Alternative D. Transmission and distribution pipelines, along with pump related to the infiltration gallery could directly impact delineated wetlands. In most cases, impacts on delineated wetlands would be avoided by boring under arroyos and rerouting pipelines and facilities. Approximately 3 acres of wetlands would be directly affected by construction of pipelines, transmission lines, and other project facilities. This includes 3 acres of temporary disturbance and <1 acre of permanent disturbance.

Site visits to measure the OHWM at waterways in the biological resources area of analysis determined the potential short- and long-term impacts under Alternative D. There would be a total of 16 acres of non-wetland waters disturbed, including 16 acres of temporary disturbance and <1 acres of permanent disturbance. Other wetland impacts would be the same as described under **Section 4.11.3.2**, Impacts Common to All Action Alternatives, for the RWS.

For floodplains, the extent that electrical distribution lines are within the FEMA-designated 100-year floodplain is provided in **Table 4-36**, below. The electrical distribution lines within the floodplains in the Santa Fe County area would be eliminated under Alternative D. The impacts of electrical distribution lines would be the same as those described under Alternative B.

Table 4-36. Extent of Electrical Distribution Lines within Floodplains (Alternative D)

	Feet of Electrical Distribution Lines		
Floodplain Location	**Detailed Study Floodplains (Zone AE)**	**Approximate Study Floodplains (Zone A)**	**Total**
Pueblo of Nambé	0	0	0
Pueblo of Pojoaque	0	0	0
Pueblo de San Ildefonso	0	4,651	4,651
Pueblo of Tesuque	0	0	0
Santa Fe County	38	915	953
Total	**38**	**5,566**	**5,604**

Sources: Reclamation GIS 2017; FEMA 2012

Mitigation and Residual Impacts

Wetlands and non-wetland waters mitigation and residual impacts would be the same as those listed under **Section 4.11.3.2**, Impacts Common to All Action Alternatives, for the RWS. Floodplain mitigation and residual impacts are the same as those described under Alternative C.

4.11.3.6 Alternative E (Preferred Alternative)

Direct and indirect impacts could occur in delineated wetlands and non-wetland waters under Alternative E. Transmission and distribution pipelines related to the horizontal radial well collectors could directly impact delineated wetlands. In most cases, impacts on wetlands would be avoided by boring under arroyos and rerouting pipelines and facilities. Approximately <1 acres of delineated wetlands would be directly affected by pipelines and other project facilities, including <1 acres of temporary disturbance. There is no permanent disturbance expected.

Site visits to measure the OHWM at waterways in the biological resources area of analysis determined the potential short- and long-term impacts under Alternative E. There would be a total of 15 acres of non-wetland waters impacted. This includes 15 acres of temporary impacts, and <1 acre of permanent impacts. Other wetlands and non-wetlands water impacts would be the same as described under **Section 4.11.3.2**, Impacts Common to All Action Alternatives, for the RWS.

For floodplains, the collection caissons under Alternative E would be as close to the riverbank as possible; therefore, they would be within the Rio Grande floodplain. If the caissons are not flush to the ground, they would extend above the 100-year floodwater surface. The caissons could impede flood flows.

The construction of four caissons extending above the 100-year floodplain could increase water surface elevations by less than 1 inch. This is within the regulatory limit for this reach, and no mitigation is proposed.

The water treatment plant under Alternative E would be north of SH 502 and west of County Road 101D. It would not be within a designated floodplain.

The extent that electrical distribution lines are within the FEMA designated 100-year floodplain is provided in **Table 4-37**, below. Electrical distribution lines within the floodplain areas of the Pueblo of Pojoaque and Santa Fe County would be eliminated under Alternative E. The impacts of electrical distribution lines are the same as those described under Alternative B.

Table 4-37. Extent of Electrical Distribution Lines within Floodplains (Alternative E)

	Feet of Electrical Distribution Lines		
Floodplain Location	Detailed Study Floodplains (Zone AE)	Approximate Study Floodplains (Zone A)	Total
Pueblo of Nambé	0	0	0
Pueblo of Pojoaque	0	0	0
Pueblo de San Ildefonso	0	2,557	2,557
Pueblo of Tesuque	0	0	0
Santa Fe County	42	0	42
Total	**42**	**2,557**	**2,599**

Sources: Reclamation GIS 2017; FEMA 2012

Mitigation and Residual Impacts

Wetlands and non-wetland waters mitigation and residual impacts would be the same as those listed under **Section 4.11.3.2**, Impacts Common to All Action Alternatives, for the RWS. Floodplain mitigation and residual impacts are the same as those described for Alternative C.

4.11.3.7 Summary of Impacts

For wetlands and non-wetland waters, there could be construction disturbance as a result of trenching for transmission and distribution pipelines for all action alternatives. These direct impacts could be avoided by placing transmission and distribution lines under roadways or waterways rather than placing them through the wetlands or non-wetland waters. The action alternatives may require Sections 404 and 401 permitting under the CWA.

The action alternatives could increase groundwater resources within the general project area since a reduction of pumping from some existing wells could allow water levels to recover over time. Increased groundwater levels could increase wetland habitat in the general project area.

Floodplains could be affected by various project elements and alternatives. Caissons associated with horizontal radial well collectors (Alternative E) could have limited impacts on the 100-year floodplain.

4.11.4 Rio Pojoaque Irrigation Improvement Project

4.11.4.1 Alternative RP-A—No Action

If the Rio Pojoaque irrigation improvement project were not implemented, there would be no direct or indirect impacts on wetlands, non-wetland waters, or floodplains associated with transmission line or pipeline installation. The existing Rio Pojoaque irrigation system would continue to operate as it currently does.

Mitigation and Residual Impacts

Under Alternative RP-A, No Action, no mitigation is proposed, and no residual impacts would occur.

4.11.4.2 Impacts Common to All Action Alternatives

The goal of the Rio Pojoaque irrigation improvement project is to increase the efficiency of irrigation diversions into the Ortiz Ditch. There would be no temporary or permanent impacts on wetlands under any action alternatives. Impacts on floodplains are anticipated only under Alternative RP-B.

Site visits to delineate the OHWM at non-wetland waters in the biological resources area of analysis determined the potential temporary and permanent disturbance at each site: <1 to 3 acres of disturbance under Alternatives RP-B, RP-C, and RP-E. No temporary or permanent disturbance is expected under Alternative RP-D.

Sections 404 and 401 permitting may be required under the CWA. Specific project-related impacts on wetlands and non-wetland waters are identified in the Pojoaque Basin

Regional Water System Wetland and Non-wetland Waters Delineation Report (Parametrix 2017).

Mitigation and Residual Impacts

There are no wetlands in this project area, so there would be no mitigation; however, non-wetland waters may be affected by action alternatives. For unavoidable impacts, compensatory mitigation may be required once avoidance and minimization measures have been demonstrated. This may include revegetating riparian areas and multi-year monitoring to minimize temporary impacts. Other mitigation and residual impacts would be the same as those listed under **Section 4.11.3.2**, Impacts Common to All Action Alternatives, for the RWS.

4.11.4.3 Alternative RP-B

Under Alternative RP-B, the existing Rio Pojoaque Barrier Dam would be extended from the north edge of the existing dam, across the Rio Pojoaque, to its north bank. The extended barrier dam would improve the effectiveness of recharging the alluvium (loose sediment deposited on the riverbank) and diverting alluvial flows to the Rio Pojoaque infiltration gallery under drought conditions.

Wetlands would not directly or indirectly be affected by Alternative RP-B, since none are present within this project area.

Site visits to delineate the OHWM at non-wetland waters in the biological resources area of analysis determined the potential temporary and permanent impacts under Alternative RP-B; <1 acre would be disturbed due to construction of pipelines, transmission lines, and other project activities. This includes <1 acres of temporary disturbance and <1 acre of permanent disturbance.

The proposed barrier dam would cross the full Rio Pojoaque channel at a height of 3 feet above the stream bed (HKM 2008). The 100-year floodplain may increase in size and require modifying the maps of the existing delineated floodplain. **Table 4-38**, below, provides the estimated changes in floodwater surface elevations and flooded areas. A full channel-width dam would cause increases in water surfaces from 2.5 to 2.6 feet from

Table 4-38. Rio Pojoaque Irrigation Improvement Project Alternative RP-B Floodplain Changes

Flood Event Annual Probability (Reoccurrence Year)	Change in Water Surface Elevation (Feet)	Change in Flooded Area (Acres)
50 percent (2-year)	2.5	1.1
20 percent (5-year)	2.4	1.5
10 percent (10-year)	2.4	1.7
4 percent (25-year)	2.4	1.1
2 percent (50-year)	2.4	1.3
1 percent (100-year)	2.6	1.8
0.2 percent (500-year)	2.6	1.8

Source: Appendix I
Note: Values are relative changes, compared with Alternative RP-A conditions.

existing conditions. Flooded areas would range from 1.1 to 1.8 acres above existing conditions. The length of affected channel would be from the barrier dam to approximately 600 feet upstream.

Mitigation and Residual Impacts

No wetland mitigation is proposed for Alternative RP-B, since there are no wetlands in this area. Mitigation and residual impacts for non-wetland waters would be the same as those listed under **Section 4.11.3.2**, Impacts Common to All Action Alternatives, for the RWS.

In-channel structures for the Rio Pojoaque irrigation improvement project have the potential for increasing the water surface elevations of adjacent floodplains. Mitigating this increase depends in part on specific regulations associated with Zone AE areas. Future engineering designs for this alternative could target improvement of bank and alluvium seepage for more frequent flows while minimizing the floodplain impacts during a 100-year flood event.

4.11.4.4 Alternative RP-C (Preferred Alternative)

Under Alternative RP-C, Rio Pojoaque water would be diverted into a new 9,300-foot-long conveyance system, which would tie into the existing Pueblo de San Ildefonso irrigation system.

Wetlands would not be directly or indirectly affected under Alternative RP-C, since there are no wetlands identified in the project area.

Site visits to delineate the OHWM at waterways in the biological resources area of analysis determined that there are no potential short- and long-term impacts under Alternative RP-C. A total of <1 acres non-wetland waters would be disturbed, including <1 acres of temporary disturbance and <1 acre of permanent disturbance.

Proposed Alternative RP-C infrastructure would not impact floodplains along the Rio Pojoaque.

Mitigation and Residual Impacts

No wetlands mitigations are proposed for this area, since there are no wetlands present. No floodplain mitigations are proposed for Alternative RP-C. Mitigation and residual impacts on non-wetland waters would be the same as those listed under **Section 4.11.3.2**, Impacts Common to All Action Alternatives, for the RWS.

4.11.4.5 Alternative RP-D

Under Alternative RP-D, Reclamation would analyze the working condition of the existing infiltration gallery in coordination with the surrounding stratigraphy. Based on this analysis, Reclamation would identify operational issues that could be addressed to improve infiltration to the Pueblo de San Ildefonso irrigation system. The existing 15-inch-diameter pipe would be replaced with a larger perforated pipe, and new gravel would be added. The existing infiltration gallery is just upstream of the Pojoaque Barrier Dam, but its exact location is unknown.

Wetlands would not be directly or indirectly affected by Alternative RP-D, since no wetlands were identified in the project area. Proposed Alternative RP-D infrastructure would not impact floodplains along the Rio Pojoaque.

Site visits to delineate the OHWM at non-wetland waters in the biological resources area of analysis determined that would be no temporary or permanent impacts under Alternative RP-D.

Mitigation and Residual Impacts

No wetland, non-wetland, or floodplain mitigation is proposed for Alternative RP-D. Mitigation and residual impacts on non-wetland waters would be the same as those listed under **Section 4.11.3.2**, Impacts Common to All Action Alternatives, for the RWS.

4.11.4.6 Alternative RP-E

Under Alternative RP-E, Reclamation would add approximately 2,543 feet of perforated pipe to the existing Rio Pojoaque infiltration gallery to deliver more water to the Pueblo de San Ildefonso irrigation system. Eighteen-inch perforated pipe would be installed, with a bed of engineered gravel for the infiltration gallery extension.

Wetlands would not be directly or indirectly affected under Alternative RP-E, since no wetlands were identified in the project area.

Site visits to delineate the OHWM at waterways in the biological resources area of analysis determined the potential short- and long-term impacts under Alternative RP-E: 3 acres would be impacted, including 2 acres of temporary impacts and <1 acre of permanent impacts.

Proposed Alternative RP-E infrastructure would not impact floodplains along the Rio Pojoaque.

Mitigation and Residual Impacts

No wetland or floodplain mitigation is proposed for Alternative RP-E.

4.11.4.7 Summary of Impacts

Short- and long-term direct impacts on wetlands are not anticipated under any of the action alternatives.

Impacts on floodplains are anticipated only under Alternative RP-B, which could increase the 100-year water surface elevations to a degree requiring permitting via a floodplain map change. Other alternatives (RP-C to RP-E) would not impact floodplains.

4.11.5 Rio Tesuque Channel Modification Project

4.11.5.1 Alternative RT-A—No Action

Under Alternative RT-A, No Action, the form and function of the Rio Tesuque and its associated wetlands and floodplains would continue. Historically, the amount of channel migration has been low in the reaches of concern. Floodplain surface elevations would remain the same.

Mitigation and Residual Impacts

Under Alternative RT-A, No Action, no mitigation is proposed and no residual impacts would occur.

4.11.5.2 Impacts Common to All Action Alternatives

The goals of the Rio Tesuque channel modification project vary among alternatives. Some alternatives involve channel restoration, while other alternatives focus on specific flood concerns, and others on irrigation diversion efficiency. The action alternatives may require permitting under Sections 404 and 401 of the CWA.

There would be <1 acre of wetlands directly affected by construction of new pipelines and transmission lines, but only under Alternative RT-E. This includes <1 acre of temporary disturbance and <1 acre of permanent disturbance. No other temporary or permanent impacts are expected under any of the other alternatives. Specific project-related impacts on wetlands and non-wetland waters are identified in the Pojoaque Basin Regional Water System Wetland and Non-wetland Waters Delineation Report (Parametrix 2017).

Site visits to delineate the OHWM at waterways in the biological resources area of analysis determined that <1 acre of non-wetland waters would be directly impacted under each alternative action. CWA Sections 404 and 401 permitting may be required.

Mitigation and Residual Impacts

All work areas would be restricted to the smallest and narrowest possible footprint. Activities within the channel and adjacent areas such as floodplains would be conducted during dry periods to minimize short-term impacts. Other alternative-specific mitigation strategies are detailed below.

4.11.5.3 Alternative RT-B

Under Alternative RT-B, the Rio Tesuque channel modification project would restore the existing incised channel between the Upper Ponds Diversion Dam and the U.S. Highway 84/285 bridge. This restoration would aim to reconnect the channel with its floodplain, allowing excess water to spill over the channel banks and into the floodplain.

No wetlands would be directly affected under Alternative RT-B. Site visits to delineate the OHWM at waterways in the biological resources area of analysis determined that <1 acres of non-wetland waters would be directly and permanently impacted.

Specific project-related impacts on non-wetland waters are identified in the Pojoaque Basin Regional Water System Wetland and No-wetland Waters Delineation Report (Parametrix 2017).

For floodplains, the channel restoration of the Rio Tesuque would be located from the Upper Navajo Diversion Dam, at RM 10.9, to the U.S. Highway 84/285 bridge at RM 10.5. The total length of the Rio Tesuque directly affected would be 0.4 miles. The modified existing channel would promote overflows from the main channel at frequent flows while the overbank bench would limit the amount of flood rise at less frequent flows.

Table 4-39, below, provides the estimated change in surface water elevation and the projected increase in flooded area associated with Alternative RT-B. The more frequent events would remain in the main channel. The increases in water surface elevation could be up to 0.9 feet with up to a 2-acre increase in potential flooded area. Based on engineering projections, once the main channel overtops, the bank excavation would result in no change in the water surface elevation from the existing conditions. The bank excavated area would provide 0.1 to 0.5 additional acres of flooded area from the existing conditions.

Table 4-39. Rio Tesuque Alternative RT-B Floodwater Surface and Flooded Area

Flood Event Annual Probability (Reoccurrence Year)	Average Change in Water Surface Elevation (Feet)	Change in Flooded Area (Acres)
50 percent (2-year)	0.9	0.3
20 percent (5-year)	0.7	1.5
10 percent (10-year)	0.7	2
4 percent (25-year)	0.6	1.1
2 percent (50-year)	0.4	1.1
1 percent (100-year)	0	0.1
0.2 percent (500-year)	0	0.5

Source: Appendix I
Note: Values are relative, compared with Alternative RT-A conditions.

Mitigation and Residual Impacts

For non-wetland waters, mitigation and residual impacts would be the same as those discussed under **Section 4.11.5.2**, Impacts Common to All Action Alternatives.

General floodplain mitigation and residual impacts would be the same as those listed under **Section 4.11.5.2**, Impacts Common to All Action Alternatives. For floodplains under Alternative RT-B, the estimated changes in flooded area and water surface elevation is based on a description and a proposed typical cross section (Reclamation 2016a). No mitigation would be proposed because flood impacts would either remain in the modified channel or would be the same as in existing conditions for infrequent floods.

4.11.5.4 Alternative RT-C

The channel realignment of the Rio Tesuque under Alternative RT-C would occur in the same location and length of channel as Alternative RT-B. The major difference under Alternative RT-C is that, rather than encouraging the channel to follow the channel evolution model processes, a new channel would be excavated within the existing floodplain to the east of the current channel alignment. This alternative is still intended to restore natural geomorphic processes, improve floodplain connection, reduce main channel velocities during high-flow events, and to reduce risk of damage to the irrigation ponds.

No impacts on wetlands are expected under this alternative. For non-wetland waters, direct and indirect impacts under Alternative RT-C are anticipated. Approximately <1

acre of wetlands would be directly affected under Alternative RT-C. This includes a total of <1 acres of temporary impacts and <1 acre of permanent impacts. Specific project-related impacts on wetlands and non-wetland waters are identified in the Pojoaque Basin Regional Water System Wetland and No-wetland Waters Delineation Report (Parametrix 2017).

For floodplains, the length of channel affected for Alternative RT-C (new channel) is the same as in Alternative RT-B. The new channel would be located at a higher elevation and generally wider than the current channel. The average water surface elevation in the new channel would increase from the existing conditions.

Table 4-40, below, provides the estimated changes in water surface elevations and flooded areas. The range of water surface elevations would increase from 1.9 feet for frequent floods to less than 1 foot for projected 100-year and 500-year flood events. The change in the water surface elevations for the new channel are not directly comparable to existing conditions as the new channel would be located at a higher elevation from the old channel. While water surface elevations would increase, the flood flows would remain in the new channel up to a 25-year event, with increased flooded areas generated by the wider channel. Flows overtopping the new channel would combine into the remnants of the old channel, increasing the amount of additional flooded area from between 2 to 3.7 acres.

Table 4-40. Rio Tesuque Alternative RT-C Floodwater Surface and Flooded Area

Flood Event Annual Probability (Reoccurrence Year)	Average Change in Water Surface Elevation (Feet)	Change in Flooded Area (Acres)
50 percent (2-year)	1.9*	1.4
20 percent (5-year)	1.7*	1.7
10 percent (10-year)	1.6*	2.4
4 percent (25-year)	1.5*	1.3
2 percent (50-year)	1.4	2
1 percent (100-year)	0.9	2.5
0.2 percent (500-year)	0.9	3.7

Source: Appendix I
*Higher water surface elevation from higher elevation of new channel; water is projected to stay within the new channel limits.

Mitigation and Residual Impacts

Non-wetland waters mitigation and residual impacts would be the same as those listed under **Section 4.11.5.2**, Impacts Common to All Action Alternatives.

Alternative RT-C could increase the water surface elevations of floodplains for infrequent floods. Mitigation of this increase depends in part on specific regulations associated with a Zone A area. Further engineering design of this alternative could provide mitigation through a wider new channel or by incorporating the remnant channel as part of the larger floodplain during infrequent floods. The intent would be to prevent increases to the floodwater surface elevations.

4.11.5.5 Alternative RT-D (Preferred Alternative)

Under Alternative RT-D, the Rio Tesuque channel modification project would remove 1,320 to 1,426 cubic yards of accumulated sediment from the east side of the Rio Tesuque. This would be just upstream of the TP-806 Bridge between RMs 8.4 and 8.2. The goal of this alternative would be to increase the capacity of the river to carry water and sediment past this bridge during a high-flow event.

For wetlands, no direct or indirect impacts resulting from Alternative RT-D are anticipated. Approximately <1 acre of non-wetland waters would be directly affected under Alternative RT-D, but impacts would be temporary.

Specific project-related impacts on wetlands and non-wetland waters are identified in the Pojoaque Basin Regional Water System Wetland and Non-etland Waters Delineation Report (Parametrix 2017).

Under Alternative RT-D, removal of the spoil pile would occur over approximately 0.2 miles. Frequent river flows would not be affected by the change. The flooded overbank area would increase when flows leave the channel, beginning with a projected 50-year flood event. The flooded area would increase from 0.6 to 0.8 acres. The change in water surface elevations would be similar to existing conditions for frequent floods. Water surface elevations near the bridge could decrease by 0.4 feet for infrequent floods. **Table 4-41**, below, provides the change in water surface and flooded area.

Table 4-41. Rio Tesuque Alternative RT-D Floodwater Surface and Flooded Area

Flood Event Annual Probability (Reoccurrence Year)	Change in Water Surface Elevation (Feet)	Change in Flooded Area (Acres)
50 percent (2-year)	0	0
20 percent (5-year)	0	0
10 percent (10-year)	0	0
4 percent (25-year)	0	0
2 percent (50-year)	0	0.8
1 percent (100-year)	-0.4	0.6
0.2 percent (500-year)	-0.1	0

Source: Appendix I

Mitigation and Residual Impacts

This alternative would not directly or indirectly impact wetlands, therefore no mitigation is proposed. For non-wetland waters, mitigation and residual impacts would be the same as those discussed under **Section 4.11.5.2**, Impacts Common to All Action Alternatives.

For floodplains, no mitigation is proposed for Alternative RT-D.

4.11.5.6 Alternative RT-E

Under Alternative RT-E, an infiltration gallery upstream of the Upper Ponds Diversion Dam would be constructed to collect water from the Rio Tesuque and transmit the water to the Pueblo of Tesuque irrigation system.

For wetlands, there would be <1 acres of wetlands impacted by pipelines, transmission lines, and other project construction under Alternative RT-E. This includes a <1 acre of temporary impacts and <1 acre of permanent impacts.

In addition, there would be <1 acres of non-wetland waters impacted under Alternative RT-E. This includes <1 acres of temporary impacts and <1 acres of permanent impacts. Specific project-related impacts on wetlands and non-wetland waters are identified in the Pojoaque Basin Regional Water System Wetland and Non-wetland Waters Delineation Report (Parametrix 2017).

Alternative RT-E would have no impacts on the floodplains along the Rio Tesuque.

Mitigation and Residual Impacts

All work areas would be restricted to the smallest and narrowest possible footprint. For wetland and non-wetland waters, mitigation and residual impacts would be the same as those discussed under **Section 4.11.5.2**, Impacts Common to All Action Alternatives.

For floodplains, no mitigation is proposed for Alternative RT-E.

4.11.5.7 Summary of Impacts

For wetlands, direct and indirect impacts could result under Alternative RT-E. CWA Sections 404 and 401 permitting may be required. Specific project-related impacts on wetlands and non-wetland waters are identified in the Pojoaque Basin Regional Water System Wetland and Non-etland Waters Delineation Report (Parametrix 2017). Non-wetland waters would be impacted under all of the alternatives.

For floodplains, Alternatives RT-B and RT-C have the goal of channel restoration between the Upper Navajo Diversion Dam and the U.S. Highway 84/285 bridge. Both alternatives would increase the flooded areas, starting with frequent floods. Alternative RT-C would generally produce more flooded areas than Alternative RT-B. The new channel under Alternative RT-C would have a shallower slope than Alternative RT-B, which would promote higher river stages.

4.11.6 Pueblo de San Ildefonso Future Projects Alternatives

4.11.6.1 Alternative SI-A—No Action

Under Alternative SI-A, No Action, the Pueblo de San Ildefonso future projects alternatives would not be constructed. There would be no construction of facilities and no resultant potential direct or indirect effects on wetlands, non-wetland waters, and floodplains.

Mitigation and Residual Impacts

Under Alternative SI-A, No Action, no mitigation is proposed.

4.11.6.2 Alternative SI-B—Proposed Wastewater and Water Infrastructure

The proposed Pueblo de San Ildefonso preliminary wastewater system design could affect non-wetland waters and floodplains. Direct and indirect impacts on these resources

would be the same as those described above for the RWS project. There are no wetlands in the wastewater system improvements area.

A total of <1 acre of non-wetland waters would be directly impacted under this alternative, which is expected to be a temporary impact. No permanent impacts are expected. Specific project-related impacts on wetlands and non-wetland waters are identified in the Pojoaque Basin Regional Water System Wetland and Non-etland Waters Delineation Report (Parametrix 2017).

Table 4-42, below, lists the acres of floodplains recognized by FEMA that may be disturbed by pipelines.

Table 4-42. Alternative SI-B Disturbance in the 100-Year Floodplain

Floodplain Zone	Acres
Detailed study floodplains (Zone AE)	16
Approximate study floodplains (Zone A)	4
Total	**20**

Sources: Reclamation GIS 2017; FEMA 2012

Construction and stockpiling construction materials in delineated floodplains could cause short-term increases in flood risk. With no aboveground infrastructure to impede flow, these pipelines would cause no long-term direct impacts on floodplains. The new wastewater treatment plant would not be constructed in the 500-year floodplain.

In addition to, and separate from, the wastewater system improvements, the Pueblo de San Ildefonso is considering additional water-related infrastructure in a 680-acre area, near the northern boundary of the Pueblo, along with three potential new pipeline alignments. For some alternatives, non-wetland waters may be affected, and Sections 404 and 401 permitting under the CWA may be required, depending on pipeline alignments. Specific project-related impacts on non-wetland waters are identified in the Pojoaque Basin Regional Water System Wetland and Non-etland Waters Delineation Report (Parametrix 2017). Floodplains may also be impacted.

Mitigation and Residual Impacts

Under the proposed wastewater and water infrastructure, no mitigation related to wetlands is proposed and no residual impacts would occur.

For non-wetland waters, mitigation measures and residual impacts are the same as those identified under **Section 4.11.3.2**, Impacts Common to All Action Alternatives, for the RWS.

For floodplains, mitigation measures and residual impacts are the same as those identified under **Section 4.11.3.2**, Impacts Common to All Action Alternatives, and **Section 4.11.3.3**, Alternative B—HKM Implementable.

4.12 Wildlife

This section addresses potential impacts on wildlife from actions associated with each alternative of the RWS, Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and Pueblo de San Ildefonso future projects alternatives. Impacts on federally listed threatened and endangered wildlife species are addressed in **Section 4.14**, Federally Listed Threatened and Endangered Species.

4.12.1 Impact Indicators

The following indicators, as described in **Table 3-1**, are used to analyze impacts on wildlife:

- Acres and location of different types of vegetation that would be disturbed.
- Level of noise that would be generated during construction near habitat.

4.12.2 Analysis Methods and Assumptions

In order to assess the impacts of the potential RWS and other projects on wildlife, Reclamation, in consultation with other agencies, defined a general project area around the proposed RWS infrastructure and other projects. This area was further refined to an approximately 5,900-acre biological resources area of analysis (described in **Section 3.12**, Wildlife). Biological field surveys were conducted within this area.

4.12.3 RWS Alternatives

4.12.3.1 Alternative A—No Action

Under Alternative A, no ground-disturbing activities and no construction would occur in the general project area (**Section 2.6.1**, Alternative A, No Action). However, the depletion of groundwater would continue over time, which could impact habitat and food sources for wildlife in the biological resources area of analysis (**Figure 3-8**, Biological Resources Area of Analysis) and the general project area. In addition, over time additional groundwater wells may be required to meet the needs of Pojoaque Basin residents. As a result, additional roads may need to be built to provide access to the new wells. This could indirectly impact wildlife and their habitat.

Mitigation and Residual Impacts

Under Alternative A, no mitigation is proposed and no residual impacts would occur.

4.12.3.2 Impacts Common to All Action Alternatives

Habitat is present along waterways and near associated wetlands for the bald eagle, black tern, least tern, and spotted bat within the biological resources area of analysis and in the surrounding RWS general project area. These species are protected under the MBTA and are state listed threatened and endangered species.

Habitat is present in piñon-juniper and juniper landscapes within the biological resources area of analysis and within the RWS general project area for golden eagle and gray vireo. These species are protected under the MBTA and are state listed threatened and endangered species.

During field surveys no state listed species were observed. Therefore, direct impacts on any state listed species are not expected from project construction of any of the action alternatives. Project details indicate that water distribution lines would follow existing roadways and disturbed areas, which would minimize impacts on habitat for state listed species.

For each of the action alternatives, the acreage and location of ground disturbance would vary. Between 856 and 1,203 acres would be disturbed during construction of the RWS, resulting in a short-term loss of wildlife habitat.

On a long-term basis, constructing the RWS would permanently convert between 26 and 51 acres of wildlife habitat to other uses, although some of these areas are already disturbed roadways or ROWs. Although the acreages of the area disturbed varies by alternative, direct and indirect impacts resulting in the overall loss of wildlife habitat would be similar for Alternatives B, C, D, and E.

Short-term indirect impacts include possible temporary displacement of wildlife or avoidance from specific areas where construction activities or operations and maintenance are underway. Once these activities are completed, wildlife are expected to return to affected areas. Indirect impacts may also include changes in wildlife habitat due to potential replacement of native vegetation by noxious weeds, in areas where vegetation is disturbed to accommodate construction.

In addition to the impacts discussed above, implementing one of the action alternatives could increase wildlife habitat. Groundwater pumping would be reduced, allowing water levels and native vegetation to recover over time.

Mitigation and Residual Impacts

In general, potential impacts would be mitigated by minimizing work hours to a standard work day, and by minimizing work areas to the smallest and narrowest possible footprint.

The RWS would likely be constructed over a period of 6 years. Construction is expected to begin at the Pueblo de San Ildefonso, continue south to the Pueblo of Pojoaque, east to the Pueblo of Nambé, and then south to the Pueblo of Tesuque. Mitigation measures would be implemented in the order in which each site is affected. Given the proposed gradual progression of construction activities, the impacts of construction would be limited to a relatively small area at any given time. In areas such as along water transmission lines, impacts would be minimal, since these areas are generally already disturbed by roads and ROWs.

Reclamation, in consultation with the Service, would design a monitoring plan to ensure construction does not have an adverse effect on nest sites. In addition, Reclamation would coordinate with the Service to determine requirements for preconstruction nest surveys during the migratory bird-breeding season. If avoidance of nest sites were not possible, Reclamation would obtain a take permit for migratory birds from the Service before clearing activities begin.

Although these measures would reduce direct and indirect impacts, residual impacts would include habitat destruction in areas where wildlife previously may have foraged, nested, or perched. For example, habitat in the mature cottonwoods that would be destroyed during construction would be replaced by pole plantings, which would grow to

be mature cottonwood habitat over time, but would reduce this habitat type in the short term. Although BMPs would be used, noxious weeds could continue to spread in some of the drier upland areas and could replace native vegetation that is currently utilized by wildlife.

4.12.3.3 Alternative B—HKM Implementable

Alternative B would result in the short-term disturbance of 1,203 acres of land to accommodate the installation of water supply, pipelines, and storage facilities. Direct, long-term impacts under Alternative B would be limited to the permanent conversion of 51 acres of wildlife habitat to other uses. Short-term, direct impacts under Alternative B would be from the departure of wildlife from RWS areas during construction. Indirect impacts under Alternative B would be the same as described above in **Section 4.12.3.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Mitigation and residual impacts on wildlife under Alternative B are the same as those described under **Section 4.12.3.2**, Impacts Common to All Action Alternatives.

4.12.3.4 Alternative C

Alternative C would impact 26 acres over the long term and 1,140 acres during the short-term construction period. Other direct and indirect impacts associated with Alternative C are described in **Section 4.12.3.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Mitigation and residual impacts on wildlife under Alternative C are the same as those under **Section 4.12.3.2**, Impacts Common to All Action Alternatives.

4.12.3.5 Alternative D

Alternative D would disturb 26 acres over the long term and 1,146 acres during the short-term construction period. Other direct and indirect impacts associated with Alternative D are described in **Section 4.12.3.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Mitigation and residual impacts on wildlife under Alternative D are the same as those discussed under **Section 4.12.3.2**, Impacts Common to All Action Alternatives.

4.12.3.6 Alternative E (Preferred Alternative)

Alternative E would impact 27 acres over the long term and 856 acres during the short-term construction period. Other direct and indirect impacts associated with Alternative E are described in **Section 4.12.3.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Mitigation and residual impacts on wildlife under Alternative E are the same discussed under **Section 4.12.3.2**, Impacts Common to All Action Alternatives.

4.12.3.7 Summary of Impacts

Between 856 and 1,203 acres would be disturbed during construction of the RWS, resulting in a short-term loss of wildlife habitat. On a long-term basis, constructing the RWS would permanently convert between 26 and 51 acres of wildlife habitat to other uses, although some of these areas are already disturbed roadways or ROWs.

Short-term indirect impacts include possible temporary displacement of wildlife or avoidance from specific areas where construction activities or operations and maintenance are underway. Once these activities are completed, wildlife is expected to return to affected areas. Indirect impacts may also include changes in wildlife habitat due to the potential replacement of native vegetation by noxious weeds in areas where vegetation is disturbed to accommodate construction.

In addition to the impacts discussed above, implementing one of the action alternatives could increase wildlife habitat. Groundwater pumping would be reduced, allowing water levels and native vegetation to recover over time.

4.12.4 Rio Pojoaque Irrigation Improvement Project

4.12.4.1 Alternative RP-A—No Action

There would be no direct impacts on wildlife if the Rio Pojoaque irrigation improvement project were not implemented. Under Alternative RP-A, No Action, the existing Rio Pojoaque irrigation system would continue to operate as it currently does.

Mitigation and Residual Impacts

Under Alternative RP-A, no mitigation is proposed and therefore no residual impacts would occur.

4.12.4.2 Impacts Common to All Action Alternatives

During field surveys no state listed species were observed. Therefore, no direct impacts on any state listed species are expected from project construction.

Indirect impacts on wildlife may include disturbance during construction of the Rio Pojoaque irrigation improvement project, causing any migrating species to move to another area.

Indirect impacts may also include changes in wildlife habitat due to the potential replacement of native vegetation by noxious weeds in areas where vegetation is disturbed to accommodate construction on the north and south sides of the Rio Pojoaque.

Mitigation and Residual Impacts

No direct impacts are anticipated for special status species and other wildlife. Steps to avoid, minimize, and/or mitigate indirect impacts may include:

- Minimizing work areas to the smallest, and narrowest, possible footprint
- Coordinating with the Service and following MBTA requirements, in cases where special status species move into the Rio Pojoaque irrigation improvement project area during migration and establish a nest site

- Designing a monitoring plan to ensure construction would not have an adverse effect on nest sites during the migratory bird breeding season; coordination with the Service would determine if preconstruction nest surveys are required before construction, and if a take permit is required following the results of the preconstruction inventories
- Designing a plan to ensure avoidance of impacts by installing fencing, flagging, signs, buffers, or other measures around nest sites, as directed by the Service
- Developing additional mitigation measures as Reclamation prepares treatment plans in consultation with the appropriate parties
- Replacing cottonwood trees in areas where construction reduces habitat (see description in **Section 4.10.2.3**, Cottonwood Galleries)
- Implementing BMPs to reduce the spread of noxious weeds

4.12.4.3 Alternative RP-B

Under Alternative RP-B, the existing Pojoaque River Barrier Dam would be extended from the north edge of the existing dam, across the Rio Pojoaque, to its north bank. Impacts discussed under **Section 4.12.4.2**, Impacts Common to All Action Alternatives, would apply, except that Alternative RP-B would have a short-term disturbance of <1 acre and a long-term disturbance of <1 acre. Short-term indirect impacts could also occur if birds or other wildlife in areas adjacent to work sites temporarily leave the area due to construction.

Mitigation and Residual Impacts

Mitigation and residual impacts on wildlife under Alternative RP-B would be the same as those discussed under **Section 4.12.4.2**, Impacts Common to All Action Alternatives.

4.12.4.4 Alternative RP-C (Preferred Alternative)

Under Alternative RP-C, Preferred, Rio Pojoaque water would be diverted into a conveyance system that would tie into the existing Pueblo de San Ildefonso irrigation system. Impacts discussed under **Section 4.12.4.2**, Impacts Common to All Action Alternatives, would apply except that Alternative RP-C would have a short-term disturbance of 11 acres, and there would be 5 acres of long-term disturbance. Short-term indirect impacts could also occur if birds or other wildlife in areas next to work sites temporarily leave the area due to construction.

Mitigation and Residual Impacts

Mitigation and residual impacts on wildlife under Alternative RP-C would be the same as those discussed under **Section 4.12.4.2**, Impacts Common to All Action Alternatives.

4.12.4.5 Alternative RP-D

Under Alternative RP-D, Reclamation would analyze the working condition of the existing infiltration gallery in coordination with the surrounding stratigraphy. Based on this analysis, Reclamation would identify operational issues that could be addressed to improve infiltration to the Pueblo de San Ildefonso irrigation system. Impacts for

Alternative RP-D would be the same as those discussed under **Section 4.12.4.2**, Impacts Common to All Action Alternatives**.** There would be no long-term disturbances to wildlife.

Mitigation and Residual Impacts

Mitigation and residual impacts on wildlife under Alternative RP-D would be the same as those discussed under **Section 4.12.4.2**, Impacts Common to All Action Alternatives.

4.12.4.6 Alternative RP-E

Under Alternative RP-E, Reclamation would add approximately 2,543 feet of perforated pipe to the existing Rio Pojoaque infiltration gallery to deliver more water to the Pueblo de San Ildefonso irrigation system. Eighteen-inch perforated pipe would be installed, with a bed of engineered gravel for the infiltration gallery extension. Impacts under Alternative RP-E would be the same as those discussed under **Section 4.12.4.2**, Impacts Common to All Action Alternatives, except there would be a short-term disturbance of 38 acres and there would be 2 acres of long-term disturbance. Short-term indirect impacts could also occur if birds or other wildlife in areas next to work sites leave the area temporarily due to construction.

Mitigation and Residual Impacts

Mitigation and residual impacts on wildlife under Alternative RP-E would be the same as those discussed under **Section 4.12.4.2**, Impacts Common to All Action Alternatives.

4.12.4.7 Summary of Impacts

No state listed threatened or endangered species were documented in the Rio Pojoaque irrigation improvement project area; therefore, no direct impacts on these species are expected.

Short-term, indirect impacts on wildlife may include disturbance during construction causing any migrating species to move to another area. Indirect impacts may also include changes in wildlife habitat due to the potential replacement of native vegetation by noxious weeds in areas where vegetation is disturbed to accommodate construction on the north and south sides of the Rio Pojoaque.

4.12.5 Rio Tesuque Channel Modification Project

4.12.5.1 Alternative RT-A—No Action

Under Alternative RT-A, No Action, the Rio Tesuque channel modification project would not be completed, and overall wildlife habitat along this reach of the river corridor would not be improved.

Mitigation and Residual Impacts

Under Alternative RT-A, No Action, no mitigation is proposed and no residual impacts would occur.

4.12.5.2 Impacts Common to All Action Alternatives

No direct impacts on special status species are expected due to construction of the Rio Tesuque channel modification project, due to the lack of habitat along the Rio Tesuque for these species. During field surveys, no state listed species were observed. On completion of construction, it is expected that state listed special status species or birds covered under the MBTA would return to the Rio Tesuque channel modification project area.

Indirect impacts on wildlife may include disturbance during construction, causing any migrating special status species to move to another area. These impacts would be short term. Indirect impacts may also include changes in wildlife habitat, due to the potential replacement of native vegetation by noxious weeds in areas where vegetation is disturbed to accommodate construction, potentially eliminating foraging sites for migrating birds such as the Baird's sparrow.

Mitigation and Residual Impacts

Steps to avoid, minimize, and/or mitigate direct and indirect impacts on wildlife or their associated habitats may include the following:

- Minimizing work areas to the smallest, and narrowest, possible footprint
- Coordinating with the Service and following MBTA requirements, if a state listed species is documented utilizing the area
- Designing a monitoring plan to ensure construction would not have an adverse effect on nest sites during the migratory bird-breeding season; coordination with the Service would determine if preconstruction nest surveys are required before construction, and if a take permit is required following the results of the preconstruction inventories
- Avoiding impacts by installing fencing, flagging, signs, buffers, or other measures around nest sites, as directed by the Service, if necessary
- Developing additional mitigation measures as Reclamation prepares treatment plans in consultation with the appropriate parties

Although these measures would reduce direct and indirect impacts, residual impacts would include short-term habitat destruction in areas where wildlife previously may have foraged, nested, or perched. For example, mature cottonwoods that may be destroyed during construction would be replaced by pole plantings, which would grow to be mature cottonwood habitat over time; however, this habitat type would be reduced in the short term. Although BMPs would be used, noxious weeds could continue to spread in some of the drier upland areas and could replace areas of native vegetation that are currently utilized by wildlife.

4.12.5.3 Alternative RT-B

Under Alternative RT-B, the Rio Tesuque channel modification project would restore the existing incised channel between the Upper Ponds Diversion Dam and the U.S. Highway 84/285 bridge. This restoration would aim to reconnect the channel with its floodplain, allowing excess water to spill over the channel banks and into the floodplain habitat.

No direct impacts on wildlife from implementing Alternative RT-B are anticipated if construction were to take place when the channel is dry. In the short term, disturbances associated with construction could indirectly displace wildlife and birds from the channel modification area. This would be due to noise from heavy equipment and workers. Other impacts under Alternative RT-B are the same as those discussed under **Section 4.12.5.2**, Impacts Common to All Action Alternatives. Alternative RT-B would have a short-term disturbance of 11 acres, and there would be 3 acres of long-term disturbance.

Mitigation and Residual Impacts

Direct and indirect impacts for Alternative RT-B would be the same as those discussed under **Section 4.12.5.2**, Impacts Common to All Action Alternatives.

4.12.5.4 Alternative RT-C

Under Alternative RT-C a new channel would be excavated within the existing floodplain to the east of the current channel alignment. As with Alternative RT-B, Alternative RT-C would be implemented to restore natural geomorphic processes, improve floodplain connection, reduce main channel velocities during high-flow events, and reduce risk of damage to the irrigation ponds.

Short-term direct impacts on wildlife may occur from implementing Alternative RT-C, such as the destruction of wildlife habitat along the new channel construction area. In the short term, disturbances associated with construction could also indirectly displace nearby wildlife and birds. This would be due to noise from heavy equipment and workers.

Other impacts under Alternative RT-C are the same as those discussed under **Section 4.12.5.2**, Impacts Common to All Action Alternatives. Alternative RT-C would have a short-term disturbance of 13 acres, and there would be 4 acres of long-term disturbance.

Mitigation and Residual Impacts

Direct and indirect impacts for Alternative RT-C would be the same as those discussed under **Section 4.12.5.2**, Impacts Common to All Action Alternatives.

4.12.5.5 Alternative RT-D (Preferred Alternative)

The Rio Tesuque channel modification project, under Alternative RT-D, would remove portions of accumulated sediment just upstream of the TP-806 bridge, between RMs 8.4 and 8.2. The length of the channel affected would be approximately 0.2 mile.

No direct impacts on wildlife from implementing Alternative RT-D are anticipated if construction were to take place when the channel is dry. In the short term, disturbances associated with construction could indirectly displace wildlife and birds from the channel modification area. This would be due to noise from heavy equipment and workers. Other impacts under Alternative RT-D are the same as those discussed under **Section 4.12.5.2**, Impacts Common to All Action Alternatives. Alternative RT-D would have a short-term disturbance of 4 acres, and there would be <1 acre of long-term disturbance.

Mitigation and Residual Impacts

Direct and indirect impacts for Alternative RT-D would be the same as those discussed under **Section 4.12.5.2**, Impacts Common to All Action Alternatives.

4.12.5.6 Alternative RT-E

Under Alternative RT-E, the Rio Tesuque channel modification project would construct an infiltration gallery upstream of the Upper Ponds Diversion Dam to collect water from the Rio Tesuque and transmit the water to the Pueblo of Tesuque irrigation system. The goals of this alternative would be to allow for low-flow collection so that water can be collected during more times of the year than just the spring runoff season, and to minimize sediment delivery to the Pueblo of Tesuque irrigation ponds.

No direct impacts on wildlife from implementing Alternative RT-E are anticipated if construction were to take place when the channel is dry. In the short term, disturbances associated with construction could indirectly displace wildlife from the channel modification area. This would be due to noise from heavy equipment and workers. Other impacts under Alternative RT-E are the same as those discussed under **Section 4.12.5.2**, Impacts Common to All Action Alternatives. Alternative RT-E would have a short-term disturbance of 5 acres, and there would be 1 acre of long-term disturbance.

Mitigation and Residual Impacts

Direct and indirect impacts on state listed threatened and endangered species under Alternative RT-E would be the same as those discussed under **Section 4.12.5.2**, Impacts Common to All Action Alternatives.

4.12.5.7 Summary of Impacts

No state listed species were documented during field surveys; therefore, no direct impact is expected to occur within the project area. Migratory species foraging along the Rio Tesuque may move to other areas farther away from construction activities, but these indirect impacts are expected to be indirect and short-term. Indirect impacts may also include changes in wildlife habitat, due to the potential replacement of native vegetation by noxious weeds in areas where vegetation is disturbed to accommodate construction, potentially eliminating foraging sites for migrating birds such as the Baird's sparrow.

4.12.6 Pueblo de San Ildefonso Future Projects Alternatives

4.12.6.1 Alternative SI-A—No Action

Under Alternative SI-A, No Action, there would be no construction associated with water-related infrastructure improvements on the Pueblo de San Ildefonso; therefore, there would be no impacts on wildlife.

Mitigation and Residual Impacts

Under Alternative SI-A, No Action, no mitigation is proposed and no residual impacts would occur.

4.12.6.2 Alternative SI-B—Proposed Wastewater and Water Infrastructure

The proposed Pueblo de San Ildefonso preliminary wastewater system design has the potential to affect wildlife. Direct and indirect impacts on wildlife would be the same types as those described above for the RWS project. However, direct and indirect impacts would be on a smaller scale than for the RWS project because the project's direct short-term impacts would only occur on 59 acres.

In addition to, and separate from, the wastewater system improvements, the Pueblo de San Ildefonso is considering additional water-related infrastructure in a 680-acre area, near the northern boundary of the Pueblo, along with three potential new pipeline alignments.

Direct impacts related to this alternative would be from removing vegetation from the construction footprint. Indirect impacts would be associated with the potential spread of noxious weeds in the disturbed areas, which could alter available wildlife habitat.

Direct and indirect impacts from this alternative are the long-term loss of habitat and the potential short-term displacement of wildlife, due to construction, maintenance, or operations-related disturbances such as the presence of workers and construction equipment. Specific impact analyses would be completed following refined engineering and feasibility studies. Surveys of the Pueblo de San Ildefonso future projects area for wildlife and related resources have not identified any state listed species.

Mitigation and Residual Impacts

Mitigation and residual impacts on wildlife under Alternative SI-B are expected to be the same as discussed under the RWS in **Section 4.12.3.2**, Impacts Common to All Action Alternatives.

4.13 Aquatic Resources

This section addresses potential impacts on aquatic resources, including special status fish, from actions associated with each alternative. Aquatic species refers to general aquatic species and special status fish. Potential impacts on federally threatened or endangered fish are assessed in **Section 4.14**, Federally Listed Threatened and Endangered Species.

4.13.1 Impact Indicators

The following indicators, as described in **Table 3-1**, are used to analyze impacts on aquatic resources, including special status fish:

- Number of acres of instream disturbance and number of linear feet of downstream river potentially exposed to sedimentation or turbidity
- Changes to aquatic habitat measured by flows and the wetted channel width and depth

4.13.2 Analysis Methods and Assumptions

Project biologists assessed impacts on aquatic resources and special status fish from in-water and streambank construction of all project alternatives, as well as operation of the

completed facilities. When identifying operational impacts on aquatic habitat, Reclamation took into consideration the potential hydrologic impacts (primarily flow changes) in riverine systems attributable to project operations (see **Sections 3.3**, Surface Water, and **4.3**, Surface Water). It then evaluated the amount of any aquatic habitat affected for potential impacts on aquatic life, as indicated by impacts on channel conditions in the river.

The following assumptions were used in analyzing aquatic resources and special status fish impacts:

- The measured acreage of temporary aquatic habitat impact for each water body was considered to be a 20-foot-wide construction corridor.
- Relative to linear footage of sedimentation and turbidity associated with in-water work, Reclamation assumed that construction in the wetted channel would be restricted to activities in and along the Rio Grande (e.g., surface water intake). The agency assumed that other water body crossings and related construction activities associated with the Rio Pojoaque and Rio Tesuque projects would occur "in the dry"; for this reason, no in-water work would be necessary, so instream habitat would not be subject to increased turbidity.
- Changes in wetted channel width and depth are difficult to predict and have not been modeled for the RWS. Therefore, such changes are described qualitatively.

4.13.3 RWS Alternatives

4.13.3.1 Alternative A—No Action

Under the No Action Alternative, there would be no in-water construction associated with a surface water diversion on the Rio Grande or construction of subsurface infiltration infrastructure along its banks. No in-channel work for installing water transmission or distribution pipelines would occur.

Under Alternative A, groundwater would continue to be the primary source of drinking water in the Pojoaque Basin. Continued pumping from the groundwater aquifer at a rate that exceeds recharge rates would contribute to continuing declines in groundwater levels. Continued groundwater pumping could result in decreased water recharge to tributaries and could indirectly reduce available aquatic habitat in the general project area.

Mitigation and Residual Impacts

No mitigation or residual impacts are anticipated under Alternative A.

4.13.3.2 Impacts Common to All Action Alternatives

For all action alternatives, construction and operation of the following RWS components would not require in-water work and would therefore have no impact on aquatic resources and special status fish:

- Water treatment facilities
- Short-term water storage facilities

- Electrical power (no buried lines would traverse the Rio Grande or its major tributaries)

In most cases, power lines and facility-associated access roads would avoid drainages, arroyos, and other water conveyance features. In the event that access roads associated with the above features must traverse arroyos or ditches, work would be conducted when there is no flow. Following construction, all sites would be returned to preconstruction contours. Therefore, no impacts on aquatic species and habitat would occur under any action alternative.

Primary Source Water Use

Transferring water use from groundwater to surface water and reallocating existing surface water rights do not increase the baseline quantity of water depletions in the Middle Rio Grande Basin. Therefore, water diverted for the project would not represent a new net depletion of annual flows downstream of the RWS diversion/collection sites proposed under any action alternative (see **Section 4.3**, Surface Water for details).

Overall, the RWS diversion and collection sites would receive higher consistent year-round flow, due to the transfer of groundwater rights from Top of the World Farms and the reach of the Rio Grande near Questa, New Mexico (see **Section 4.3**). Reallocating San Juan-Chama diversion water from storage at Heron Reservoir to the RWS diversion sites would also increase flow between Heron Reservoir and the RWS collection sites. These increased flows would not measurably improve or degrade aquatic habitat upstream of the RWS collection sites (Reclamation 2015b; INTERA 2016a, 2016b).

The RWS would divert the increased flow provided by source waters upstream of the general project area. Reclamation would manage contracted water from the Heron Reservoir in a manner that would not measurably affect flows downstream of the RWS diversion locations (see **Section 2.3.1.1**, Operational Planning and Scheduling of San Juan-Chama Project Water Supplies).

The projected RWS water supply would result in no net depletion of annual flows downstream of Otowi Bridge (INTERA 2016a, 2016b; see **Section 4.3**, Surface Water). Based on this analysis, no measurable impacts, positive or negative, are anticipated relative to aquatic habitat or species use under any of the action alternatives.

For these reasons, operating the RWS would not impact aquatic habitat or communities in the Rio Grande reach from the confluence with the Red River to the RWS diversion and collection locations, or further downstream of these locations to Cochiti Dam.

An average of approximately 27,000 gpd of brine would be generated at the water treatment plant; this would increase to an average of 149,000 gpd of brine at full future demand, which would be discharged to the Rio Grande. A NPDES permit would be required for the sediment return and brine discharge. There could be a localized impact to fish directly at the discharge site. However, the area of impact would be small as the brine dilutes within the river. Discharge would be designed to ensure that water on the opposite bank would not be impacted, thereby not impeding fish movement up and downstream.

Water Transmission and Distribution Pipelines

Impacts on aquatic habitat associated with pipeline installation and operation would be similar under each action alternative; they are described below.

Construction

The water transmission and distribution pipeline routes would vary slightly among alternatives (see **Section 2.6**, RWS Alternatives Considered in Detail). Each alternative would affect aquatic habitat during construction of the water distribution system (**Table 4-43**, below).

Table 4-43. Acreage of Temporary and Permanent Impacts on Aquatic Habitat by RWS Action Alternative

	Alternative B		Alternative C		Alternative D		Alternative E	
Water Body Type[1]	Perm.	Temp.	Perm.	Temp.	Perm.	Temp.	Perm.	Temp.
Arroyo/canal[2]	1	7	<1	7	<1	8	<1	5
Intermittent stream[3]	3	13	<1	9	<1	9	<1	8
Perennial stream[4]	<1	2	<1	2	<1	2	0	<1
Totals	**4**	**22**	**1**	**18**	**1**	**19**	**1**	**14**

Source: Reclamation GIS 2017
Note: See Appendix B for figures showing detailed pipeline alignments (i.e., affected areas) for each alternative. A 10-foot buffer on either side of each pipeline crossing a water body is included in all acreages.
[1] Water body type determined using NHD (NHD 2013).
[2] Canals and arroyos grouped for NHD codes 33400 (connector between two segments with flow); 33600 (canal/ditch); and 55800 (Artificial Path: Feature that represents flow through a two-dimensional feature, such as a lake or stream).
[3] NHD Code 46003 (intermittent stream).
[4] NHD Code 43006 (perennial stream).

Trenched Pipeline Installation. Under all action alternatives, most construction would occur in upland and riparian areas, away from the river or creek channels. It would be managed by using erosion control devices, removing the least amount of vegetation possible, and revegetating the site following disturbance. Direct impacts on aquatic species and habitat from upland and riparian construction of the water distribution system are anticipated to be localized and short term.

For construction across streams and arroyos, including the Rio Pojoaque, Rio Tesuque, and Rio Nambé, Reclamation would install the water transmission and distribution pipelines when there is little to no flow. In the unlikely event that flow is present at the time of pipeline trenching, water would be diverted around the construction area to create a dry work area. As presented in **Section 3.13**, Aquatic Resources, with the exception of the Rio Grande, all pipeline water body crossings are devoid of fish, though benthic invertebrates may be present in wetted habitat, particularly in upper reaches of the Rio

Tesuque and Rio Nambé. Based on these baseline conditions, and because Reclamation would install the pipelines in the dry, construction would not directly impact aquatic species. However, the riverbed of each affected water body would be temporarily disturbed during trenching.

Following pipeline installation, Reclamation would return all streambeds to preconstruction contours and would remove all excess spoils to ensure construction-related soils are not deposited downstream. Further, Reclamation would stabilize all affected streambanks and would seed the pipeline corridor with native grass mix.

Trenchless Pipeline Installation. No in-water work would be required for any of the trenchless pipeline installation methods. All methods involve subsurface installation, with no trenching or excavation of streambeds. Thus, these methods avoid direct impacts on aquatic species and aquatic habitat.

Operation

Over time, buried pipelines may become exposed in a streambed and create barriers to flow and movement of aquatic species. To address this issue, Reclamation would install pipelines below estimated scour depth elevations, thereby minimizing the potential for pipeline exposure. These measures would minimize the potential for pipeline exposure at water body crossings.

Upland and Riparian Actions

Construction and grading would disturb upland and riparian habitats. Construction would increase impervious surface area, which could increase or reroute runoff and sediment. This could impair feeding behaviors of aquatic species and disturb individuals, causing them to relocate from the affected area.

Mitigation and Residual Impacts

For all action alternatives, Reclamation would conduct in-water work during periods of low flow to minimize impacts on aquatic resources. Reclamation's qualified biologists would also minimize impacts on aquatic resources and riparian vegetation, to the extent practicable, by implementing standard BMPs, such as fish salvage and silt fencing. No residual impacts are anticipated.

4.13.3.3 Alternative B—HKM Implementable

Construction

Direct impacts on aquatic habitat from in-water construction of RWS components would be temporary and localized. For all construction taking place in active flow, a bypass channel would be maintained to allow fish passage around the work area, and any stranded fish would be salvaged and moved below the construction area. The impacts of construction on aquatic habitat and resources are described by RWS component, below.

Firm, Reliable Water Supply

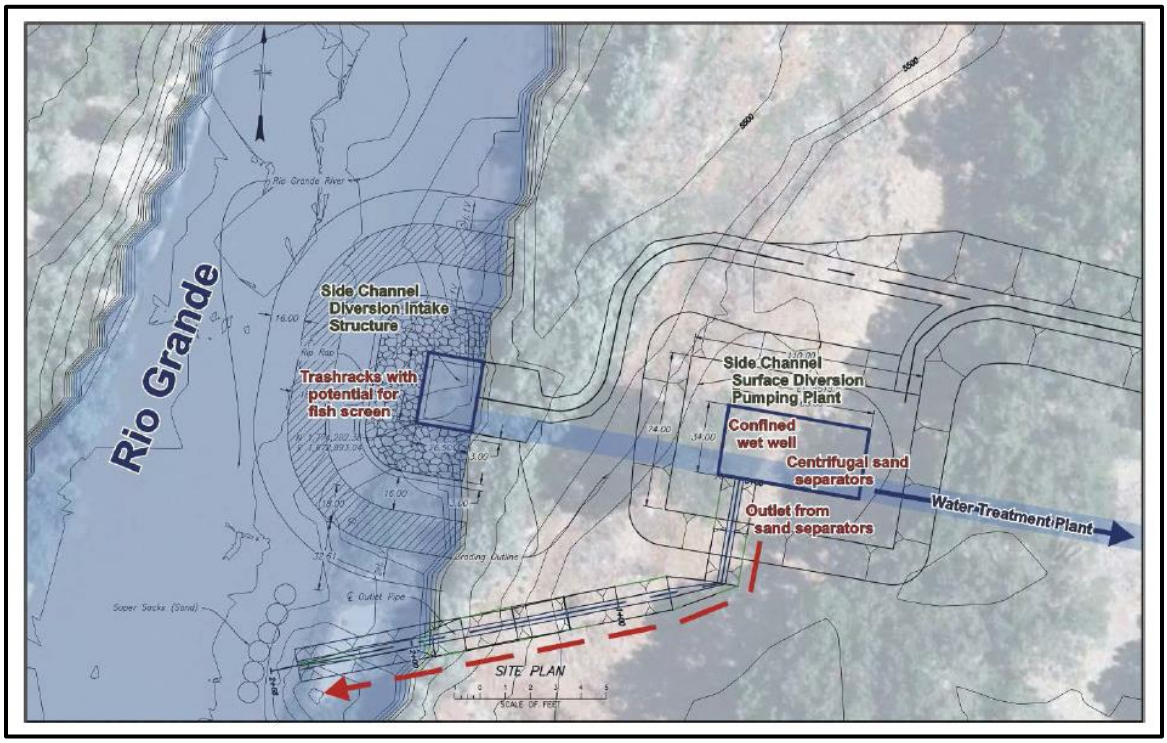
Alternative B includes several options for developing a firm, reliable water supply. Options 1 and 4 would not involve work within water bodies, including arroyos. Under Options 2 and 3, Reclamation would construct wells or grade control structures, or both,

in arroyos. Because such construction would occur during dry periods when the arroyos have no flow, no impacts on aquatic species would occur. Following installation of wells or grade control structures, Reclamation would remove excess spoils to reduce the quantity of sediment in the construction area. This measure would minimize potential downstream sedimentation and deposition of materials during the next flow event.

Primary Source Water Collection—Side Channel Surface Diversion

Under Alternative B, Reclamation would construct a surface water intake and sediment return pipe along the east bank of the Rio Grande, just upstream of Otowi Bridge (**Figure 4-1**). The surface water intake would be constructed during low-flow periods to minimize impacts on aquatic habitats and species. Anticipated impacts are described below.

Figure 4-1. Intake, Alternative B Side Channel Surface Diversion Intake Plan



Underwater Noise. Underwater noise is a project-related impact that would impact aquatic habitat near the in-water work area. Reclamation would install a temporary sheet pile cofferdam to allow intake construction along the east bank of the Rio Grande to occur in the dry. The cofferdam installation method has yet to be specified; however, sheet pile cofferdams are typically installed using impact or vibratory hammers or via pre-excavation drilling. These methods each produce underwater noises that would be perceptible to any fish in the immediate work area.

The extent of the elevated underwater noise depends on background noise levels in the Rio Grande. Reported underwater sound levels for vibratory installation 0.6-meter AZ sheet piles are 177 dB peak and 163 dB rms. Sound from vibratory sheet pile installation would transmit from the construction area into adjacent waters. To determine how far noise would extend from sheet pile installation, the Service uses the practical spreading loss calculation, as described by Thomsen et al. (2006).

$$TL = 15Log(R1/R2)$$

Where R1 is the range or distance at which transmission loss is estimated, and R2 is the range or distance of the known or measured sound level.

Conversely, the distance to where the source sound level drops off to some predetermined sound level, such as the background sound level, can be calculated by rearranging the terms in the equation, above, giving $R1 = R2*10^{(TL/15)}$.

Using the practical spreading model to predict the distance at which in-water sheet pile driving sound levels would return to background levels, and assuming vibratory installation of sheet piles, pile driving noise should attenuate to ambient levels 2,411 feet from pile driving activities. However, river bends are encountered before reaching this distance, particularly downstream, and noise would not extend beyond river bends. Assuming an average wetted width of 150 feet at the intake location, about 8.3 acres of instream habitat on the Rio Grande might be temporarily affected by underwater noise from intake construction.

Most fish would perceive construction-related noise in the affected area. However, vibratory sheet pile installation would not produce underwater noise that exceeds injury levels for fish, as defined by the Fisheries Hydroacoustic Working Group (2008), which includes the Service. Depending on the proximity of a fish to the noise source, it could become stressed and temporarily avoid habitat near the construction site until the noise ceases. Fish could reduce or abandon foraging activity in the affected river reach for the duration of the activity. This is a short-term localized impact that would last for the duration of cofferdam installation.

Displacement from Habitat. At the Rio Grande intake location, construction would require the use of equipment in and next to the river. Reclamation would construct the intake during the winter low-flow period, from August through March (Reclamation 2015b). This would be to avoid, to the extent possible, the high flows associated with spring snowmelt and the summer monsoon season. The cofferdam would be installed in August and removed the following March.

Direct impacts on aquatic species due to in-water construction would be minimized by use of a sheet pile cofferdam to isolate the intake construction area from the river flow (described in **Chapter 2**). Based on the use of 2,100-foot-long wing-walls and an estimated intake cofferdam width of 50 feet, the dewatering structure would temporarily displace aquatic species from about 0.23 acre of instream habitat along the right (east) bank of the river (facing downstream), just upstream of Otowi Bridge.

In addition, temporary "super sacks" would be used to dewater the construction area during installation of the sediment outlet pipe (downstream of the proposed cofferdam). Placing both cofferdams would displace aquatic species from habitat along the east shoreline of the Rio Grande, temporarily reducing available habitat for foraging and rearing. However, this habitat represents a small fraction of available habitat in the general project area, and no long-term impacts on aquatic species are anticipated.

Physical Habitat Alteration. The physical disturbance of in-stream habitat has the potential to affect spawning, feeding, and rearing of aquatic species. Aquatic habitat in the vicinity of the proposed intake consists of a swiftly flowing stream reach, with low-gradient, uniform flow, little to no turbulence, and limited pools. The temporary loss of

about 0.23 acres of such habitat during intake construction would not isolate fish or other aquatic species from unique or complex instream habitat; similar habitat is present both upstream and downstream of the proposed intake location. For this reason, and given the temporary nature of in-water work associated with intake construction, physical habitat alteration along the bank would not result in measurable impacts on aquatic species in the general project area.

Prey Species for Fish. Benthic invertebrates are an important component in the diet of many fish species. Coffer damming the intake work area and subsequent dewatering would result in the loss of individuals within the construction footprint. In addition, in-water work could impact benthic invertebrates downstream of the construction area through habitat degradation, such as turbidity and sediment deposition. However, following construction, benthic invertebrates would likely recolonize affected habitat.

Full recovery of benthic invertebrate communities usually requires 6 months to a year after in-water work associated with excavation (Tsui and McCart 1981; Young and Mackie 1991; Vinikour and Schubert 1987). Only a small area of river would be affected by instream construction and isolation (i.e., relative to the shoreline of the Rio Grande), and fish could seek and use other food resources (e.g., terrestrial insects) during the summer. Because of this, few, if any, measurable impacts on the growth or survival of aquatic resources are anticipated from the loss of benthic species in the vicinity of the proposed intake.

Fish Salvage. At the Rio Grande intake location, qualified fish biologists would remove all fish from the 0.23-acre cofferdam area. This would minimize the potential for lethal impacts on fish that could be trapped under material as cofferdams are installed. Any remaining fish would be flushed from the area behind the cofferdams, typically by seining, and, if absolutely necessary, by use of a conventional backpack electro-fisher, or other method, as determined by the Service and Settlement Pueblo biologists.

Sedimentation and Turbidity. Following cofferdam installation, water pumped from behind it would be settled before being discharged to the Rio Grande. This would minimize the discharge of sediment-laden water into the river. During cofferdam installation and removal, localized increases in turbidity would occur for a distance of about 300 feet downstream. Aquatic fauna in the area would be temporarily affected during these activities; they are expected to vacate affected habitat if turbidity exceeds individual species' tolerances. Given the limited area affected, no aquatic species' population is expected to be measurably affected in the general project area. The cofferdams, once constructed, would mitigate the most severe siltation impacts from construction of the intake structure and sediment return pipe.

Operation

Firm, Reliable Water Supply

As described in **Section 2.6.2**, Alternative B: HKM Implementable Alternative, under Alternative B, Options 2 and 3 for a "Firm, Reliable Water Supply" would include wells or grade control structures in arroyos. During high flow periods following the installation of wells or grade control features, aquatic species may temporarily enter the arroyos, seeking refuge from high flows and velocities in adjacent tributaries. The presence of grade control structures would limit fish movement in the arroyo. However, considering

that flow velocities are also likely to be high during monsoons, when arroyos convey water, use of arroyos by aquatic species would be low, and the potential for impacts on their movement is unlikely.

Primary Source Water Collection—Side Channel Surface Diversion

The intake structure and associated sediment return outlet pipe would permanently replace about 50 linear feet of shoreline habitat upstream of the Otowi Bridge. Long-term direct impacts on aquatic habitat due to the presence of these structures would be limited to the loss of a small amount of bed and bank habitat and a minor reduction in the introduction of organic materials, such as leaves and terrestrial insects, from riparian vegetation.

The intake structure would be designed and constructed to allow for fish screens to be installed in the three intake bays, if they become necessary. Although the proposed trash racks would deter larger fish, if left unscreened, operating the intake would entrain fish that are not capable of swimming away from the intake openings. These would be such fish as weak swimming species, juveniles, and drifting life stages, including larval fish.

As for larval fishes, Rio Grande chub, white suckers, and longnose dace have drifting larvae. However, as described in **Section 3.13**, white suckers and longnose dace are common in this reach of the Rio Grande. Because larval fishes usually experience high natural mortality rates, a slight increase, if any, in mortality from intake entrainment is unlikely to measurably affect these populations. The Rio Grande chub has larvae that drift for a short period; therefore, the surface water intake could entrain drifting larvae. However, considering that the Rio Grande chub has not been collected from nearby reaches of the Rio Grande during recent surveys (see **Section 3.13**), it is highly unlikely that entrainment by the proposed intake would measurably impact the population. Because none of the fish species in this reach of the Rio Grande have drifting eggs (Forest Service and BLM 2006), egg entrainment is unlikely.

Sediment that is returned to the Rio Grande following removal would produce a turbidity plume at the point of discharge; however, the extent of the plume and resulting level of turbidity would vary, based on raw water characteristics. Aquatic species that may be present in the vicinity of the sediment discharge would be exposed to increased turbidity; depending on the quantity of sediment, this could clog gills, smother benthic invertebrates, and disrupt aquatic species feeding or moving through the affected reach (Waters 1995; Service and NMFS 2004). However, because the Rio Grande typically carries a relatively high sediment load (Reclamation 2015b), the concentrated return of a small amount of sediment contained in the diverted water would not measurably impact downstream fish and aquatic invertebrates beyond the immediate discharge area.

Further, higher amounts of sediment in diverted water would typically be present in high flow periods during spring runoff. For this reason, returned sediment would be carried downstream relatively quickly and would not likely be measurable above baseline conditions within about 300 feet of the discharge location. Because fish in this reach of the Rio Grande are adapted to seasonal periods of high sediment, the return of a small amount of sediment downstream of the intake would not result in measurable changes to aquatic habitat or species assemblages.

Hand-cleaning the intake trash racks could disturb aquatic species in the immediate vicinity of the intake. Such disturbance would be temporary and would not result in long-term negative impacts on aquatic species habitat or use.

Mitigation and Residual Impacts

Under Alternative B, Reclamation would implement the mitigation measures for water body pipeline crossings, as proposed for all action alternatives (see **Section 4.13.3.2**, Impacts Common to All Action Alternatives).

For installation of the side channel surface diversion, Reclamation would install a sheet pile cofferdam so that construction would take place in the dry. During initial dewatering of the cofferdam, experienced fish biologists would remove fish from the area behind the cofferdam and relocate them to the main stem habitat, upstream of the work area. Fish removal and relocation would stress fish and could result in some mortality. During construction, water would continuously be pumped from the cofferdam to ensure a dry work environment. This water would be routed to settling basins and discharged downstream of the work area. Discharged water would create a localized increase in turbidity, which could cause fish and other organisms to avoid the area during construction.

4.13.3.4 Alternative C

Construction

Firm, Reliable Water Supply

Reclamation would use operational planning and scheduling of San Juan-Chama Project water supplies to support a firm, reliable water supply under Alternative C. Therefore, no construction-related impacts on aquatic species would occur.

Primary Source Water Collection—Parallel River Interceptor Drain

As described in **Section 2.6.3**, Alternative C, Reclamation would construct a river interceptor drain parallel to the Rio Grande. The drain would be in an excavated trench, below the water table in the bosque, on the east side of the Rio Grande, near Otowi Bridge. Its construction would not require work in the Rio Grande.

During excavation, groundwater would be pumped from the excavation pits, settled, and returned to the Rio Grande. Aquatic species in the immediate vicinity of the water return location would experience an increase in turbidity, depending on the quantity of pumped water and sediment loadings.

Operation

Firm, Reliable Water Supply

Impacts on aquatic habitat associated with ensuring a firm, reliable water supply from subsurface collection are common to Alternatives C, D, and E and are described in **Section 4.13.3.2**, Impacts Common to All Action Alternatives.

Primary Source Water Collection—Parallel River Interceptor Drain

The parallel interceptor drain would penetrate the shallow water aquifer and intercept hyporheic flow between the ground and the river. The impacts from allocating RWS water from primary water sources and collecting source water, as proposed under Alternative C, are described in **Section 4.13.3.2**, Impacts Common to All Action Alternatives.

Water Transmission and Distribution System

Impacts associated with operating the water transmission and distribution pipeline system under Alternative C are common to all action alternatives and are described in **Section 4.13.3.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Under Alternative C, Reclamation would implement the mitigation measures for water body pipeline crossings, as proposed for all action alternatives (**Section 4.13.3.2**, Impacts Common to All Action Alternatives). To install the horizontal radial well collectors, Reclamation would use silt fencing or similar BMPs along the streambank to prevent the entry of excavated materials into the Rio Grande. When pumping groundwater from the excavation pit, Reclamation would allow all pumped water to settle before discharging it to the Rio Grande. Pumped water would be released downstream of the construction area atop an energy dissipater, such as rocks or sandbags, to minimize turbidity at the release location. By implementing these measures, residual impacts on aquatic habitat are unlikely.

4.13.3.5 Alternative D

Construction

Firm, Reliable Water Supply

Reclamation would use operational planning and scheduling of San Juan-Chama Project water to support a firm, reliable water supply under Alternative D. No construction-related impacts on aquatic species would occur.

Primary Source Water Collection—Infiltration Gallery

Under Alternative D, Reclamation would construct a number of horizontal drains along the east bank of the Rio Grande. Similar to Alternative C, this would require excavation in the Rio Grande bosque, resulting in the removal of riparian vegetation. For this reason, most impacts on aquatic habitat would be similar to those described for the primary source water collection under Alternative C. However, the infiltration gallery proposed under Alternative D would disturb a larger area during construction, and more vegetation clearing may be required.

Operation

Firm, Reliable Water Supply

Impacts on aquatic habitat associated with ensuring a firm, reliable water supply are common to Alternatives C, D, and E and are described in **Section 4.13.3.2**, Impacts Common to All Action Alternatives.

Primary Source Water Collection—Infiltration Gallery

Under Alternative D, horizontal drains would penetrate the shallow water aquifer and intercept hyporheic flow between the ground and the river. The impacts associated with collecting water under Alternative D are common to all action alternatives and are described in **Section 4.13.3.2**, Impacts Common to All Action Alternatives.

Water Transmission and Distribution System

Impacts associated with operating the water transmission and distribution pipeline system would be common to all action alternatives and are described in **Section 4.13.3.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Under Alternative D, Reclamation would implement the mitigation measures for water body pipeline crossings, as proposed for all action alternatives (**Section 4.13.3.2**, Impacts Common to All Action Alternatives). Mitigation measures and associated impacts associated with construction of the stream-side infiltration gallery would be the same as those proposed for Alternative C's horizontal radial well collection system.

4.13.3.6 Alternative E (Preferred Alternative)

Construction

Firm, Reliable Water Supply

Reclamation would use operational planning and scheduling of San Juan-Chama Project water supplies to support a firm, reliable water supply under Alternative E. No construction-related impacts on aquatic resources would occur.

Primary Source Water Collection—Horizontal Radial Well Collectors

As described in **Section 2.6.5**, Alternative E (Preferred Alternative), each of the four horizontal well construction areas would be approximately 0.1 acres, near the bank of the Rio Grande. No work in the Rio Grande would be required, but riparian vegetation would be removed from the bosque. Such vegetation contributes organic material to the river. To offset potential indirect impacts on aquatic habitat associated with clearing to install the wells, Reclamation would revegetate temporarily disturbed work areas.

During excavation to install the horizontal well collectors, groundwater would be pumped from the excavation pits, settled, and returned to the Rio Grande. Aquatic species in the immediate vicinity of the water return location would experience an increase in turbidity, depending on the quantity of pumped water and sediment loadings.

Operation

Firm, Reliable Water Supply

Impacts on aquatic habitat associated with ensuring a firm, reliable water supply are common to Alternatives C, D, and E and are described in **Section 4.13.3.2**, Impacts Common to All Action Alternatives.

Primary Source Water Collection—Horizontal Radial Well Collectors

The horizontal well collectors would penetrate the shallow water aquifer and intercept hyporheic flow between the ground and river. The impacts associated with the diversion and collection of water under Alternative E are common to all action alternatives and are described in **Section 4.13.3.2**, Impacts Common to All Action Alternatives.

Water Transmission and Distribution System

Impacts from operating the water transmission and distribution pipeline system would be common to all action alternatives and are described in **Section 4.13.3.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Under Alternative E, Reclamation would implement the mitigation measures for water body pipeline crossings, as proposed for all action alternatives (**Section 4.13.3.2**, Impacts Common to All Action Alternatives). Mitigation measures and impacts associated with constructing the stream-side parallel interceptor drain would be the same as those proposed for Alternative C's horizontal radial well collection system.

4.13.3.7 Summary of Impacts

Alternative B would result in about 1 acre of temporary instream disturbance, due to constructing the side channel intake. Sediment and turbidity would likely affect habitat, for a downstream distance of 1,000 feet. The subsurface water collection systems proposed under Alternatives C, D, and E would not result in instream habitat disturbance.

Streambed trenching for pipeline installation would temporarily affect the 20-foot-wide construction corridor at each crossing location (see **Table 4-43**, Acreage of Temporary and Permanent Impacts on Aquatic Habitat by RWS Action Alternative). However, under all action alternatives, construction would avoid direct impacts on aquatic species. This is because pipelines would be installed during periods of low to no flow and in reaches where aquatic species do not typically occur.

All action alternatives would divert or collect the same volumes of source water. None of the action alternatives would result in a net depletion of annual flows downstream of Otowi Bridge.

4.13.4 Rio Pojoaque Irrigation Improvement Project

4.13.4.1 Alternative RP-A—No Action

Under Alternative RP-A, No Action, for the Rio Pojoaque irrigation improvement project, no changes would be made to the existing diversion dam or related water collection structures. No new in-water structures would be built, and aquatic resources would not be affected, except for temporary in-water maintenance to remove sediments at the existing diversion.

Mitigation and Residual Impacts

Under Alternative RP-A, No Action, no mitigation is proposed, so no residual impacts would occur.

4.13.4.2 Impacts Common to All Action Alternatives

All action alternatives (Alternatives RP-B through RP-E) would result in some level of in-channel work or streambank disturbance, or both. Such work would impact any aquatic resources in the vicinity of construction. If there is any water in the river during in-channel work, aquatic macroinvertebrates could be lost; in-water habitat would be temporarily degraded during construction from increases in sediment or instream turbidity.

Mitigation and Residual Impacts

For all action alternatives, Reclamation would conduct in-water work during periods of low or no flow in Rio Pojoaque to minimize impacts on aquatic resources. Reclamation would minimize impacts on riparian vegetation to the extent practicable. No residual impacts are anticipated from implementing mitigation measures.

4.13.4.3 Alternative RP-B

Construction

Under Alternative RP-B, the existing barrier dam would be extended from the north edge of the existing dam to the north bank of the Rio Pojoaque. The north bank is higher in elevation than the south bank. Because of this, the right side (looking downstream) of the channel is typically dry and flows only during heavy spring runoff or monsoons. Considering this baseline condition, the extended portions of the Pojoaque Barrier Dam would be constructed during periods of low or no flow. This would avoid the potential for displacing aquatic species.

It is probable that localized increases in downstream turbidity would occur during the first high flow event following completion of the dam extension. It is unlikely, however, that turbidity associated with this project would affect aquatic species. This is because the Rio Pojoaque does not provide aquatic habitat during most periods. Reclamation would minimize potential post-construction sedimentation by returning the streambed to existing grade following construction and removing excess spoils from the work area.

Operation

Less than an acre of aquatic habitat would be permanently lost due to the channel-spanning dam on Rio Pojoaque. The dam extension would be in an ephemeral reach of the river that is typically dry. It provides no habitat for aquatic species, except during periods of runoff, such as monsoons. Because of this, very little, if any, flow is currently conveyed to the Rio Grande from the Rio Pojoaque during most of the year. Construction of a channel-spanning barrier, therefore, is unlikely to measurably affect surface water flows in the Rio Grande, due to reductions in flow from Rio Pojoaque (see **Section 4.3**, Surface Water) or groundwater conveyance (INTERA 2016a, 2016b). Therefore, impacts on aquatic habitat in the Rio Grande are unlikely to occur.

While the extended portions of the dam would constitute a barrier to fish passage, the Rio Pojoaque does not provide significant habitat for fish that could use lower portions of river, during the limited periods when there is flow connecting it to the Rio Grande. Most fish that could use the lower reach of the Rio Pojoaque (flathead chub, Rio Grande chub,

shite sucker, fathead minnow, red shiner, green sunfish, and black bass) tend to be main channel and backwater habitat species.[1] Considering this, operating the barrier dam would not impact aquatic species during the vast majority of days in any given year. During monsoons, when Rio Pojoaque conveys flow, the extended dam could impede movement if fish were present in the vicinity of the dam during these high flow events.

Mitigation and Residual Impacts

Reclamation would conduct in-water work during periods of no or low flow to minimize impacts on aquatic resources. Reclamation would minimize impacts on riparian vegetation to the extent practicable. No residual impacts are anticipated from implementing mitigation measures.

4.13.4.4 Alternative RP-C (Preferred Alternative)

Construction

Under Alternative RP-C, Rio Pojoaque water would be diverted into a new conveyance system that would tie into the existing Pueblo de San Ildefonso irrigation system (see **Section 2.7.4**). Because this alternative would not require in-water work in the Rio Pojoaque, no construction-related impacts on aquatic habitat or species would occur.

Operation

Water from Rio Pojoaque is currently diverted into the Acequia de Los Indios and is therefore a baseline condition. However, increased diversion from the Rio Pojoaque could reduce flows downstream of the intersection with the Acequia de Los Indios. As described in **Section 3.13**, during most of the year, the Rio Pojoaque downstream of the Acequia de Los Indios is typically dry and does not provide habitat for aquatic species. Therefore, operating this element under Alternative RP-C would not degrade aquatic habitat or impact resources in the Rio Pojoaque. Potential impacts on aquatic habitat in the Rio Grande would be similar to those described for Alternative RP-B.

Mitigation and Residual Impacts

Reclamation would conduct in-water work during periods of no or low flow to minimize impacts on aquatic resources. Reclamation would minimize impacts on riparian vegetation to the extent practicable. No residual impacts are anticipated from implementing mitigation measures.

4.13.4.5 Alternative RP-D

Construction

Under Alternative RP-D, Reclamation would analyze the working condition of the existing infiltration gallery, which is just upstream of the Pojoaque Barrier Dam. Reclamation would replace the gallery's existing 15-inch-diameter pipe with larger

[1]Hansen, Richard, Coldwater Fisheries Biologist, NMDGF, personal communication with Becky Holloway, HDR Engineering, February 20, 2013.

perforated pipe and would add new gravel. Pipe replacement and subsurface gravel supplementation would require excavation in both the Rio Pojoaque bosque and the river channel.

All in-channel work would be conducted when Rio Pojoaque is dry and does not provide habitat for aquatic species. Following excavation, pipe replacement, and backfill, the Rio Pojoaque streambed would be returned to preconstruction contours, and excess spoils would be removed from the river channel. Spoils removal would minimize project-related sedimentation during the first post-construction high flow event. Because Reclamation would conduct all work when the river is dry and would return the disturbed streambed to pre-project contours, no impacts on aquatic habitat or aquatic resources would occur.

Operation

Operating the project with new infiltration gallery infrastructure would increase withdrawal efficiencies and could reduce available aquatic habitat, compared with the Alternative RP-A, No Action. During most of the year, this section of the Rio Pojoaque is typically dry, and aquatic species are not present. Therefore, Alternative RP-D would not measurably affect its aquatic resources. Potential impacts on aquatic habitat in the Rio Grande would be similar to those described for Alternative RP-B.

Mitigation and Residual Impacts

Reclamation would conduct in-water work during periods of no or low flow to minimize impacts on aquatic resources. Reclamation would minimize impacts on riparian vegetation to the extent practicable. No residual impacts are anticipated from implementing mitigation measures.

4.13.4.6 Alternative RP-E

Construction

Under Alternative RP-E, Reclamation would add perforated pipe to the existing Rio Pojoaque infiltration gallery to deliver more water to the Pueblo de San Ildefonso irrigation system. Eighteen-inch-diameter perforated pipe would be installed, with a bed of engineered gravel for the infiltration gallery extension. Impacts on aquatic habitat from excavating the channel and installing perforated pipe and backfill would be similar to those described under Alternative RP-D.

Operation

Similar to Alternative RP-D, operating the project with improved infiltration infrastructure would increase withdrawal efficiencies and could reduce available aquatic habitat, compared with the Alternative RP-A, No Action. Fish are not present in this reach of the Rio Pojoaque, and habitat for other aquatic species (e.g., benthic macroinvertebrates) is limited to periods of high runoff or monsoons. Therefore, Alternative RP-E would not measurably affect aquatic resources in the Rio Pojoaque. Potential impacts on aquatic habitat in the Rio Grande would be similar to those described for Alternative RP-B.

Mitigation and Residual Impacts

Reclamation would conduct in-water work during periods of no or low flow to minimize impacts on aquatic resources. Reclamation would minimize impacts on riparian vegetation to the extent practicable. No residual impacts are anticipated from implementing mitigation measures.

4.13.4.7 Summary of Impacts

All action alternatives (Alternatives RP-B through RP-E) would result in some level of in-channel work or streambank disturbance. Such work would impact aquatic resources if present in the vicinity of construction. However, the Rio Pojoaque is dry during most times of the year, and construction would occur during the dry or very low flow periods. If any water were present in the river during in-channel construction, aquatic macroinvertebrates could be lost. Further, in-water habitat would be temporarily degraded during construction from increased sediment or instream turbidity.

4.13.5 Rio Tesuque Channel Modification Project

4.13.5.1 Alternative RT-A—No Action

No in-water work would occur under Alternative RT-A, No Action, and aquatic resources would not be affected. However, the quantity and quality of available aquatic habitat would not be improved under this alternative.

Mitigation and Residual Impacts

Under Alternative RT-A, no mitigation is proposed, so no residual impacts would occur.

4.13.5.2 Impacts Common to All Action Alternatives

With the exception of Alternative RT-E, all action alternatives would result in some level of in-water work or streambank modification or both. Such work would impact any aquatic resources in the vicinity of construction. Aquatic macroinvertebrates could be lost during instream excavation, and in-water habitat would be temporarily degraded during construction from increases in sediment or instream turbidity. Fish do not occupy any of the action alternative river reaches, so they would not be affected by any alternative.

Mitigation and Residual Impacts

For all action alternatives, Reclamation would conduct in-water work during periods of low or no flow to minimize impacts on aquatic resources. Reclamation would minimize impacts on riparian vegetation to the extent practicable. No residual impacts are anticipated from implementing mitigation measures.

4.13.5.3 Alternative RT-B

Construction

This alternative would reshape the channel to restore natural processes and would include vegetation clearing, streambed and bank modification, the addition of instream grade control structures (e.g., riprap), and the construction of detention ponds in the floodplain.

Based on a flow assessment (Benoit 2014) there are periods of little to no flow in the construction reach during which this work could be completed.

To the extent possible, Reclamation would modify the Rio Tesuque channel from adjacent riparian areas along the streambank. If water is present in the channel during proposed in-water work, it may be necessary to dewater portions of the channel and bypass flows around the active worksite to allow work to occur in the dry. If dewatering and in-water work isolation were needed, no impacts on fish would occur, since fish do not currently occupy the channel where work would occur (see **Section 3.13**).

Macroinvertebrate species (caddis flies, for example) may be lost or temporarily displaced from occupied habitat during dewatering and associated in-channel work.

Operation

Overall, following initial construction-related disturbance, the project would increase the connectivity of the river with the floodplain and the available habitat for aquatic species in this reach of the river.

Mitigation and Residual Impacts

Reclamation would conduct in-water work during periods of no or low flow to minimize impacts on aquatic resources. Reclamation would minimize impacts on riparian vegetation to the extent practicable. No residual impacts are anticipated from implementing mitigation measures.

4.13.5.4 Alternative RT-C

Construction

Under Alternative RT-C, Reclamation would excavate a new channel within the floodplain in the same reach of the Rio Tesuque proposed for channel modification as under Alternative RT-B. Similar to Alternative RT-B, this alternative would restore natural processes, improve floodplain connection, and reduce main channel velocities during times of high flow. Due to the similar nature of proposed instream and streambank modifications as those proposed under Alternative RT-B, impacts on aquatic resources under Alternative RT-C would be same as those described under Alternative RT-B (**Section 4.13.5.3**, Alternative RT-B).

Operation

Overall, following the initial construction-related disturbance, the project would increase the connectivity of the river with the floodplain and the available habitat for aquatic species in this reach of the river.

Mitigation and Residual Impacts

Reclamation would conduct in-water work during periods of no or low flow to minimize impacts on aquatic resources. Reclamation would minimize impacts on riparian vegetation to the extent practicable. No residual impacts are anticipated from implementing mitigation measures.

4.13.5.5 Alternative RT-D (Preferred Alternative)

Construction

Under Alternative RT-D, Reclamation would remove accumulated instream sediment from the Rio Tesuque, just upstream of the TP-806 Bridge. This alternative would temporarily increase the capacity of the river to carry water and sediment past this bridge during periods of high flow. Specific approaches to accomplish this have not yet been identified; however, excavators or other heavy equipment could operate in the stream or on the banks to remove sediment during low or no-flow periods in the channel. Based on a flow assessment (Benoit 2014) there are periods of little to no flow in the construction reach during which this work could be completed. Impacts on aquatic habitat would be similar, though lesser in extent and duration, to those described for this RWS element under Alternative RT-B.

Operation

Overall, following initial construction-related disturbance, the project would increase the capacity of flow through this reach of the Rio Tesuque. Benefits to aquatic species and habitat would be limited.

Mitigation and Residual Impacts

Reclamation would conduct in-water work during periods of no or low flow to minimize impacts on aquatic resources. Reclamation would minimize impacts on riparian vegetation to the extent practicable. No residual impacts are anticipated from implementing mitigation measures.

4.13.5.6 Alternative RT-E

Construction

Under Alternative RT-E, Reclamation would construct an infiltration gallery next to the Rio Tesuque channel. This alternative would provide increased low flow diversion and would minimize sediment delivery to existing irrigation ponds. Construction of an infiltration gallery would not likely require excavation or disturbance of the Rio Tesuque streambed; however, if necessary, instream excavation would be conducted during periods of little to no flow. The streambank and adjacent riparian corridor would be disturbed to install the structure. Disturbed riparian areas would be revegetated following installation, and long-term impacts on aquatic habitat and species would be minimal.

Operation

Fish do not currently occupy this reach of the Rio Tesuque, so none would be affected during operations. Impacts on aquatic species are anticipated to be limited, and benefits for aquatic habitat would be minimal.

Mitigation and Residual Impacts

Reclamation would conduct work along the streambank during periods of no or low flow and would minimize impacts on riparian vegetation to the extent practicable. No residual impacts are anticipated from implementing mitigation measures.

4.13.5.7 Summary of Impacts

Alternative RT-E would not require in-water work. Alternatives RT-B, RT-C, and RT-D would result in some level of in-water work or streambank modification or both. Such work would impact any aquatic resources in the vicinity of construction. Aquatic macroinvertebrates could be lost during instream excavation, and in-water habitat would be temporarily degraded during construction from increases in sediment or instream turbidity. Following implementation of Alternatives RT-B and RT-C, Reclamation expects that the quantity and quality of available aquatic habitat would be improved.

4.13.6 Pueblo de San Ildefonso Future Projects Alternatives

4.13.6.1 Alternative SI-A—No Action Alternative

Under Alternative SI-A, No Action, there would be no construction associated with water-related infrastructure improvements on the Pueblo de San Ildefonso. No new roads, water or wastewater pipelines, or support facilities would be constructed; therefore, no construction-related impacts on aquatic habitat or species would occur.

Mitigation and Residual Impacts

Under Alternative SI-A, No Action, no mitigation is proposed, so no residual impacts would occur.

4.13.6.2 Alternative SI-B—Proposed Wastewater and Water Infrastructure

Construction of future Pueblo de San Ildefonso wastewater system improvements and other water-related infrastructure projects would require pipeline installation across arroyos or ditches; however such work would be conducted when water conveyance channels are dry. Therefore, no direct impacts on aquatic species would occur during implementation of future projects. Following construction, channel beds would be returned to preconstruction condition and contours, and excess spoils would be taken off-site to limit post-construction sediment pulses during subsequent high flow events. Potential impacts on aquatic resources due to post-construction sedimentation and turbidity would be temporary and localized; therefore, they would not impact the long-term survival and fitness of any aquatic resources in the general project area.

Mitigation and Residual Impacts

Reclamation would conduct in-water work during periods of no or low flow to minimize impacts on aquatic resources. Reclamation would minimize impacts on riparian vegetation to the extent practicable. No residual impacts are anticipated from implementing mitigation measures.

4.14 Federally Listed Threatened and Endangered Species

This section addresses potential impacts on federally listed threatened and endangered species from actions associated with each alternative.

4.14.1 Impact Indicators

The indicator used to analyze impacts on federally listed threatened and endangered species, as described in **Table 3-1**, is acres of habitat disturbed. Five federally listed species for this project area were reviewed: the federally endangered SWFL, NMMJM, and Rio Grande silvery minnow, and the federally threatened YBCU and MSO. There is no habitat for the NMMJM in the project area. The Service determined that no protocol surveys for the species was necessary. No protocol surveys were conducted for the MSO in the project area, due to the lack of habitat.

The Rio Grande silvery minnow has been extirpated from the action area and does not occur in any water bodies associated with the project's in-water work. As stated in the Pojoaque Basin Regional Water System Biological Assessment concurrence letter, dated June 5, 2017 (**Appendix J**), there would be no direct or indirect impacts on the YBCU, MSO, NMMJM, or the Rio Grande silvery minnow associated with the following:

- The Pojoaque Basin RWS
- The Rio Pojoaque Irrigation Improvement project
- The Rio Tesuque Channel Modification project
- The Pueblo de San Ildefonso future projects

Only SWFL could be affected by action alternatives; it is reviewed in greater detail in this section.

4.14.2 Analysis Methods and Assumptions

The area of analysis for federally listed avian and mammalian species is the 5,900-acre biological resources area of analysis on Pueblo and non-Pueblo land, where pedestrian field surveys were conducted.

The area of analysis for federally listed threatened and endangered Rio Grande silvery minnow is the Rio Grande. Specifically, it is from its confluence to with the Rio Chama to Cochiti Reservoir, including tributaries in the RWS action area. This reach of the Rio Grande, plus the 5,900-acre biological resources area of analysis, is the action area described in the Pojoaque Basin Regional Water System Biological Assessment. The Service concurred with the biological assessment on June 5, 2017 (**Appendix J**), in compliance with Section 7(a)(2) of the ESA.

Reclamation, in consultation with the Service, prepared a biological assessment analyzing the potential impacts of the proposed RWS, Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and Pueblo de San Ildefonso future projects alternatives on federally listed threatened and endangered species. (For more detailed information regarding federally listed species in the project areas, refer to the Pojoaque

Basin Regional Water System Biological Assessment and U.S. Fish and Wildlife Service Concurrence Letter in **Appendix J**.)

4.14.3 RWS Alternatives

4.14.3.1 Alternative A—No Action

Avian Species

Under Alternative A, no construction, operation, or maintenance would occur. However, due to the myriad of wells depleting groundwater throughout the general project area, groundwater will continue to diminish over time, which could impact habitat utilized by federally listed species. For example, the loss of water could reduce the number of cottonwoods and willows over time, which currently provide habitat for SWFL. Quantifying this possible impact is speculative; therefore, it is difficult to fully understand the impact of the No Action Alternative on SWFL and their associated habitat in the future.

Mitigation and Residual Impacts

Under Alternative A, no mitigation is proposed and therefore no residual impacts would occur.

4.14.3.2 Impacts Common to All Action Alternatives

Avian Species

To make determinations of the potential impacts of RWS construction on federally listed threatened and endangered species, Reclamation compared areas planned for disturbance associated with each alternative, with areas of potential federally listed species habitat.

In the RWS project area of analysis, potential habitat for federally listed threatened and endangered species is present only in riparian areas along the rivers for the SWFL (**Figure 3-13**, Southwestern Willow Flycatcher and Yellow-billed Cuckoo Habitat).

During biological surveys in 2015, and subsequent protocol surveys for SWFL in 2016, migrating willow flycatchers were documented, but none were confirmed to be SWFLs. Although no SWFL were confirmed during protocol surveys, construction activities could directly impact SWFLs, if they were present within the vegetated area being modified, such as in willow thickets along the Rio Grande. These direct impacts would be short term due to the nature of construction and birds' ability to fly into other areas. However, if eggs or nestlings of SWFL were present in a nest that is destroyed during construction, the young of the listed species would be directly affected.

Indirect impacts on SWFL would include habitat modifications in areas along the Rio Grande if construction destroys coyote willows and cottonwoods used by migrating SWFLs as foraging areas.

Mitigation and Residual Impacts

There could be indirect impacts for migrating SWFLs. Steps to avoid, minimize, or mitigate such potential impacts are as follows:

- Minimizing work areas to the smallest and narrowest possible footprint
- Maintaining a 100-foot buffer of no construction around any active nests during construction
- Coordinating with the Service and following MBTA and ESA requirements, if a federally listed species were documented in the area
- Coordinating with the Service, if future surveys were to detect listed, proposed, or candidate species in habitat where they have not been previously observed
- Coordinating with the Service, if the project were to change or new information were to reveal effects of the actions on the listed species or their habitats to an extent not considered in these evaluations
- Coordinating with the Service, if a new species were listed that may be affected by this project
- Conducting formal surveys for the Southwestern willow flycatcher, the year before construction activities; if a flycatcher territory is identified in the project area, Reclamation would coordinate with the Service; steps may include the need to obtain a take permit during migratory bird breeding season, if the Service requires such a permit
- Developing additional mitigation options, agreed on by Reclamation, as the agency prepares treatment plans, in consultation with the appropriate parties
- Replacing cottonwood trees in areas where construction reduces mature cottonwood trees used by federally listed species, as described in **Section 4.10.2.3**, Impacts Common to All Action Alternatives, Mitigation and Residual Impacts
- Following BMPs that reduce the spread of noxious weeds

Although these measures would reduce direct and indirect impacts, residual impacts would include habitat destruction in areas where wildlife previously may have foraged, nested, or perched—for example, in the mature cottonwoods that would be destroyed during construction and replaced with pole plantings. Although BMPs would be used, noxious weeds would continue to spread in some of the drier upland areas.

4.14.3.3 Alternative B—HKM Implementable

Direct and indirect impacts on threatened and endangered species under Alternative B would be the same as those discussed under **Section 4.14.3.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Mitigation and residual impacts on threatened and endangered species under Alternative B would be the same as those discussed under **Section 4.14.3.2**, Impacts Common to All Action Alternatives.

4.14.3.4 Alternative C

Direct and indirect impacts on threatened and endangered species under Alternative C would be the same as those discussed under **Section 4.14.3.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Mitigation and residual impacts on threatened and endangered species under Alternative C would be the same as those discussed under **Section 4.14.3.2**, Impacts Common to All Action Alternatives.

4.14.3.5 Alternative D

Direct and indirect impacts on threatened and endangered species under Alternative D would be the same as those discussed under **Section 4.14.3.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Mitigation and residual impacts on threatened and endangered species under Alternative D would be the same as those discussed under **Section 4.14.3.2**, Impacts Common to All Action Alternatives.

4.14.3.6 Alternative E (Preferred Alternative)

Direct and indirect impacts on threatened and endangered species under the preferred alternative (Alternative E) would be the same as those discussed under **Section 4.14.3.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Mitigation and residual impacts on threatened and endangered species under the preferred alternative (Alternative E) would be the same as those discussed under **Section 4.14.3.2**, Impacts Common to All Action Alternatives.

4.14.3.7 Summary of Impacts

There could be indirect impacts on SWFLs, although these impacts would be short-term, minimal impacts.

In addition, the action alternatives would increase the groundwater resources within the general project area. The alternatives would reduce pumping from existing infrastructure and would allow water levels to recover over time. The reduction in water being pumped from the area could increase habitat for federally listed threatened and endangered species in the future. Any cottonwoods destroyed during construction activities if mulched and left on site would provide important nutrients to the soil, and provide

additional hunting, perching, and foraging sites for many wildlife species, including threatened and endangered avian species.

4.14.4 Rio Pojoaque Irrigation Improvement Project

4.14.4.1 Alternative RP-A—No Action

Under Alternative RP-A, No Action, the Rio Pojoaque irrigation improvement project would not be constructed; therefore, there would be no direct or indirect impacts on federally listed species.

Mitigation and Residual Impacts

Under Alternative RP-A, No Action, no mitigation is proposed and therefore no residual impacts would occur.

4.14.4.2 Impacts Common to All Action Alternatives

Avian Species

Although willow flycatchers were detected along the Rio Grande in 2015 and the Rio Pojoaque in 2015 and 2016, they were not confirmed to be SWFLs. Documented willow flycatchers were identified in areas outside of the Rio Pojoaque irrigation improvement project (see **Figure 2-20**, Comparison of Rio Pojoaque Irrigation Improvement Project Alternatives). Young willows are present in the project area and have grown significantly since the initial reconnaissance survey was conducted in 2014. Currently, the flow of water is inconsistent and changes dramatically over the breeding season. No SWFL habitat is present, and there would be no direct impacts for this species under any of the action alternatives.

Indirect, short-term impacts on SWFL could include habitat modifications in this area if construction destroys coyote willows and cottonwoods utilized by migrating SWFLs, as described under **Section 4.14.3.2**. If disturbed by construction activities, foraging SWFLs would likely fly into areas away from the disturbance.

Mitigation and Residual Impacts

Mitigation of impacts on federally listed species and residual impacts resulting from the Rio Pojoaque irrigation improvement project are the same as those described under **Section 4.14.3.2**, Impacts Common to All Action Alternatives.

4.14.4.3 Alternative RP-B

Direct and indirect impacts on threatened and endangered species under Alternative RP-B would be the same as those discussed under **Section 4.14.4.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Mitigation of impacts on federally listed species and residual impacts under Alternative RP-B are the same as those described under **Section 4.14.3.2**, Impacts Common to All Action Alternatives.

4.14.4.4 Alternative RP-C (Preferred Alternative)

Direct and indirect impacts on threatened and endangered species under Alternative RP-C, Preferred, would be the same as those discussed under **Section 4.14.4.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Mitigation and residual impacts on threatened and endangered species under Alternative RP-C, Preferred, would be the same as those discussed under **Section 4.14.3.2**, Impacts Common to All Action Alternatives.

4.14.4.5 Alternative RP-D

Direct and indirect impacts on threatened and endangered species under Alternative RP-D would be the same as those discussed under **Section 4.14.4.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Mitigation and residual impacts on threatened and endangered species under Alternative RP-D would be the same as those discussed under **Section 4.14.3.2**, Impacts Common to All Action Alternatives.

4.14.4.6 Alternative RP-E

Direct and indirect impacts on threatened and endangered species under Alternative RP-E would be the same as those discussed under **Section 4.14.4.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Mitigation and residual impacts on threatened and endangered species under Alternative RP-E would be the same as those discussed under **Section 4.14.3.2**, Impacts Common to All Action Alternatives.

4.14.4.7 Summary of Impacts

No federally listed threatened or endangered species were documented in the Rio Pojoaque irrigation improvement project area. Nevertheless, willows have grown along the Rio Pojoaque and the Rio Grande, since the initial reconnaissance survey was conducted in 2014. Migrating, foraging SWFLs could use the willows; therefore, short-term, indirect impacts on individual SWFLs would be possible.

4.14.5 Rio Tesuque Channel Modification Project

4.14.5.1 Alternative RT-A—No Action

Under Alternative RT-A, No Action, the Rio Tesuque channel modification project would not be constructed; therefore, there would be no direct impacts on federally listed threatened and endangered species.

Mitigation and Residual Impacts

Under Alternative RT-A, No Action, no mitigation is proposed and therefore no residual impacts would occur.

4.14.5.2 Impacts Common to All Action Alternatives

Avian Species

No SWFL have been documented within the project area.

Short-term, indirect impacts on SWFL habitat could include habitat modifications in this area if construction were to destroy coyote willows and cottonwoods used by migrating, foraging SWFLs. Therefore, the action alternatives could have indirect impacts on individuals of this species. However, migrating SWFLs are expected to fly to areas away from construction-related disturbances. Upon completion of construction, federally listed species would likely return to these areas.

Mitigation and Residual Impacts

Mitigation of impacts on federally listed species and residual impacts resulting from the Rio Tesuque channel modification project are the same as those described under **Section 4.14.3.2**, Impacts Common to All Action Alternatives.

4.14.5.3 Alternative RT-B

Direct and indirect impacts on threatened and endangered species under Alternative RT-B would be the same as those discussed under **Section 4.14.5.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Mitigation of impacts on federally listed species and residual impacts resulting from Alternative RT-B are the same as those described under **Section 4.14.3.2**, Impacts Common to All Action Alternatives.

4.14.5.4 Alternative RT-C

Direct and indirect impacts on threatened and endangered species under Alternative RT-C would be the same as those discussed under **Section 4.14.5.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Mitigation and residual impacts on threatened and endangered species under Alternative RT-C would be the same as those discussed under **Section 4.14.3.2,** Impacts Common to All Action Alternatives.

4.14.5.5 Alternative RT-D (Preferred Alternative)

Direct and indirect impacts on threatened and endangered species under Alternative RT-D would be the same as those discussed under **Section 4.14.5.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Mitigation and residual impacts on threatened and endangered species under Alternative RT-D would be the same as those discussed under **Section 4.14.3.2**, Impacts Common to All Action Alternatives.

4.14.5.6 Alternative RT-E

Direct and indirect impacts on threatened and endangered species under Alternative RT-E would be the same as those discussed under **Section 4.14.5.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Mitigation and residual impacts on threatened and endangered species under Alternative RT-E would be the same as those discussed under **Section 4.14.3.2**, Impacts Common to All Action Alternatives.

4.14.5.7 Summary of Impacts

No federally listed threatened or endangered species were documented in the Rio Tesuque channel modification project area. Nevertheless, migrating, foraging SWFLs could use areas along the Rio Tesuque and could be indirectly affected by project construction on a short-term basis.

4.14.6 Pueblo de San Ildefonso Future Projects Alternatives

4.14.6.1 Alternative SI-A—No Action

Under Alternative SI-A, No Action, no construction, operation, or maintenance would occur; therefore, there would be no impacts on federally listed threatened and endangered species or their associated habitat.

Mitigation and Residual Impacts

Under Alternative SI-A, No Action, no mitigation is proposed and therefore no residual impacts would occur.

4.14.6.2 Alternative SI-B—Proposed Wastewater and Water Infrastructure

The Pueblo de San Ildefonso may construct wastewater system improvements and other water-related infrastructure; however, based on existing plans for these projects, protocol surveys of the Pueblo de San Ildefonso future projects area are not anticipated due to the lack of available habitat for federally listed threatened and endangered species within the project area.

Mitigation and Residual Impacts

Mitigation and residual impacts on threatened and endangered species under the Pueblo de San Ildefonso future projects alternatives would not be expected to occur, due to the lack of habitat within this project area.

4.15 Cultural Resources

This section addresses potential impacts on cultural resources from each alternative.

4.15.1 Impact Indicators

The following indicators, as described in **Table 3-1**, are used to analyze impacts on cultural resources:

- Number of historic properties adversely affected (36 CFR, Part 800)
- Changes in access to Indian sacred sites, either temporary or permanent
- Changes to resources of Pueblo concern, including plants and wildlife

4.15.2 Analysis Methods and Assumptions

The methods of analysis for cultural resources differ by resource type: historic properties, Indian sacred sites, and resources of Pueblo/Tribal concern. The term historic properties refers to the subset of cultural resources that meet criteria for eligibility for listing on the NRHP (36 CFR, Subpart 60.4).

For cultural resources that qualify as historic properties, the method of analysis is to apply the regulatory process described at 36 CFR, Part 800, to the selected alternative. This pertains to archaeological, historic, and ethnographic sites, districts, buildings, structures, and objects. The regulatory process includes inviting consulting parties to participate in identifying and evaluating historic properties. It also includes applying the criteria of adverse effects (36 CFR, Subpart 800.5) to those properties, in consultation with the SHPO, THPOs, Settlement Pueblos, and interested Tribes.

An effect is defined as adverse "when an undertaking may alter the characteristics that make a property eligible for the NRHP by diminishing its integrity of location, design, setting, materials, workmanship, feeling, or association" (36 CFR, Subpart 800.5a).

The method of analysis for Indian sacred sites, as outlined at Executive Order 13007, was to consult with the Tribes to identify sacred sites. This was done to determine if the selected alternatives would diminish the physical integrity or alter access of Indian religious practitioners to the sites.

The method of analysis for resources of Pueblo or Indian Tribal concern involved consulting with Tribal governments and interested members of Pueblos or Tribes.

The Analysis is based on data as of July 2017.

4.15.3 RWS Alternatives

4.15.3.1 Alternative A—No Action

Under Alternative A, the RWS would not be constructed; therefore, there would be no direct or indirect impacts on cultural resources. This includes historic properties, Indian sacred sites, and resources of Pueblo/Tribal concern.

Mitigation and Residual Impacts

Under Alternative A, no mitigation would be required, and no residual impacts from the project would occur.

4.15.3.2 Impacts Common to All Action Alternatives

All action alternatives would include adverse impacts on one or more historic properties, despite every effort made to avoid or minimize impacts. Examples of resources that may be affected by implementing the RWS are archaeological sites, historic buildings, and historic structures (acequias). Reclamation is coordinating with the Settlement Pueblos to avoid impacts on any sacred areas and will continue this coordination through the construction of the RWS.

Reclamation will continue to consult with the Settlement Pueblos, and others as appropriate, throughout the design and construction of the RWS.

Archaeological Sites

Reclamation identified 177 archaeological sites during the Class III pedestrian survey of the RWS cultural resources area of analysis. It identified an additional 28 sites in the Pueblo de San Ildefonso future projects alternatives area of analysis and one site in the Rio Tesuque channel modification project area of analysis. To date, no archaeological sites have been identified in the Rio Pojoaque irrigation improvement project area of analysis.

A summary of cultural resources in the cultural resources area of analysis is presented in **Table 4-44**, Summary of Documented Cultural Resources Under Each Alternative, below. This table demonstrates the potential number of known cultural resources that occur under each alternative. It is highly likely that additional archaeological sites are present but are buried in the physical footprint of each alternative. Buried sites are more likely to be present in less developed portions of the project area, such as undeveloped upland areas along U.S. Highway 84/285 and SH 502. Facility alignments and locations will continue to be adjusted to avoid or minimize impacts on cultural resources, where possible. For example, Reclamation could move a pipeline alignment across a road to avoid a site.

Historic Built Environment

A total of 657 historic buildings, 12 national or state registered historic properties, and 50 historic structures (including acequias and non-linear structures such as bridges, wells, and erosion-control structures) were identified during the Class III survey of the RWS area of analysis. Reclamation plans to avoid all standing buildings during project construction, not just those that have been determined to be or recommended as eligible for listing on the NRHP. However, indirect impacts on historic buildings and structures, particularly adobe buildings lacking concrete foundations, could result from the vibrations of some types of construction equipment. Eliminating these effects by using non-vibratory construction techniques within 50 feet of all standing historic buildings may not be feasible; therefore, impacts on NRHP-eligible historic properties are possible.

Table 4-44. Summary of Documented Cultural Resources Under Each Alternative

Project	Alternative	Archaeological Sites	Historic Buildings	Historic Structures (Acequias)	National Historic Trails	Battle of Puertecito de Pojoaque
RWS	A (No Action)	0	0	0	0	N/A
	B	99	114	38	2	Y
	C	99	114	38	2	N
	D	100	123	38	2	N
	E (Preferred)	84	103	38	2	Y
Rio Pojoaque irrigation improvement project	A (No Action)	0	0	0	0	N/A
	B	0	0	0	0	N/A
	C (Preferred)	0	0	2	1	N/A
	D	0	0	0	0	N/A
	E	0	0	1	0	N/A
Rio Tesuque channel modification project	A (No Action)	0	0	0	0	N/A
	B	0	0	0	0	N/A
	C	0	0	0	0	N/A
	D (Preferred)	2	0	0	1	N/A
	E	0	0	0	0	N/A
Pueblo de San Ildefonso Future Projects Alternatives	No Action	0	0	0	0	N/A
	Water-related Infrastructure	28	0	2	1	N/A
	Wastewater system improvements	4	21	5	1	N/A

Source: Field survey, May 2014 to March 2016

No impacts on historic buildings are expected as a result of changes to their visual settings. This is because none are in the viewshed of any of the proposed aboveground infrastructure, under any of the action alternatives. However, depending on final design specifications, it is possible that the primary water intake facility on the eastern side of the Rio Grande, north of the Otowi Bridge Historic District, could be visible from the district. Large cottonwood trees in this area, if left in place, may sufficiently obscure this view. Because the Otowi Suspension Bridge is located on the south side of SH 502, and below the level of the current roadway, it is not likely that the proposed facility would be visible from this individually listed historic property. Any visual effects from the facility on the district as a whole are not anticipated to be adverse. This is due to the existing impacts on the setting and feeling of the district that have resulted from the following:

- Intrusion of the SH 502 alignment and a power line
- The poor condition of the contributing elements of the district, such as the Otowi stop/tearoom buildings

Water transmission and distribution lines would intersect many of the named acequia systems that extend through the general project area, in several locations. It may be possible for Reclamation to bore beneath all acequia segments, avoid impacts on these resources, and arrive at a no effect determination. However, even if this were not feasible, no adverse effects on acequias are anticipated, for several reasons. Trenching across acequias is a short-term impact; whether these in-use historic structures are earthen or concrete-lined, they can be returned to their original condition and appearance following construction.

In addition, effects from construction would cause direct impacts on only a small portion of these extensive, linear elements. Rather than their material construction, acequias are generally considered eligible for listing on the NRHP, based on their intact alignments (which would not be altered) and their association with important local and regional historic trends and events. Because acequias are active irrigation facilities that have been used for multiple generations, they have been and are often now subjected to maintenance and modification, which has altered the nature of their material construction over time.

Two National Historic Trails (the Old Spanish Trail and El Camino Real de Tierra Adentro) extend through the general project area. Given that most of the RWS infrastructure will be underground, construction of the RWS is anticipated to have no adverse effect on cultural landscapes, viewsheds, or settings associated with either the Old Spanish Trail or El Camino Real de Tierra Adentro. The interpretive potential of these trails will not be affected either.

The Puertecito de Pojoaque battlefield site extends into the project area. Possible visual impacts to the setting, feeling, and association of this resource could result from the construction of above-ground water tanks in the vicinity of the site.

Mitigation and Residual Impacts

Reclamation has elected to enter into a programmatic agreement (PA) to comply with the requirements of the NHPA and 36 CFR, Part 800. This is because construction, funding, and implementation of the RWS would be phased over multiple years and because of the potential for redesign. The PA is being developed in consultation with numerous parties and includes the following signatories: the Pueblo of Pojoaque, the Pueblo of Nambé, the Pueblo de San Ildefonso, the Pueblo of Tesuque, the New Mexico SHPO, the Advisory Council on Historic Preservation, and the BIA.

In addition, the USACE and NMDOT have requested to be concurring parties to the PA.

Additional agreement documents may also be prepared with each of the four Settlement Pueblos and Santa Fe County, identifying a customized set of management priorities and protocols that would apply to project-related cultural resources management. These may take the form of stand-alone agreements, or they may be attached as appendices to the PA.

After the PA is prepared and signed, along with any additional agreements and appendices to the PA, Reclamation would prepare specific mitigation and treatment plans. The plans would detail the measures to be used to resolve adverse effects. These plans would be implemented following the Record of Decision should an action alternative be selected.

The following is a preliminary list of mitigation options that has been prepared for the draft PA:

- Designing a plan to ensure avoidance of impacts by installing fencing, flagging, signs, buffers, or other measures
- Designing a monitoring plan to ensure construction does not have an adverse effect on historic properties
- Minimizing impacts, for example, by redesigning the project's built features that are within the viewshed of historic properties and by selecting construction methods that minimize vibration near properties sensitive to vibration
- Recording using such means as photography, mapping, feature descriptions, and artifact analysis
- Recovering archaeological data
- Preparing Historic American Building Survey/Historic American Engineering Record/Historic American Landscapes Survey documentation
- Developing public or Pueblo educational materials on the history and prehistory of the region and disseminating research results to interested parties in the scientific and education communities
- Adopting other forms of treatment appropriate to a specific property or property type, not yet identified
- Using creative mitigation strategies that allow for alternative forms of treatment in lieu of, or as a supplement to, standard methods
- Additional mitigation options may be developed and agreed on as Reclamation prepares the treatment plans, in consultation with the appropriate parties

Any construction realignments or areas that were not surveyed due to landowners denying access will be surveyed and consulted on before construction, as needed. If acequias, trails, or other historic properties are adversely affected, the parties will consult on appropriate resolution of effect.

4.15.3.3 Alternative B—HKM Implementable

Direct and indirect impacts on cultural resources under Alternative B would be the same as those described above, because these are common to all of the action alternatives. The proposed White Sands HKM short-term storage tank would be within the boundaries of the Battle of Puertecito de Pojoaque battlefield.

Mitigation and Residual Impacts

Mitigation strategies and residual impacts on cultural resources Under Alternative B would be the same as those described above, because these are common to all of the action alternatives.

4.15.3.4 Alternative C

Direct and indirect impacts on cultural resources under Alternative C would be the same as those described above, because these are common to all of the action alternatives.

Mitigation and Residual Impacts

Mitigation strategies and residual impacts on cultural resources under Alternative C would be the same as those above as these are common to all of the action alternatives.

4.15.3.5 Alternative D

Direct and indirect impacts on cultural resources under Alternative D would be the same as those described above, because these are common to all of the action alternatives.

Mitigation and Residual Impacts

Mitigation strategies and residual impacts on cultural resources under Alternative D would be the same as those described above as these are common to all of the action alternatives.

4.15.3.6 Alternative E (Preferred Alternative)

Direct and indirect impacts on cultural resources under the preferred alternative (Alternative E) would be the same as those described above, because these are common to all of the action alternatives. The White Sands tank was removed to avoid the Battle of Puertecito de Pojoaque battlefield and replaced with the Turtle tank.

Mitigation and Residual Impacts

Mitigation strategies and residual impacts on cultural resources under the preferred alternative (Alternative E) would be the same as those described above as these are common to all of the action alternatives.

4.15.3.7 Summary of Impacts

Direct impacts would occur only where RWS infrastructure intersects the boundary of a cultural resource. Indirect impacts would occur when permanent, aboveground facilities impact the visual setting of resources within the viewshed of such infrastructure, or when construction-related vibrations impact an NRHP-eligible historic structure or building.

Short-term impacts would be minimal and would consist primarily of visual, auditory, and vibratory impacts during construction of transmission and distribution pipelines and the water treatment plant. Historic properties may be subjected to long-term impacts as well. These impacts would be from the construction of any infrastructure within a cultural resource boundary, as well as future operation and maintenance of the RWS, because ground disturbance and other activities could permanently remove elements that contribute to a historic property's NRHP eligibility.

Other long-term impacts are those on the visual setting of historic properties via the construction of permanent, aboveground infrastructure in the viewshed of these properties. All proposed infrastructure, both within and outside of cultural resource boundaries, could result in a cumulative impact on these resources.

4.15.4 Rio Pojoaque Irrigation Improvement Project

4.15.4.1 Alternative RP-A—No Action

Under Alternative RP-A, the Rio Pojoaque irrigation improvement project would not be constructed; therefore, no impacts on cultural resources would occur.

Mitigation and Residual Impacts

Under Alternative RP-A, no mitigation would be required, and no impacts from the project would occur.

4.15.4.2 Impacts Common to All Action Alternatives

Direct and indirect impacts on cultural resources resulting from the Rio Pojoaque irrigation improvement project are the same as those described above for the RWS.

Mitigation and Residual Impacts

Mitigation of impacts on cultural resources and residual impacts resulting from the Rio Pojoaque irrigation improvement project are the same as those described above for the RWS.

4.15.4.3 Alternative RP-B

No cultural resources have been identified within the impact area for Alternative RP-B and no direct or indirect impacts on cultural resources are anticipated to occur from this alternative.

Mitigation and Residual Impacts

No cultural resources have been identified within the impact area for Alternative RP-B and no direct or indirect impacts on cultural resources are anticipated to occur.

4.15.4.4 Alternative RP-C (Preferred Alternative)

Two historic structures (acequias) have the potential to be affected under Alternative RP-C, Preferred. Direct and indirect impacts are the same as those described above for the RWS.

Mitigation and Residual Impacts

Mitigation of impacts on cultural resources and residual impacts resulting from Alternative RP-C, Preferred, are the same as those described above for the RWS.

4.15.4.5 Alternative RP-D

No cultural resources have been identified within the impact area for Alternative RP-D and no direct or indirect impacts on cultural resources are anticipated to occur.

Mitigation and Residual Impacts

Under Alternative RP-D, no mitigation would be required and no residual impacts from the project would occur.

4.15.4.6 Alternative RP-E

One historic structure (an acequia) has the potential to be affected under Alternative RP-E.

Direct and indirect impacts are the same as those described above for the RWS.

Mitigation and Residual Impacts

Mitigation of impacts on cultural resources and residual impacts resulting from Alternative RP-E are the same as those described above for the RWS.

4.15.4.7 Summary of Impacts

Only two cultural resources (historic acequias) have the potential to be affected by the Rio Pojoaque irrigation improvement project under Alternative RP-C (the preferred alternative) and Alternative RP-E. Direct, indirect, and residual impacts, as well as proposed mitigation strategies, are the same as those described above for the RWS. No direct or indirect impacts would occur under Alternatives RP-B and RP-D for this project.

4.15.5 Rio Tesuque Channel Modification Project

4.15.5.1 Alternative RT-A—No Action

Under Alternative RT-A, No Action, the Rio Tesuque channel modification project would not be constructed; therefore, no direct or indirect impacts on cultural resources would occur.

Mitigation and Residual Impacts

Under Alternative RT-A, No Action, no mitigation would be required, and no residual impacts from the project would occur.

4.15.5.2 Impacts Common to All Action Alternatives

Direct and indirect impacts on cultural resources resulting from the Rio Tesuque channel modification project are the same as those described above for the RWS.

Mitigation and Residual Impacts

Mitigation of impacts on cultural resources and residual impacts resulting from the Rio Tesuque channel modification project are the same as those described above for the RWS.

4.15.5.3 Alternative RT-B

No cultural resources have been identified within the impact area for Alternative RT-B and no direct or indirect impacts on cultural resources are anticipated to occur.

Mitigation and Residual Impacts

Under Alternative RT-B, no mitigation would be required and no residual impacts from the project would occur.

4.15.5.4 Alternative RT-C

No cultural resources have been identified within the impact area for Alternative RT-C and no direct or indirect impacts on cultural resources are anticipated to occur.

Mitigation and Residual Impacts

Under Alternative RT-C, no mitigation would be required and no residual impacts from the project would occur.

4.15.5.5 Alternative RT-D (Preferred Alternative)

Two archaeological sites have the potential to be affected under Alternative RT-D of the Rio Tesuque channel modification project. Direct and indirect impacts are the same as those described above for the RWS.

Mitigation and Residual Impacts

Mitigation of impacts on cultural resources and residual impacts resulting from Alternative RT-D are the same as those described above for the RWS.

4.15.5.6 Alternative RT-E

No cultural resources have been identified within the impact area for Alternative RT-E and no direct or indirect impacts on cultural resources are anticipated to occur.

Mitigation and Residual Impacts

Under Alternative RT-E, no mitigation would be required and no residual impacts from the project would occur.

4.15.5.7 Summary of Impacts

For the Rio Tesuque channel modification project, impacts on cultural resources would only occur under Alternative RT-D, which could impact two archaeological sites. Direct, indirect, and residual impacts, as well as proposed mitigation strategies, are the same as those described above for the RWS.

4.15.6 Pueblo de San Ildefonso Future Projects Alternatives

4.15.6.1 Alternative SI-A—No Action

Under Alternative SI-A, No Action, the Pueblo de San Ildefonso future projects would not be constructed; therefore, no direct or indirect impacts on cultural resources would occur.

Mitigation and Residual Impacts

Under Alternative SI-A, No Action, no mitigation would be required, and no residual impacts from the project would occur.

4.15.6.2 Alternative SI-B—Proposed Wastewater and Water Infrastructure

The proposed Pueblo de San Ildefonso preliminary wastewater system design could affect 4 archaeological sites, 21 historic buildings, and 5 acequias. Twenty-eight

archaeological sites and two historic structures could be affected by other future water-related infrastructure projects. Direct and indirect impacts on these resources would be the same types as those described above for the RWS project.

Mitigation and Residual Impacts

Mitigation strategies and residual impacts would be the same as those described above for the RWS.

4.16 Indian Trust Assets

This section addresses potential impacts on ITAs from actions associated with each alternative.

4.16.1 Impact Indicators

The indicator, as described in **Table 3-1**, is whether any assets would be adversely affected.

4.16.2 Analysis Methods and Assumptions

The area of analysis for direct and indirect impacts is the same as described in **Section 3.16**, Indian Trust Assets.

The method of analyzing impacts on ITAs in the general project area is to consult with the Settlement Pueblos and other Pueblos/Tribes and the BIA. This is to identify ITAs that might be affected by the alternatives and, if the impact would be adverse, to determine appropriate avoidance or mitigation measures.

Impacts are determined by concluding if their implementation would result in the loss, damage, depletion, or waste of ITAs.

4.16.3 RWS Alternatives

4.16.3.1 Alternative A—No Action

Under the Alternative A, there would be no new construction of facilities requiring the use of Pueblo land for easements, ROWs, construction, or future operations. Thus, there would be no direct or indirect effects on ITAs from this activity. Groundwater pumping would continue to be relied on as the primary source of water in the Pojoaque Basin. The exercise of priority Pueblo water rights would not change, but litigation regarding water rights would likely resume. The Settlement Pueblos would not be able to access the portion of the water provided under the Settlement Act, nor would the additional water-related improvements be made on the Settlement Pueblos.

Mitigation and Residual Impacts

Residual impacts include continued reliance on groundwater, unimproved water treatment and distribution infrastructure, lack of access to water provided under the Settlement Act, litigation, and continued uncertainty about water supply limiting future Pueblo economic uses. No mitigation has been identified.

4.16.3.2 Impacts Common to All Action Alternatives

Under all action alternatives, the proposed RWS would require the use of Settlement Pueblo land for easements, ROWs, and facility construction. There would be permanent changes to the Pueblo use of these lands from constructing facilities and operating the RWS; there would be temporary changes during construction.

In general, the change in the use of these lands would not result in net loss, damage, depletion, or waste of assets, property, or property rights. Most of the anticipated surface disturbance on Pueblo lands would be short term and construction related. Long-term disturbance and change in use of Pueblo land is anticipated to be similar across the alternatives (approximately 22 to 48 acres). Pipelines, treatment, storage, electrical lines, and road infrastructure supporting the RWS would ensure access to water provided under the Settlement Act and would ensure protection and use of Pueblo water rights into the future.

All of the action alternatives would create a portfolio of San Juan-Chama contract and native Rio Grande water rights to supply the RWS. A portion of the portfolio consists of new water brought into the area for specific use of this project and existing water rights that would be allocated for this purpose. The Pueblo of Nambé's reserved water rights and water contracted from the San Juan-Chama Project for use by the Settlement Pueblos would be part of this supply.

Groundwater in the Pojoaque Basin is hydrologically connected to the Rio Grande. The reallocation of existing water rights do not represent a net loss or depletion of the asset or affect Pueblo property rights. These transfers and reallocation are consistent with the resolution of water rights issues and quantification of water rights in the Settlement Act; they would reduce groundwater dependence, would allow the Settlement Pueblos to receive a portion of the surface water provided under the Settlement Act, and would ensure a more reliable supply for the future economic uses at each Settlement Pueblo.

Mitigation and Residual Impacts

No long-term, adverse impacts are anticipated from implementing any of the action alternatives; therefore, no mitigation or compensation would be required.

4.16.3.3 Alternative B—HKM Implementable

Direct and indirect impacts would be similar to those described under Mitigation and Residual Impacts. Under Alternative B, ASR options are considered for a backup water supply to supplement Rio Grande surface flows, along with existing community wells on Settlement Pueblo lands.

In addition to the potential use of Pueblo lands and infrastructure, water sources could include Pueblo water rights, as quantified in the Settlement Agreement. The reallocation of existing groundwater rights and the maintenance or construction would not represent a net loss or depletion of the asset or impact Pueblo property rights.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementing any of the action alternatives. No mitigation has been identified.

4.16.3.4 Alternative C

Direct and indirect impacts would be the same as those described under **Section 4.16.3.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementing any of the action alternatives. No mitigation has been identified.

4.16.3.5 Alternative D

Direct and indirect impacts would be the same as those described under **Section 4.16.3.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementing any of the action alternatives. No mitigation has been identified.

4.16.3.6 Alternative E (Preferred Alternative)

Direct and indirect impacts would be the same as those described under **Section 4.16.3.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementing any of the action alternatives. No mitigation has been identified.

4.16.3.7 Summary of Impacts

Lands on the four Settlement Pueblos would be used for easements, ROWs, and facility construction. There would be permanent and temporary changes to the Pueblo use of these lands, but the asset values of the change in use would not result in net loss, damage, depletion, or waste of assets, property, or property rights.

The RWS would create a beneficial impact on ITAs, in that Pueblo water rights and water that is new to the basin would be allocated for the RWS. The reallocation of existing water rights would not represent a net loss or depletion of the asset or affect Pueblo property rights.

4.16.4 Rio Pojoaque Irrigation Improvement Project

4.16.4.1 Alternative RP-A—No Action

Under Alternative RP-A, No Action, the Rio Pojoaque irrigation improvement project would not be completed. The objectives of the project described in **Section 1.4** would not be realized. There would be no construction of facilities, requiring the use of Pueblo land, so there would be no direct or indirect impacts on ITAs from this activity. Irrigation infrastructure would not be improved to allow more efficient exercise of Pueblo water rights.

Mitigation and Residual Impacts

Residual impacts include relying on existing irrigation infrastructure, limiting efficient use of Pueblo water rights, and potentially limiting future economic uses. No mitigation has been identified.

4.16.4.2 Impacts Common to All Action Alternatives

Under all action alternatives, there would be temporary and permanent changes to the Pueblo use of these lands from constructing facilities and operating the improvement project. The change in the use of these lands would not result in net loss, damage, depletion, or waste of assets, property, or property rights. The anticipated long-term surface disturbance would be fewer than 5 acres and would not vary greatly among action alternatives. Short-term construction disturbance would vary among the alternatives from <1 acre to 38 acres. The project would allow the more efficient use of Pueblo water rights into the future.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementing any of the action alternatives. No mitigation has been identified.

4.16.4.3 Alternative RP-B

Direct and indirect impacts for the Rio Pojoaque irrigation improvement project would be the same as those described under **Section 4.16.4.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementing any of the action alternatives. No mitigation has been identified.

4.16.4.4 Alternative RP-C (Preferred Alternative)

Direct and indirect impacts for the Rio Pojoaque irrigation improvement project would be the same as those described under **Section 4.16.4.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementing any of the action alternatives. No mitigation has been identified.

4.16.4.5 Alternative RP-D

Direct and indirect impacts for the Rio Pojoaque irrigation improvement project would be the same as those described under **Section 4.16.4.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementing any of the action alternatives. No mitigation has been identified.

4.16.4.6 Alternative RP-E

Direct and indirect impacts for the Rio Pojoaque irrigation improvement project would be similar to those described under **Section 4.16.4.2**, Impacts Common to All Action Alternatives. Alternative RP-E, however, includes 38 acres of temporary disturbance to Pueblo lands for installing approximately 2,543 feet of perforated pipe to the existing Rio Pojoaque infiltration gallery. The short-term change in land use would not impact Pueblo property rights and would contribute to more efficient use of Pueblo water rights into the future.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementing any of the action alternatives. No mitigations have been identified.

4.16.4.7 Summary of Impacts

There would be small permanent and temporary changes to the Pueblo use of these lands. The asset values of the change in use would not result in net loss, damage, depletion, or waste of assets, property, or property rights. The project would allow the more efficient use of Pueblo water rights in the long term.

4.16.5 Rio Tesuque Channel Modification Project

4.16.5.1 Alternative RT-A—No Action

Under Alternative RT-A, No Action, the Rio Tesuque channel modification project would not be completed, and the objectives of the project described in **Section 1.4** would not be realized. There would be no new facilities requiring the use of Pueblo land, so there would be no direct or indirect impacts on ITAs from this activity. Improvements in infrastructure used to store water for agriculture, wildlife, and resources would not be completed. Infrastructure supporting the exercise of Pueblo water rights for these purposes would not be improved.

Mitigation and Residual Impacts

Residual impacts include relying on existing infrastructure and limiting the more efficient use of Pueblo water rights for agriculture and future Pueblo economic uses. No mitigation has been identified.

4.16.5.2 Impacts Common to All Action Alternatives

Under all action alternatives, there would be temporary and permanent changes to the Pueblo use of these lands from constructing facilities and operating the improvement project. The change in the use of these lands would not result in net loss, damage, depletion, or waste of assets, property, or property rights. The anticipated long-term surface disturbance would be fewer than 4 acres and would not vary greatly among alternatives. Short-term construction disturbance would vary among the alternatives, from 4 acres to 13 acres. The project would allow the more efficient use of Pueblo water rights to store water for agriculture, wildlife and cultural resources.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementing any of the action alternatives. No mitigation has been identified

4.16.5.3 Alternative RT-B

Direct and indirect impacts for the Rio Tesuque channel modification project would be the same as those described under **Section 4.16.5.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementing any of the action alternatives. No mitigation has been identified.

4.16.5.4 Alternative RT-C

Direct and indirect impacts for the Rio Tesuque channel modification project would be the same as those described under **Section 4.16.5.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementing any of the action alternatives. No mitigation has been identified.

4.16.5.5 Alternative RT-D (Preferred Alternative)

Direct and indirect impacts for the Rio Tesuque channel modification project would be the same as those described under **Section 4.16.5.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementing any of the action alternatives. No mitigation has been identified.

4.16.5.6 Alternative RT-E

Direct and indirect impacts for the Rio Tesuque channel modification project would be the same as those described under **Section 4.16.5.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementing any of the action alternatives. No mitigation has been identified.

4.16.5.7 Summary of Impacts

There would be small permanent and temporary changes to the Pueblo use of these lands. The asset values of the change in use would not result in net loss, damage, depletion, or waste of assets, property, or property rights. The project would allow the more efficient use of Pueblo water rights to store water for agriculture, wildlife, and cultural resources.

4.16.6 Pueblo de San Ildefonso Future Projects Alternatives

4.16.6.1 Alternative SI-A—No Action

Under the Alternative SI-A, No Action, the Pueblo de San Ildefonso future projects would not be constructed, and the objectives of the project described in **Section 1.4** would not be realized. There would be no new facilities, requiring the use of Pueblo land for easements, ROWs, construction, or future operations; therefore, there would be no direct or indirect impacts on ITAs from this activity. No new water and wastewater distribution infrastructure would be constructed, and there would be no benefits to the Pueblo in maintaining water quality and in efficient use of its water rights.

Mitigation and Residual Impacts

Residual impacts include relying on existing water and wastewater infrastructure, potentially limiting future economic growth, improvements in water quality, and more efficient use of Pueblo water resources. No mitigation has been identified.

4.16.6.2 Alternative SI-B—Proposed Wastewater and Water Infrastructure

The Pueblo de San Ildefonso wastewater system improvements would require the use of Pueblo land for constructing a wastewater treatment facility, wastewater and sanitary pipelines and sewers, and access roads. Direct and indirect impacts on ITAs would be the same as those described above for the RWS project, but direct and indirect impacts would be on a smaller scale. This is because the project's direct short-term impacts would affect only 59 acres.

In addition to, and separate from, the wastewater system improvements, the Pueblo de San Ildefonso is also considering additional water-related infrastructure in a 680-acre area, near the northern boundary of the Pueblo, on the west side of the Rio Grande, along with three potential new pipeline alignments. There would be permanent changes to the Pueblo's use of these lands from constructing and operating these facilities and temporary changes during the construction.

New wastewater and water distribution infrastructure would assist the Pueblo in maintaining water quality and in efficient use of its water rights. The asset values of the change in use of these lands and water rights would not result in net loss, damage, depletion, or waste of assets, property, or property rights.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementing the proposed wastewater and water resources. No mitigation has been identified

4.17 Land Use

This section addresses potential impacts on land use on or near the water transmission and distribution system and RWS facilities under each alternative. The impacts on land use and recreation are described.

4.17.1 Impact Indicators

The indicators, as described in **Table 3-1**, are the acres that would be permanently acquired or altered for RWS facilities and the linear miles (with variable widths) of ROWs acquired where ownership or use changes temporarily for construction and permanently.

4.17.2 Analysis Methods and Assumptions

Data collection included a review of available land use plans and landownership. This review indicated that the RWS would conform and comply with existing land use plans, such as those for Santa Fe County (2007, 2010, and 2013). There would be no conflicts with existing plans and no need to amend them. These plans identify sustainable water and wastewater systems as a fundamental requirement to support existing community values and future population and economic growth.

The assumption regarding growth-inducing impacts is that the RWS substitutes one water supply for another; therefore, there would be no growth-inducing impacts of the project and no need to analyze impacts.

4.17.3 RWS Alternatives

4.17.3.1 Alternative A—No Action

Under Alternative A, the RWS would not be constructed, and there would be no changes to or conflicts with land uses, zoning, access, or recreation from the construction or operation of the RWS.

Mitigation and Residual Impacts

There would be no mitigation proposed and no residual impacts on land use, access, or recreation under Alternative A.

4.17.3.2 Impacts Common to All Action Alternatives

The action alternatives would affect land use on or near the ROW for pipeline installation and the land where permanent RWS facilities are constructed, such as the water treatment plant, short-term storage tanks, and pumping plants. **Table 4-45** and **Table 4-46**, below, show the breakdown of acres of land needed for permanent RWS facilities and the anticipated miles of water transmission and distribution pipelines along roads by alternative.

The greatest potential for RWS facilities to conflict with existing land uses and zoning is in locations where new facilities are proposed, near residential-zoned parcels or next to areas identified for future residential development. In these locations, proposed RWS elements, which are generally industrial in nature, would be incompatible with adjacent residential land uses. The industrial uses could generate noise or light glare that is typically not found in such areas, which would be incompatible with residential land uses.

Under all action alternatives, RWS elements would result in temporary and permanent changes in land use. These elements are pipelines, electrical lines, short-term storage tanks, pumping plants, a water treatment plant, and water intake structures.

Table 4-45. Acres of Land Needed for Permanent RWS Facilities (Excluding Pipelines) by Action Alternative and Land Ownership

Landownership	Alternative B	Alternative C	Alternative D	Alternative E
Pueblo de San Ildefonso/BIA	12	8	9	6
Pueblo of Pojoaque/BIA	21	9	6	4
Pueblo of Nambé/BIA	2	2	2	3
Pueblo of Tesuque/BIA	2	2	3	2
NMDOT (not on Tribal lands), SH 502, and U.S. Highway 84/285	0	0	0	0
Santa Fe County	0	0	0	0
Private owner	3	2	4	1
Total	**40**	**23**	**24**	**16**

Source: Reclamation GIS 2017

Table 4-46. Miles of Water Transmission and Distribution Pipelines along Roads (All RWS Action Alternatives)

Along Roads Maintained By	Number of Miles
Pueblo de San Ildefonso/BIA	1 to 2
Pueblo of Pojoaque/BIA	1
Pueblo of Nambé/BIA	3 to 4
Pueblo of Tesuque/BIA	2 to 3
NMDOT (not on Tribal lands), SH 502, and U.S. Highway 84/285	1 to 2
Santa Fe County	5 to 15
Private owner	2 to 7
Total	**23 to 26**

Source: Reclamation GIS 2017

During construction of the RWS, there would be short-term conflicts with existing residential, commercial, and public land uses. This would come from approximately 23 to 26 miles of water transmission and distribution pipelines, depending on the alternative (**Table 4-46**). Impacts would be from localized reductions or delays in access to private properties and public open space. For example, pipeline excavation, temporary materials storage, materials transport, and resurfacing after pipelines and electrical lines are placed would result in temporary traffic detours on public streets. Access limitations would directly correspond with the duration of construction. No long-term change in access is anticipated from installing, operating, or maintaining the pipelines. Temporary easements would be relinquished on substantial completion of the RWS construction.

Most pipelines would be constructed in public ROWs and on public land; however, temporary encroachment of construction is possible. This would come in the form of

temporary parking for loading and unloading of employees and materials or vehicle maneuvering on private property. Any activity would be along the portion of the property, next to an existing public ROW or within a temporary construction easement; therefore, it would not result in a long-term change in the underlying use of the private property or a change in private property rights.

Where easements are required for RWS permanent facilities, land use, in general, is not anticipated to change; conformance with existing land use or zoning plans would continue.

Installing the pipelines for the RWS would conform with land use planning objectives, such as the Santa Fe County Sustainable Growth Management Plan (Santa Fe County 2010). These advocate for a more sustainable water supply in the region. Accordingly, there would be no long-term conflict with private property as a result of pipeline installation. This portion of the project would be in conformance and would not conflict with existing land use and zoning plans.

Mitigation and Residual Impacts

Potential mitigation to minimize long-term impacts on land use under all action alternatives includes design features for the water treatment plant, pumping plants, and forebay tanks. This would be to make those elements more compatible with the existing land uses. Design features are property line setbacks, landscaping, lighting requirements, and limitations on hours of operation. Implementing these design features would minimize conflicts, such as light glare and noise, on adjacent non-industrial land uses.

Gates and fences around short-term storage tanks, the water treatment plant, and pumping plants would prevent unauthorized access and short- and long-term changes in the level of access to Pueblo lands and other private property. Erecting fences and gates on existing access roads could result in short- and long-term displacement of recreation opportunities and public access, with residual impacts on recreation in those areas. These residual impacts would be localized and are not anticipated to reduce the overall recreation opportunities in the general project area.

Dust abatement during construction would minimize temporary impacts on recreation from airborne dust in the vicinity. Following construction, revegetating temporary disturbances would mitigate the potential for any long-term residual impacts on recreation from dust.

With implementation of these mitigation measures, there would be negligible residual long-term impacts on existing land uses, access, or recreation from the construction and operation of the RWS under the action alternatives.

Condemnation or Compensation

As mentioned in **Chapter 2**, based on the New Mexico State Utility Accommodations Act, there is no expectation of need for condemning private lands next to the roadside of public highways; this is where most of RWS infrastructure would be placed. Most private landowners would be subject to the state law that provides for the installation, adjustment, relocation and maintenance of public utilities within public highway ROWs. Public highways, under this policy, are any federal, state, county, or city highway, street,

road or other public way devoted to vehicular and other modes of travel, including the entire area within the ROW.

Under the New Mexico State Utility Accommodations Act, public utilities have the power of eminent domain, which gives them a quasi-public status. In addition, a public utility operating in New Mexico has a legal right to install its facilities within a highway ROW, subject to the regulations of NMDOT. Public utility facilities are not ROW encroachments, nor may they be treated as such.

Reclamation would comply with the requirements of the Uniform Relocation Assistance and Real Property Acquisition Policies Act (Uniform Act) of 1970 (80 Stat. 1894; 42 USC, Section 4601, as amended). Under the Uniform Act, 49 CFR, Part 24, provides implementing regulations for how to manage appraisals, donations of property rights, fee simple and partial acquisitions, and relocations. The Uniform Act provides temporary relocation compensation for persons temporarily displaced, where acquisition, rehabilitation, or demolition of real property takes place (see 49 CFR, Part 24, Appendix A 24.2[a][9][ii][D]). It also allows for waiver valuations for temporary construction easements that may be required for private lands needed for construction and that are not along public highways. Finally, it promulgates how acquisitions of property are managed to ensure equitable treatment of all grantors of property interests.

Where additional land interests must be obtained to provide water to county customers, Santa Fe County is expected to acquire the interests necessary for construction, operations, and maintenance. Reclamation would acquire and pay market value for temporary and long-term easements across private property where needed to construct Pueblo water facilities.

4.17.3.3 Alternative B—HKM Implementable

Under Alternative B, there is the potential for direct and indirect short-and long-term impacts on land use, access, and recreation in the general project area from the development of the RWS.

Land Use and Access

Under Alternative B, RWS elements, which would include pipelines, electrical lines, short-term storage tanks, pumping plants, a water treatment plant, and ASR wells, would result in short- and long-term changes in land use, including temporary construction easements.

During construction of the RWS, there would be short-term conflicts with existing residential, commercial, and public land uses from the approximately 25 miles of water transmission and distribution pipelines.

There would be approximately 15 miles of new overhead electrical lines constructed under Alternative B.

Construction and operation of the 11 short-term storage tanks under Alternative B would change the current use of the land from open space to industrial use. Five of the six pumping plants and forebay tanks proposed under Alternative B would be in areas where the existing uses surrounding the site are industrial, open space, or undeveloped residential. These pumping plants and tanks would therefore be compatible with surrounding land uses. However, the Bishop’s Lodge pumping plant and short-term

storage tank would be within approximately 250 feet of existing residences. Placement and operation of the pumping plants and tanks would result in short- and long-term vehicle traffic and management of the property supporting the industrial use. This could conflict with future residential and, to a lesser extent, commercial and public uses in the vicinity. These conflicts would be mitigated through land use planning strategies, such as setbacks, landscaping, lighting, and noise baffling. With mitigation, the pumping plants and tanks would be in conformance and would not conflict with existing land use plans.

The proposed water treatment plant on the Pueblo de San Ildefonso would be on currently vacant land south of SH 502. The site would be approximately 1,300 feet from the nearest residence. Locating the water treatment plant next to the highway, approximately one-quarter mile from the nearest residence and over 1.5 miles from the community of El Rancho, would make it consistent with local land use planning policies (e.g., Santa Fe County 2010). These plans advocate for placing such facilities away from residentially zoned land uses.

Recreation

Compared with Alternative A, potential outdoor recreation users of the area where the water treatment plant would be located, particularly those engaged in nonmotorized activities, could experience a decline in the quality of recreation. This would be due to noise and the presence of work vehicles and trucks on SH 502 and the access road where the water treatment plant would be located. However, these conflicts would be localized and, thus, negligible at the regional scale. There would be no conflicts with the baseball field, fishing opportunities at the community fishing pond, or the community park on the Pueblo de San Ildefonso. These community recreation sites would be a mile or more north of the proposed treatment plant.

Because new access roads to any ASR wells would be gated, there would be no short- or long-term impacts on recreation from well construction or operation.

In the short term, river-based recreation would be affected under this alternative. This would be due to the construction of coffer dams, the side channel surface diversion structure, and sediment return system on the east bank of the Rio Grande, north of Otowi Bridge.

Mitigation and Residual Impacts

Mitigation and residual impacts would be the same as described under **Section 4.17.3.2**, Impacts Common to All Action Alternatives.

4.17.3.4 Alternative C

Alternative C would result in impacts on land use, access, and recreation similar to those under Alternative B, but with several differences, described below.

Land Use and Access

The short- and long-term direct and indirect impacts on land use and access from placing the RWS pipelines would be similar to those under Alternative B. Placing approximately

26 miles of new pipelines in and next to Tribal or public roads would have the same impacts as under Alternative B.

Alternative C would result in 7 miles of new overhead and underground electrical lines. Short-term impacts would be similar to those under Alternative B, but they would apply to a smaller area. Short-term impacts from placing power lines underground would be the same as those described under Alternative B for the pipeline. Because portions of the lines would be underground and the overhead lines would be next to existing linear features, there would little to no long-term conflicts with land use or access.

Impacts on land use and access from construction and operation of 11 short-term storage tanks would be similar to Alternative B, except that the Pojoaque Main, White Sands, and Bishop's Lodge tanks would be in different locations than under Alternative B.

Construction and operation of six new pumping plants and forebay tanks under Alternative C would result in the same impacts as under Alternative B.

Under Alternative C, the water treatment plant and surge tank would be in an existing industrial area, next to an arterial roadway and existing power substation. There would be impacts on access and land use similar to those under Alternative B. The location next to an existing power substation would minimize the degree of new conflicts with existing or planned land uses, compared with Alternative B. However, the water treatment plant and surge tank would be within a quarter-mile of several residences. This proximity would be less compatible with Santa Fe County land use planning policies, but it is preferred by the Pueblo de San Ildefonso, which owns the land. Alternative C would construct and operate a parallel interceptor drain and associated underground pipelines on the east bank of the Rio Grande, north of the Otowi Bridge. These features would not change existing land uses or zoning. Because the drain would be constructed in an undeveloped area with no current access, there would be no short-term changes in the level of access to the area. Once constructed, the drain would be underground. Accordingly, there would be no long-term impacts on land use or access.

Recreation

The short- and long-term direct and indirect impacts on recreation from the construction and operation of RWS pipelines, power lines, and short-term storage tanks would be similar to those under Alternative B. The exception is that there would be fewer short-term impacts from the construction of the power lines because there would be fewer line miles. Some short-term storage tanks and associated access roads would be in different locations under Alternative C, which would change the locations and extent of future recreation opportunities on the access roads. All new access roads constructed on Tribal lands would be gated.

The proposed water treatment plant would not conflict with access or recreation because it would be next to an existing industrial use, where access is restricted and there are no recreation opportunities. The water treatment plant would be 2 miles or more to the east of the San Ildefonso community park, baseball fields, and fishing pond and would therefore not conflict with recreation at those sites.

In the short term, constructing the parallel interceptor drain and associated underground pipelines would displace fishing, hunting, and other recreation in a 4-acre area along the

Rio Grande, north of Otowi Bridge. Primarily, impacts would be from excavating a 2,000-foot-long trench within a 50-foot-wide construction easement and from grading a 12-foot-wide access road to the interceptor site. Construction could create dust and noise that may also disturb rafting, fishing, hunting, and other recreation in the vicinity of the site. Once completed, the interceptor drain would permanently disturb less than an acre and would not conflict with recreation in the long term.

Mitigation and Residual Impacts

Mitigation and residual impacts would be the same as under **Section 4.17.3.2**, Impacts Common to All Action Alternatives.

4.17.3.5 Alternative D

Implementation of Alternative D would result in impacts on land use, access, and recreation similar to those under Alternative C, except for the differences described below.

Land Use and Access

Under Alternative D, impacts on land use and access from constructing and operating pipelines, overhead and underground electrical lines, and the water treatment plant would be the same as under Alternative C. Constructing and operating short-term storage tanks, pumping plants, and the infiltration gallery would result in impacts on land use and access similar to those under Alternative C, except for the differences noted below.

Alternative D would install 16 new short-term storage tanks. The nature and types of impacts on land use and access from these tanks would be the same as those under Alternative C, but they would occur in five additional locations. Because the five additional locations would be next to existing storage sites, there would be no change in land use or access, compared with Alternative A, and the impacts would be the same as those under Alternative C.

In the short term, constructing the infiltration gallery and associated underground pipelines could temporarily displace rafting, fishing, hunting, and other recreation along the Rio Grande, north of Otowi Bridge. Once constructed, the drains would be underground, so there would be no long-term impacts on land use or access.

Recreation

Under Alternative D, the impacts on recreation from constructing and operating pipelines, aboveground and underground transmission lines, and the water treatment plant would be the same as those under Alternative C. Impacts on recreation from the short-term storage tanks would be similar to those under Alternative C, but they would occur in five additional locations. Because these five additional locations would be next to existing storage sites, there would be no increase or decrease in recreation conflicts in those locations, compared with Alternative A.

Construction of the infiltration gallery would displace rafting, fishing, hunting, and similar recreation in a 31-acre area along the Rio Grande. Construction could create dust and noise that may also disturb fishing, hunting, and other recreation activities in the

vicinity of the site. Due to the small size of permanent disturbance (less than an acre), the feature would not likely displace or conflict with recreation in the long term.

Mitigation and Residual Impacts

Mitigation and residual impacts would be the same as described under **Section 4.17.3.2**, Impacts Common to All Action Alternatives.

4.17.3.6 Alternative E (Preferred Alternative)

Implementing Alternative E would result in impacts on land use, access, and recreation similar to those under Alternative C, except for the differences described below.

Land Use and Access

Short- and long-term impacts on land use and access under Alternative E from proposed pipelines, electrical lines, water treatment plant, and pumping plants and forebay tanks would be largely the same as under Alternative C. The exception is that there would be slightly less disturbance associated with pipeline, water treatment plant, and electrical line construction and operation. This would result in slightly less potential for conflicts with land uses and access than under Alternative C.

Alternative E would include seven new short-term storage tanks. The nature and type of impacts on land use and access from these tanks would be the same as under Alternative C; however, the degree of potential impacts would be less, because there would be four fewer tank locations.

In the short term, constructing the horizontal radial well collectors and associated underground pipelines could temporarily displace fishing, hunting, and other recreation along the Rio Grande, north of Otowi Bridge. Once constructed, the wells would be underground, resulting in no long-term impacts on land use or access.

Hooking up to existing emergency use wells, a practice unique to Alternative E, would be in conformance with local land use policies, such as the Santa Fe County Sustainable Growth Management Plan (Santa Fe County 2010). These plans support emergency water use in order to be more resilient to drought and the impacts of climate change. The wells do not conflict with existing land uses or zoning.

Recreation

The nature and type of short- and long-term impacts on recreation under Alternative E from proposed pipelines, electrical lines, short-term storage tanks, pumping plants and forebay tanks, and water treatment plant would be similar to those under Alternative C; however, there would be slight changes in the locations and degree of impacts, as described under *Land Use and Access*, above.

Constructing the horizontal radial well collectors proposed under Alternative E would temporarily displace outdoor recreation opportunities along the Rio Grande, near the Otowi Bridge. The construction could affect rafting, fishing, hunting, and other recreation in the vicinity due to noise and dust. Once the wells are constructed, there would be no long-term impacts on recreation, because the features would be underground.

Mitigation and Residual Impacts

Mitigation and residual impacts would be the same as described under **Section 4.17.3.2**, Impacts Common to All Action Alternatives.

4.17.3.7 Summary of Impacts

Impacts on land use, access, and recreation would occur mostly during construction. Placing pipelines, electrical lines, wells, and other features underground would temporarily reduce access to private and public land and would displace certain types of recreation. Once installed, there would be negligible impacts from operating and maintaining the pipelines, electrical lines, and wells.

Short-term storage tanks would change the functional use of several locations in the general project area from open space to industrial. However, because the tank sites are away from existing residences, the features would be in conformance with existing land use plans. In the long-term, the RWS would result in minimal changes in land use.

The water treatment plant proposed under each alternative would create a new industrial-type land use, which would require mitigation to minimize impacts on adjacent non-industrial land uses. The amount of required mitigation would be greatest under Alternative E, because the water treatment plant would be within 230 feet of existing residences. Water collection features proposed under all action alternatives would temporarily displace recreationists near the Otowi Bridge. Once these features are installed, they would have negligible impacts on land use, access, or recreation.

Overall, the RWS proposed under Alternatives B, C, D, and E would be in conformance with the Santa Fe County Sustainable Growth Management Plan, Pojoaque Valley Community Plan, Tesuque Community Plan, and other informal community visions that promote more sustainable and equitable water supply to support current and future land uses.

4.17.4 Rio Pojoaque Irrigation Improvement Project

4.17.4.1 Alternative RP-A—No Action

Under Alternative RP-A, No Action, the Rio Pojoaque irrigation improvement project would not be constructed, so there would be no changes to or conflicts with land uses, zoning, access, or recreation.

Mitigation and Residual Impacts

There would be no mitigation proposed and no residual impacts on land use, access, or recreation under Alternative RP-A, No Action.

4.17.4.2 Impacts Common to All Action Alternatives

Under all action alternatives, the proposed Rio Pojoaque irrigation improvement project would be in conformance with existing land use planning documents and community plans, such as the Santa Fe County Sustainable Growth Management Plan (Santa Fe County 2010), the Pojoaque Valley Community Plan (Santa Fe County 2007), and the Tesuque Community Plan (Santa Fe County 2013).

None of the proposed irrigation improvements associated with any of the action alternatives would change or modify existing land uses or zoning in the analysis area; however, the ability of Tribal members to irrigate would be improved due to the increase in collected water in the Pueblo irrigation system. In the short term, construction would displace recreation users and could affect fishing, hunting, and other recreation in the vicinity, due to noise and dust. Additionally, there would be no permanent change in access or recreation opportunities under any of the action alternatives.

Mitigation and Residual Impacts

Under the action alternatives, there would be no mitigation and negligible residual long-term impacts on existing land uses, zoning, or access from the Rio Pojoaque irrigation improvement project. During construction, dust abatement would minimize temporary impacts on nearby recreation opportunities from airborne dust. Following construction, revegetating disturbed areas would mitigate the potential for any long-term residual impacts on recreation from dust.

4.17.4.3 Alternative RP-B

Impacts would be the same as those described under **Section 4.17.4.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Mitigation and residual impacts would be the same as those described under **Section 4.17.4.2**, Impacts Common to All Action Alternatives.

4.17.4.4 Alternative RP-C (Preferred Alternative)

Alternative RP-C would also result in a new conveyance system on the southern edge of the Rio Pojoaque on the Pueblo de San Ildefonso. The system would run along the northern property boundaries of several parcels, but it would not encroach on those private properties. Operation of the system would likely support local acequia systems; accordingly, the system would be in conformance with existing land uses in the area. Construction and operation of the system would prohibit trespass use of the river road, which is also in line with Pueblo de San Ildefonso land use objectives.

There would be no impacts on recreation from the new conveyance canal.

Mitigation and Residual Impacts

Mitigation and residual impacts would be the same as those described under **Section 4.17.4.2**, Impacts Common to All Action Alternatives.

4.17.4.5 Alternative RP-D

Impacts would be the same as those described under **Section 4.17.4.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Mitigation and residual impacts would be the same as those described under **Section 4.17.4.2**, Impacts Common to All Action Alternatives.

4.17.4.6 Alternative RP-E

Impacts would be the same as those described under **Section 4.17.4.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Mitigation and residual impacts would be the same as those described under **Section 4.17.4.2**, Impacts Common to All Action Alternatives.

4.17.4.7 Summary of Impacts

The Rio Pojoaque irrigation improvement project proposed under Alternatives RP-B, RP-C, RP-D, and RP-E would be in conformance with the Santa Fe County Sustainable Growth Management Plan (Santa Fe County 2010), the Pojoaque Valley Community Plan (Santa Fe County 2007), and other informal community visions that promote more sustainable water supply systems to support current and future land uses. None of the alternatives would change existing land uses, zoning, access, or recreation opportunities. However, the ability of Tribal members to irrigate would be improved due to the increase in collected water in the Pueblo irrigation system.

4.17.5 Rio Tesuque Channel Modification Project

4.17.5.1 Alternative RT-A—No Action

Under Alternative RT-A, No Action, the Rio Tesuque channel modification project would not be constructed, so there would be no changes to or conflicts with land uses, zoning, access, or recreation.

Mitigation and Residual Impacts

There would be no mitigation proposed and no residual impacts on land use, access, or recreation under Alternative RT-A, No Action.

4.17.5.2 Impacts Common to All Action Alternatives

Under all action alternatives, the proposed Rio Tesuque channel modification project would be compatible with existing land use planning documents and community plans, such as the Santa Fe County Sustainable Growth Management Plan (Santa Fe County 2010) and Tesuque Community Plan (Santa Fe County 2013). These plans identify sustainable surface water ecosystems and infrastructure to support existing community values and future population and economic growth.

None of the proposed channel improvements associated with any of the action alternatives would change or modify existing land uses or zoning in the area of analysis. In the short term, construction would displace recreation users and could affect fishing, hunting, and other recreation in the vicinity, due to noise and dust. There would be no change in access or recreation opportunities under any of the action alternatives.

Mitigation and Residual Impacts

Dust abatement during construction would minimize temporary impacts on recreation from airborne dust in the vicinity. Following construction, revegetating temporary

disturbances would mitigate the potential for any long-term residual impacts on recreation from dust.

4.17.5.3 Alternative RT-B

Impacts would be the same as those described under **Section 4.17.5.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Mitigation and residual impacts would be the same as those described **Section 4.17.5.2**, Impacts Common to All Action Alternatives.

4.17.5.4 Alternative RT-C

Impacts would be the same as those described under **Section 4.17.5.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Mitigation and residual impacts would be the same as those described under **Section 4.17.5.2**, Impacts Common to All Action Alternatives.

4.17.5.5 Alternative RT-D (Preferred Alternative)

Impacts would be the same as those described under **Section 4.17.5.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Mitigation and residual impacts would be the same as those described under **Section 4.17.5.2**, Impacts Common to All Action Alternatives.

4.17.5.6 Alternative RT-E

Impacts would be the same as those described **Section 4.17.5.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Mitigation and residual impacts would be the same as those described under **Section 4.17.5.2**, Impacts Common to All Action Alternatives.

4.17.5.7 Summary of Impacts

The Rio Tesuque channel modification project proposed under Alternatives RT-B, RT-C, RT-D, and RT-E would be in conformance with the (Santa Fe County 2010) and Tesuque Community Plan (Santa Fe County 2013), and other informal community visions that promote more sustainable water supply systems to support current and future land uses. None of the alternatives would change existing land uses, zoning, access, or recreation opportunities.

4.17.6 Pueblo de San Ildefonso Future Projects Alternatives

4.17.6.1 Alternative SI-A—No Action

Under the Alternative SI-A, No Action, the Pueblo de San Ildefonso future projects would not be constructed. There would be no changes to or conflicts with land uses, zoning, access or recreation from project construction or operation.

Mitigation and Residual Impacts

There would be no mitigation proposed and no residual impacts on land use, access, or recreation under Alternative SI-A, No Action.

4.17.6.2 Alternative SI-B—Proposed Wastewater and Water Infrastructure

Wastewater improvements and other water-related infrastructure proposed under Alternative SI-B would be consistent with and would support existing and future land uses and development on the Pueblo de San Ildefonso. In particular, the project would be in conformance with the Santa Fe County Sustainable Growth Management Plan, which states "There is a need for improved water and sewer services to be as efficient as they can be…Water and sewer infrastructure are currently limited to very discrete areas within the County (Santa Fe County 2010)."

This management plan further supports centralized water and wastewater services, suggesting that infrastructure be expanded to new and existing development.

The proposed Pueblo de San Ildefonso preliminary wastewater system design could have land use impacts. Direct and indirect impacts would be the same as those described above for the RWS project. They would mainly be from temporary declines in access and recreation opportunities where construction is taking place. Access roads would be gated and project features fenced to prevent unauthorized access to Pueblo lands.

Direct and indirect impacts from the wastewater system improvements would be on a smaller scale than for the RWS project. This is because the project's direct short-term impacts would affect 59 acres only. The magnitude of direct and indirect impacts from the other water-related infrastructure projects would be analyzed as the details of those projects are further developed.

There would be no long-term impacts on access or recreation as part of Alternative SI-B. If the wastewater system improvements or other water-related infrastructure projects were to result in new treatment plants and other industrial features on non-industrial lands, there would be short- and long-term changes in the underlying land use for that property. In addition, some of the proposed facilities are next to existing or proposed residential development, mitigation in the form of landscaping, lighting, and noise abatement could be necessary to minimize long-term impacts on adjacent uses.

Mitigation and Residual Impacts

To prevent residual impacts on adjacent land uses, mitigation could be necessary for new water and wastewater facilities. This could include landscaping, lighting, and noise baffling, and limits on the hours of operation, designed to minimize noise and light trespass onto adjacent properties.

4.18 Visual Resources

This section addresses potential impacts on visual resources from actions associated with each alternative.

4.18.1 Impact Indicators

The indicator, as described in **Table 3-1**, used to analyze impacts on visual resources is the degree of short-term and long-term contrast between current and anticipated features of the landscape from KOPs.

4.18.2 Analysis Methods and Assumptions

For the analysis of direct short-term impacts, **Table 2-4**, RWS Surface Disturbance Comparison, was used to indicate the area where there would be surface disturbance due to construction. Any area where new project features would be constructed would have direct short-term visual impacts. GIS data of this area was overlaid with KOPs (see **Figure 3-19**, Key Observation Points); KOPs that overlap this area represent viewpoints that would be affected by short-term surface disturbance from construction.

Direct long-term visual impacts are based on the visibility of the proposed project features from KOPs. For analysis of direct long-term impacts, Reclamation identified the permanent features from the RWS and other proposed actions closest to each KOP. Some KOPs were eliminated from analysis because there were no visible features from them.

Visual simulations were prepared by imposing an image of the proposed RWS feature onto photographs taken in the field (see **Section 3.18**, Visual Resources, for a description of field inventory, and figures in **Appendix D** for photographs of current conditions and simulations). The change in condition is based on changes to basic elements of form, line, color, and texture (BLM 1984). The changes to form, line, color, and texture at these KOPs are representative of changes that would occur by implementation of some RWS features into the viewshed. For the Rio Pojoaque irrigation improvement project and Rio Tesuque channel modification project, the proposed infrastructure would be consistent with existing conditions; therefore, visual simulations were not done.

Figure 4-2, below, shows the proposed infrastructure visible at specific KOPs under each alternative.

4.18.2.1 Assumptions

The following assumptions were used in analyzing impacts on visual resources:

- External lighting would be included on the water treatment plant and pumping plants, although the lighting would be shrouded and directed downward to minimize light pollution for local residents. There would be no external lights on short-term storage tanks or surge tanks. There is no information on the type or intensity of artificial light, so this is not accounted for in this analysis.
- All construction and operation lighting would be shrouded and directed downward so as to illuminate only project areas.

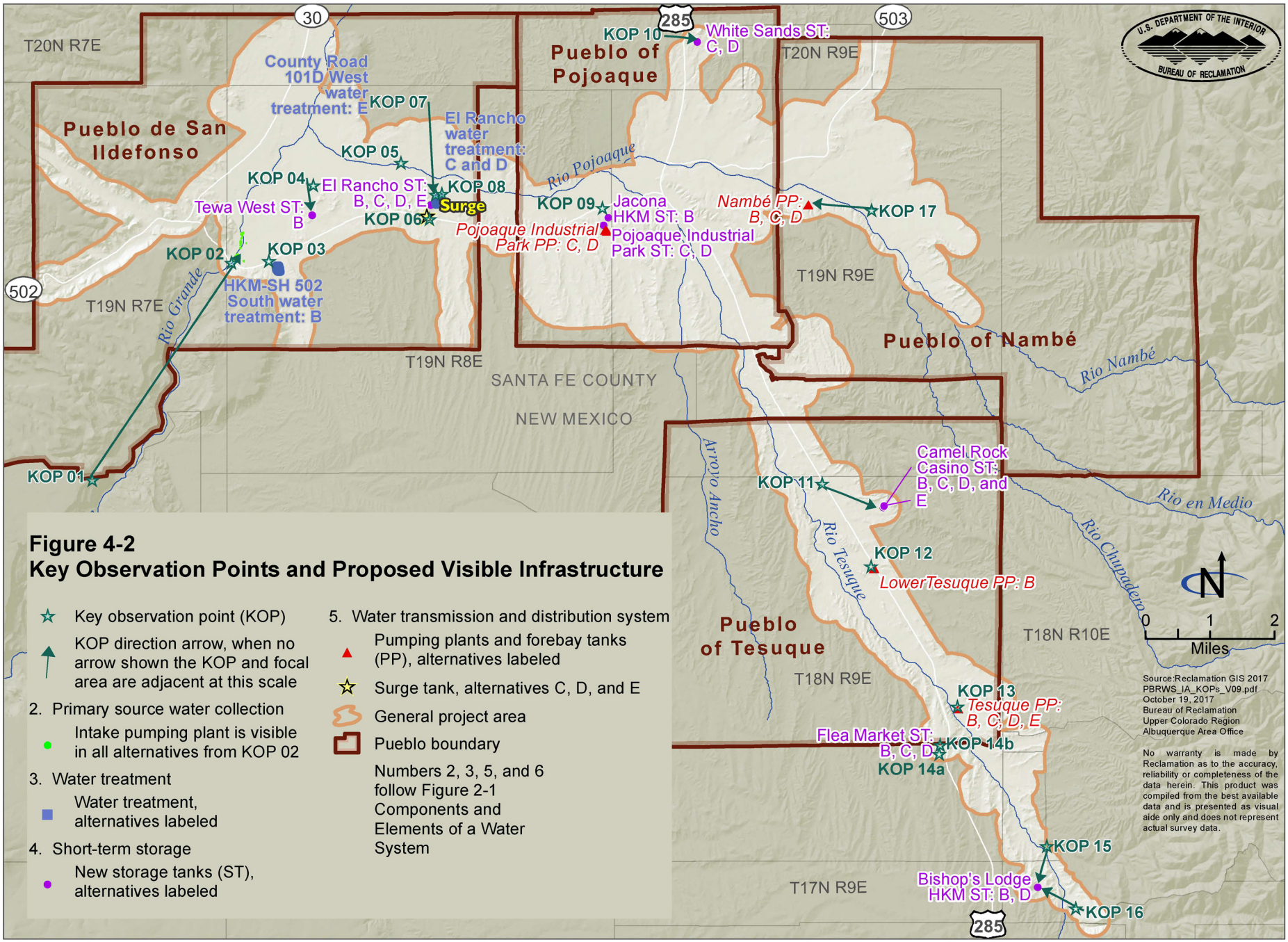


Figure 4-2
Key Observation Points and Proposed Visible Infrastructure

- Key observation point (KOP)
- KOP direction arrow, when no arrow shown the KOP and focal area are adjacent at this scale

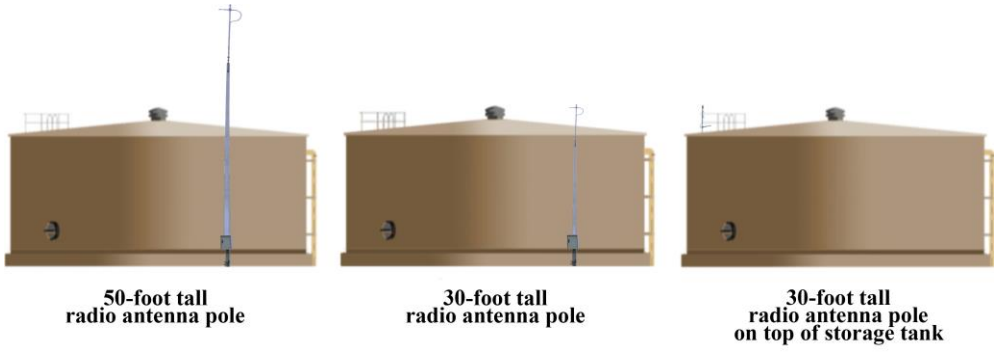
2. Primary source water collection
   - Intake pumping plant is visible in all alternatives from KOP 02
3. Water treatment
   - Water treatment, alternatives labeled
4. Short-term storage
   - New storage tanks (ST), alternatives labeled
5. Water transmission and distribution system
   - Pumping plants and forebay tanks (PP), alternatives labeled
   - Surge tank, alternatives C, D, and E
   - General project area
   - Pueblo boundary

Numbers 2, 3, 5, and 6 follow Figure 2-1 Components and Elements of a Water System

- All external construction and operation lighting would be on a timer or motion sensor. Therefore, when lights are not in use they would turn off.
- Ten-hour workdays were assumed for construction, which would occur during daytime.
- For the purposes of analysis, more acres of short-term disturbance (as indicated in **Table 2-4**) means larger areas of construction, and thus more areas with impacts on visual resources from construction.
- All tanks, including surge tanks, would be painted to blend with the surrounding landscape, regardless of which alternative is selected.
- There would be a corresponding chlorine injection building placed next to all proposed short-term storage tanks.
- All proposed short-term storage tanks, water treatment plants, and pumping plants and forebay tanks would include a corresponding radio antenna pole. Under Alternatives B, C, and D, all radio antenna poles would be next to their respective facilities. Under Alternative E, short-term storage tank radio antenna poles would be placed on top of the tanks, while all other radio antenna poles would be placed next to their respective facilities.

  Figure 4-3, below, compares the visual effects of radio antenna poles at short-term storage tanks under the RWS alternatives. Under Alternatives B, C, and D, radio antenna poles would be placed next to tanks; under Alternative E, they would be installed on top of them. The top height of poles would not change between on-tank and next-to-tank installation. For example, for a 30-foot tall pole installed on top of a tank, the pole itself would only be tall enough to reach 30 feet high when added to the total tank height.

Figure 4-3. Radio Antenna Pole Scenarios



4.18.3 RWS Alternatives

4.18.3.1 Alternative A—No Action

Under the No Action Alternative, there would be no construction or operation of RWS facilities or infrastructure; therefore, there would be no impact on the current visual landscape or on views from any KOPs. Existing water storage tanks are features of the existing visual landscape.

Mitigation and Residual Impacts

There would be no mitigation or residual impacts associated with the No Action alternative.

4.18.3.2 Impacts Common to All Action Alternatives

The types of direct impacts under each alternative are the same, but the extent of impacts on visual resources varies with each alternative. Therefore, there are no direct impacts common to all action alternatives.

Mitigation and Residual Impacts

Although there are no direct impacts on visual resources common to all action alternatives, the minimization and mitigation of the various direct visual impacts from the action alternatives are generally similar.

Direct short-term visual impacts caused by construction could be reduced through restoration. Dirt removed for construction could be stockpiled and used to restore the disturbed area; this would preserve the natural color of the soil. Surface restoration, including revegetation, of areas where underground features had disturbed the surface would reduce these impacts.

Direct long-term impacts on form, line, and texture of the visual landscape could be reduced by partially or completely burying tanks, considering natural topography for placing aboveground features (e.g., behind hills), and using vegetation as screens or installing berms around aboveground features.

4.18.3.3 Alternative B—HKM Implementable

Under Alternative B, there would be direct short-term impacts from constructing the RWS facilities and infrastructure. The proposed project features would change the visual landscape by causing surface disturbance, which would produce direct, short-term, localized changes to the visual landscape. This would come about by removing or disturbing the top layers of soil or vegetation to reveal colors that contrast with the surrounding landscape.

Table 2-4 provides the acres of short-term disturbance associated with construction, which quantifies the area where there would likely be direct short-term disturbance to the visual landscape. Under this alternative, there would be approximately 1,203 acres of short-term disturbance. Surface disturbance from construction would impact visual resources by removing or disturbing the top layers of soil or vegetation to reveal colors that contrast with the surrounding landscape. It would also introduce artificial elements, such as construction vehicles and equipment, to areas that are undeveloped.

External artificial lighting used to illuminate construction sites would cause additional visual impacts by introducing light and glare to areas that typically do not have sources of light or glare. However, since construction would occur only during daylight, there would be no such impacts at night. Also, since construction lighting would be shrouded and directed downward so as to only illuminate project areas only, any impacts would be localized.

Adding RWS features to the general project area would change the visual landscape by adding human-made modifications; these features would have direct long-term impacts

on the visual character by changing the form, line, color, or texture of the landscape. **Table 2-4** describes the acreage where there would be permanent RWS facilities, including access roads.

An indirect impact would be the possible increased off highway vehicle (OHV) and vehicle use along project access roads. This would increase ground scarring and leave a visible disturbance on the ground surface, vegetation, and color. Under this alternative, approximately 5 miles of new or improved access roads would be constructed.

Appendix D, Visual Simulations, displays some of these features on the landscape. **Table 4-47**, Alternative B: Proposed Project Features Visible from Key Observation Points, describes proposed RWS project features that would be visible from the KOPs under this alternative. These would be direct long-term impacts.

KOP 02

The side channel surface diversion structure, pumping plant, and radio antenna pole would be within view of KOP 02, as shown in **Figure D-3**, Key Observation Point 02—Simulated Condition: Alternative B (**Appendix D**). As shown in the simulation, these facilities would have contrasting line and texture with existing surroundings. Line contrasts with current lines in the landscape; the tree line is interrupted by the presence of the pumping plant and the radio antenna pole behind it. The line of the surface diversion plant adds a trapezoidal break to the continuous curving line of the river. These sharp angles also create a contrasting texture; the three structures are sharp and directional, whereas the landscape is smooth.

The visual simulation for KOP 02 shows that form and color conform somewhat to the landscape. The form of the pumping plant, and surface diversion structure conforms to the contours of the landscape; the pumping plant follows a similar contour as the vegetation line, and the surface diversion structure is low to the ground with the river. However, the radio antenna pole does not conform to the landscape, as it has a height greater than landscape features in both the foreground and background.

The color would be somewhat conforming, since earth-tone colors would be used for exterior walls, doors, and roof panels, to match native surroundings. These colors conform to the colors of the soil and water, which are earth-toned, but contrast with the colors of surrounding vegetation, which is varying shades of green. The gray radio antenna pole does not conform to other colors in the landscape, but its monotone color is not prominent, due to the adjacent green vegetation.

KOP 03

The HKM – SH 502 South water treatment plant, radio antenna pole, and overhead electrical lines would be within view of KOP 03, as shown in **Figure D-6**, Key Observation Point 03—Simulated Condition: Alternative B (**Appendix D**). Under this alternative, no earthwork would be constructed to conceal the water treatment plant from the nearby highway. Therefore, these facilities would be fairly visible to a viewer on the highway. The form and texture of the water treatment plant and radio antenna pole would contrast with existing surroundings. The form of both structures is unlike anything else in the KOP's view, which is completely undeveloped (see current condition in **Figure D-6**,

Table 4-47. Alternative B: Proposed Project Features Visible from Key Observation Points

KOP Number[1]	Direction of View	Reasons for the KOP	Proposed Project Features Observed from the KOP	Approximate Distance of KOP to Feature (feet)	Simulation Figure Number
02	East	Views from bridge over Rio Grande	Side channel surface diversion structure,	320	D-3 Key Observation Point 02—Simulated Condition: Alternative B
			pumping plant,	320	
			radio antenna pole	320	
03	Southeast	Views from highway	HKM – SH 502 South water treatment plant,	700	D-6 Key Observation Point 03—Simulated Condition: Alternative B
			overhead electrical lines,	800	
			radio antenna pole	700	
06	Northwest	Views from the highway	Overhead electrical lines	170	D-10 Key Observation Point 06—Simulated Condition: Alternative B
07	South	Views from community	El Rancho short-term storage tank,	950	D-13 Key Observation Point 07—Simulated Condition: Alternatives B, C, and D
			two overhead electrical lines,	310 and 340	
			radio antenna pole	950	

Table 4-47. Alternative B: Proposed Project Features Visible from Key Observation Points (cont.)

KOP Number[1]	Direction of View	Reasons for the KOP	Proposed Project Features Observed from the KOP	Approximate Distance of KOP to Feature (feet)	Simulation Figure Number
08	South	Views from the community	El Rancho short-term storage tank,	1,250	D-15 Key Observation Point 08—Simulated Condition: Alternative B
			two overhead electrical lines,	580 and 820	
			radio antenna pole	1,250	
09	South	Views from community and highway	Pojoaque Industrial Park pumping plant,	1,900	D-18 Key Observation Point 09—Simulated Condition: Alternative B
			air chamber building,	1,900	
			Jacona HKM short-term storage tank,	940	
			overhead electrical lines,	970	
			two radio antenna poles	1,900 and 940	
11	Southeast	Views from El Camino Real National Scenic Byway and Camel Rock	Overhead electrical lines,	2,900	D-22 Key Observation Point 11—Simulated Condition: Alternatives B, C, and D
12	Southeast	Views from El Camino Real National Scenic Byway and recreation site	Lower Tesuque pumping plant,	300	D-24 Key Observation Point 12—Simulated Condition: Alternative B
			air chamber building,	310	
			overhead electrical lines	310	
			radio antenna pole	300	

Table 4-47. Alternative B: Proposed Project Features Visible from Key Observation Points (cont.)

KOP Number[1]	Direction of View	Reasons for the KOP	Proposed Project Features Observed from the KOP	Approximate Distance of KOP to Feature (feet)	Simulation Figure Number
13	South	Views from County Road 73	Tesuque pumping plant,	150	D-26 Key Observation Point 13—Simulated Condition: Alternatives B, C, and D
			air chamber building,	150	
			forebay tank,	50	
			access road,	20	
			two radio antenna poles	150 and 50	
14a	North	Views from Crosby Theatre—Opera Club—Turner Family Lounge	Flea Market short-term storage tank,	780	D-28 Key Observation Point 14a—Simulated Condition: Alternatives B and C
			overhead electrical lines,	770	
			radio antenna pole	780	
14b	Northwest	Views from Opera Drive	Flea Market short-term storage tank,	130	D-31 Key Observation Point 14b—Simulated Condition: Alternatives B and C
			overhead electrical lines,	60	
			radio antenna pole	130	
17	West	Views from community	Overhead electrical lines	5,300	D-36 Key Observation Point 17—Simulated Condition: Alternatives B, C, and D

Source: Field inventory, September 28–30, 2015, and March 16, 2017; Appendix D.
[1] There are no proposed project features visible from KOPs 01, 04, 05, 10, 15, or 16.

Key Observation Point 03—Existing Condition: [**Appendix D**]). The building and corresponding antenna is angular, nonconforming, and therefore bold against the existing landscape. Texture is contrasting because the structures are sharp and directional, whereas the landscape is smooth.

The visual simulation for KOP 03 shows that the water treatment plant conforms to existing lines in the landscape; the top line of the plant very closely follows the continuous line of the hill directly behind it. However, since the water treatment plant deeply contrasts in color with this hill, it is still quite visible. The radio antenna pole would not follow the existing lines in the landscape, but this would not be emphasized, due to the presence of the adjacent water treatment plant. Additionally, the radio antenna pole's monotone and somewhat transparent gray would conform to existing colors in the background. The water treatment plant contrasts with the colors of this hill and the mountains in the background, which are darker grays and black. However, these colors conform to the colors of the soil and vegetation in the foreground; all are earth toned. No overhead electrical lines are visible in the existing view of KOP 03; therefore, these overhead electrical lines would have contrasting form, line, color, and texture with existing surroundings. The form of overhead electrical lines is simple and smooth. Depending on viewer distance, they can be bold or transparent. Their line is straight, angular, and continuous. Even in otherwise undeveloped areas, overhead electrical lines can blend into the current line and form of the landscape, since the lines generally follow the topography.

Because electrical lines are high aboveground, often more so than other features in the landscape, they can change the texture of the landscape and can contrast with the color of the sky. Texture is sharp and clumped around the structures supporting the lines. The horizontal lines of the electrical lines may be somewhat transparent, depending on lighting and viewer distance, but the structures supporting the lines (perpendicular to the ground) would not; their color would contrast with the landscape.

KOP 06

There are no overhead electrical lines within view of KOP 06, so the additional overhead electrical lines' form, line, color, and texture would contrast with the surroundings.

KOP 07

El Rancho short-term storage tank, a radio antenna pole, and overhead electrical lines would be within view of KOP 07, as shown in **Figure D-13**, Key Observation Point 07—Simulated Condition: Alternative B (**Appendix D**). The short-term storage tank's form and line would contrast with existing surroundings: The cylindrical form of the short-term storage tank contrasts with the linear and curving forms of the landscape. There are also no other similarly sized developments in view of KOP 07, which makes the form particularly contrasting with existing conditions. The short-term storage tank's line contrasts with current lines in the landscape; the line of the hill, which is the dominant horizontal line in the landscape, is interrupted by the presence of the short-term storage tank behind it.

The visual simulation for KOP 07 shows that the short-term storage tank conforms to the texture and color of the landscape. The texture of the short-term storage tank is smooth and rounded, which mimics the smooth roundness of the hills and road. The dominant colors in the landscape are earth toned, in a similar chroma as the short-term storage tank.

There are overhead electrical lines within view of KOP 07; these additional lines do not add contrasting features to those that are already there. The radio antenna pole would

have similar visual characteristics to the overhead electrical lines, including a vertical form, straight line, monotone color, and smooth texture; thus, it would not contrast with existing features in the surroundings.

KOP 08

As shown in **Figure D-15**, Key Observation Point 08—Simulated Condition: Alternative B (**Appendix D**), facilities visible within view of KOP 08 are the El Rancho short-term storage tank, a radio antenna pole, and two overhead electrical lines. KOP 08 shows the same infrastructure as KOP 07, including the El Rancho short-term storage tank, a radio antenna pole, and two overhead electrical lines. The only difference between the two KOPs is that KOP 08 is in the community, rather than along the highway, and is placed at a greater distance from the proposed infrastructure, when compared to KOP 07. For this reason, KOP 08 would have the same visual impacts as KOP 07 for Alternative E; however, the impacts would be slightly less prominent, due to the increased distance between the KOP and proposed facilities.

There are already overhead electrical lines within view of KOP 08, so additional lines would not add contrasting features. The radio antenna pole would have similar visual characteristics as the overhead electrical lines, including a vertical form, straight line, monotone color, and smooth texture; thus, they would not contrast to existing features in the surroundings.

KOP 09

Figure D-18, Key Observation Point 09—Simulated Condition: Alternative B (**Appendix D**), shows that the Jacona HKM short-term storage tank, Pojoaque Industrial Park pumping plant, air chamber building, two radio antenna poles, and overhead electrical lines would be within view of KOP 09. The short-term storage tank, pumping plant, and air chamber building form, line, and texture would contrast with the surroundings. The cylindrical and rhomboid forms of the facilities contrast with the curving and linear forms of the landscape. The perpendicular and angular lines of the facilities contrast with the rolling and convex lines of the landscape. The texture of the facilities is sharp and directional, whereas the existing landscape is smooth. The visual simulation for KOP 09 shows that the structures conform to the colors of the landscape, which are earth toned, in a similar chroma as the facilities. However, these facilities contrast with the colors of surrounding vegetation.

There are already overhead electrical lines within view of KOP 09; these additional lines do not add contrasting features to those that are already there. The radio antenna poles would have similar visual characteristics as the overhead electrical lines, including a vertical form, straight line, monotone color, and smooth texture; thus, they would not contrast to existing features in the surroundings.

KOP 11

Overhead electrical lines would be within view of KOP 11, as shown in **Figure D-22**, Key Observation Point 11—Simulated Condition: Alternatives B, C, and D (**Appendix D**). There are no overhead electrical lines within view of KOP 11; therefore, these

overhead electrical lines' form, line, color, and texture would contrast with existing surroundings.

KOP 12

Figure D-24, Key Observation Point 12—Simulated Condition: Alternative B (**Appendix D**), shows that the Lower Tesuque pumping plant, air chamber building, radio antenna pole, and overhead electrical lines would be within view of KOP 12. The pumping plant and air chamber building form, line, and texture would contrast with the surroundings. The rhomboid forms of the facilities contrast with the curving and linear forms of the landscape. The perpendicular and angular lines of the facilities contrast with the rolling and convex lines of the landscape. The texture of the facilities is sharp and directional, whereas the landscape is smooth.

There are no overhead electrical lines within view of KOP 12; therefore, these overhead electrical lines' form, line, color, and texture would contrast with existing surroundings. The radio antenna pole would have similar visual characteristics as the overhead electrical lines, including a vertical form, straight line, monotone color, and smooth texture; thus, it would contrast in the same manner as the overhead electrical lines, when compared to existing features in the simulation.

KOP 13

The Tesuque pumping plant, air chamber building, forebay tank, two radio antenna poles, and access road would be within view of KOP 13, as shown in **Figure D-26**, Key Observation Point 13—Simulated Condition: Alternatives B, C, and D (**Appendix D**). The access road would not contrast with existing conditions, because there is already a dirt road within view of this KOP.

The pumping plant, air chamber building, and forebay tank form, line, and texture would contrast with the surroundings. Lines in the landscape are horizontal, and curved, and the structures add angular and perpendicular lines; these lines interrupt the existing line between the ground and vegetation in the background. The forms of the structures are solid, cylindrical, and rhomboid, which contrast with flat, asymmetrical, and rugged forms in the landscape. The texture of the facilities is sharp, directional, and solid, whereas the landscape is smooth and stippled. Color would be somewhat conforming, since earth-tone colors would be used on the exteriors of these structures. These colors conform to the colors of the soil, which is earth toned, but contrast with the colors of surrounding vegetation, which is varying shades of green and yellow.

The radio antenna poles' visual characteristics include a vertical form, straight line, monotone color, and smooth texture; thus, they would contrast to existing features in the surroundings as well.

KOP 14a

The Flea Market short-term storage tank, radio antenna pole, and overhead electrical lines would be within view of KOP 14a, as shown in **Figure D-28**, Key Observation Point 14a—Simulated Condition: Alternatives B and C (**Appendix D**). The short-term storage tank's form would contrast with the linear and curving forms of the landscape. There are

other similarly sized developments in view of KOP 14a, but they are largely shielded by mature vegetation unlike the short-term storage tank. This makes its form particularly contrasting with existing conditions. The short-term storage tank's lines would not contrast with the dominant lines of hills and mountain ranges in KOP 14a, but rather would blend in with the less prominent lines in the landscape vegetation. The visual simulation for KOP 14a shows that the short-term storage tank would conform to the texture and color of the landscape. The texture of the short-term storage tank is smooth and rounded, which mimics the smooth roundness of the hills and road. The dominant colors in the landscape are earth toned, in a similar chroma as the short-term storage tank.

There are no overhead electrical lines within view of KOP 14a; therefore these overhead electrical lines' form, line, color, and texture would contrast with the surroundings. The radio antenna pole would have similar visual characteristics to the overhead electrical lines, including a vertical form, straight line, monotone color, and smooth texture; thus, it would contrast in the same manner as the overhead electrical lines, when compared to existing features.

KOP 14b

The Flea Market short-term storage tank, radio antenna pole, and overhead electrical lines would be within view of KOP 14b, as shown in **Figure D-31**, Key Observation Point 14b—Simulated Condition: Alternatives B and C (**Appendix D**). KOP 14b shows the same infrastructure as KOP 14a, but the views of the two KOPs are quite different, leading to slightly varied visual impacts. The short-term storage tank's form would contrast with the linear and curving forms of the landscape. There are no other similarly sized developments in view of KOP 14b, making its form particularly contrasting with existing conditions.

The short-term storage tank's lines would contrast with current lines in the landscape, including the dominant fence and vegetation, which are interrupted by the presence of the short-term storage tank behind them. The visual simulation for KOP 14b shows that the short-term storage tank would largely conform to the texture and color of the landscape. The texture of the short-term storage tank would be smooth and rounded, which mimics the smooth roundness of the hills and road. Some of the colors in the landscape, particularly those of the soil and fencing, are earth toned in a similar chroma as the short-term storage tank; however, the monotone short-term storage tank would contrast behind the bright green shrubs in the surroundings.

There are no other overhead electrical lines within view of KOP 14b; therefore the form, line, color, and texture of the proposed electrical lines would contrast with the surroundings. The radio antenna pole would have similar visual characteristics as the overhead electrical lines, including a vertical form, straight line, monotone color, and smooth texture; therefore, they would contrast in the same manner as the overhead electrical lines, when compared to existing features in the surroundings.

KOP 17

Overhead lines would be within view of KOP 17, as shown in **Figure D-36**, Key Observation Point 17—Simulated Condition: Alternatives B, C, and D (**Appendix D**).

There are no overhead electrical lines within view of KOP 17; therefore, these overhead lines' form, line, color, and texture would contrast with existing surroundings.

Mitigation and Residual Impacts

Direct short-term visual impacts caused by construction could be reduced through restoration. Dirt removed for construction could be stockpiled and used to restore the disturbed area; this would preserve the naturally occurring color of the soil. Surface restoration, including revegetation, of areas where surface disturbance was caused by development of underground features would reduce these impacts.

Direct long-term impacts on form, line, and texture of the visual landscape could be reduced by partially or completely burying tanks, considering natural topography for placing aboveground features (e.g., behind hills), and using vegetation as screens or installing berms around aboveground features.

4.18.3.4 Alternative C

The same nature and type of long-term impacts described for Alternative B would apply under Alternative C. Adding RWS features to the general project area would change the visual landscape; these features would have direct long-term impacts on the visual character by changing the form, line, color, or texture of the landscape. **Table 2-4** describes the acreage where there would be permanent RWS facilities, including access roads. If external lighting is included in any of these features, this could change the daytime and nighttime visual landscape by adding unnatural (human-made) illumination of areas. The use of shrouding and timers would reduce this impact.

An indirect impact would be from the possible increased OHV and vehicle use along project access roads. This would increase ground scarring and leave a visible disturbance on the ground surface, vegetation, and color. Under Alternative C, approximately 3 miles of new or improved access roads would be constructed.

Appendix D, Visual Simulations, displays visual simulations of some of these features on the landscape. **Table 4-48**, below, describes proposed RWS project features that would be visible from the KOPs under Alternative C. These would be direct long-term impacts.

Impacts at KOPs 07, 13, 14a, 14b, and 17 would be the same as those described under Alternative B.

KOP 02

Under Alternative E, the surface water diversion structure (the parallel interceptor drain) would be underground and therefore would not visible at KOP 02. However, the pumping plant and radio antenna pole would be within view of KOP 02, as shown in the simulation in **Figure D-4**, Key Observation Point 02—Simulated Condition: Alternatives C and D (**Appendix D**). The impacts of the pumping plant and radio antenna pole at this KOP would be the same as those described under Alternative B.

Table 4-48. Alternative C: Proposed Project Features Visible from Key Observation Points

KOP Number[1]	Direction of View	Reasons for the KOP	Proposed Project Features Observed from the KOP	Approximate Distance of KOP to Feature (feet)	Simulation Figure Number
02	East	Views from bridge over Rio Grande	Pumping plant,	320	D-4 Key Observation Point 02—Simulated Condition: Alternatives C and D
			radio antenna pole	320	
06	Northwest	Views from highway	Surge tank,	290	D-11 Key Observation Point 06—Simulated Condition: Alternatives C and D
			overhead electrical lines,	170	
			radio antenna pole	290	
07	South	Views from community	El Rancho short-term storage tank,	950	D-13 Key Observation Point 07—Simulated Condition: Alternatives B, C, and D
			two overhead electrical lines,	310 and 340	
			radio antenna pole	950	
08	South	Views from community	El Rancho water treatment plant,	680	D-16 Key Observation Point 08—Simulated Condition: Alternatives C and D
			filter press,	550	
			air chamber building,	410	
			clear well,	370	
			Short-term storage tank,	1,250	
			two gravity filters,	530 and 610	
			two overhead electrical lines,	580 and 820	
			two radio antenna poles	680 and 1,250	

Table 4-48. Alternative C: Proposed Project Features Visible from Key Observation Points (cont.)

KOP Number[1]	Direction of View	Reasons for the KOP	Proposed Project Features Observed from the KOP	Approximate Distance of KOP to Feature (feet)	Simulation Figure Number
09	South	Views from community and highway	Pojoaque Industrial Park pumping plant,	1,900	D-19 Key Observation Point 09—Simulated Condition: Alternatives C and D
			air chamber building,	1,900	
			Pojoaque Industrial Park short-term storage tank,	1,430	
			overhead electrical lines,	970	
			two radio antenna poles	1,900 and 1,430	
11	Southeast	Views from El Camino Real National Scenic Byway and Camel Rock	Overhead electrical lines	2,900	D-22 Key Observation Point 11—Simulated Condition: Alternatives B, C, and D
13	South	Views from County Road 73	Tesuque pumping plant,	150	D-26 Key Observation Point 13—Simulated Condition: Alternatives B, C, and D
			air chamber building,	150	
			forebay tank,	50	
			access road,	20	
			two radio antenna poles	150 and 50	

Table 4-48. Alternative C: Proposed Project Features Visible from Key Observation Points (cont.)

KOP Number[1]	Direction of View	Reasons for the KOP	Proposed Project Features Observed from the KOP	Approximate Distance of KOP to Feature (feet)	Simulation Figure Number
14a	North	Views from Crosby Theatre—Opera Club—Turner Family Lounge	Flea Market short-term storage tank,	780	D-28 Key Observation Point 14a—Simulated Condition: Alternatives B and C
			overhead electrical lines,	770	
			radio antenna pole	780	
14b	Northwest	Views from Opera Drive	Flea Market short-term storage tank,	130	D-31 Key Observation Point 14b—Simulated Condition: Alternatives B C
			overhead electrical lines,	60	
			radio antenna pole	130	
17	West	Views from community	Overhead electrical lines,	5,300	D-36 Key Observation Point 17—Simulated Condition: Alternatives B, C, and D

Source: Field inventory, September 28–30, 2015, and March 16, 2017; Appendix D
[1] There are no proposed project features visible from KOPs 01, 03, 04, 05, 10, 12, 15, or 16.

KOP 06

The surge tank associated with the transmission and distribution system, radio antenna pole, and overhead electrical lines would be within view of KOP 06, as shown in **Figure D-11**, Key Observation Point 06—Simulated Condition: Alternatives C and D (**Appendix D**). The cylindrical form of the surge tank contrasts with the linear and triangular form of the hill directly in front of the tank and the flat forms of the landscape.

There are also no other similarly sized developments in view of KOP 06, which makes the form contrast with existing conditions. The surge tank's line contrasts with current lines in the landscape; the line of the hill, which is the dominant angular line in the landscape, is interrupted by the presence of the surge tank behind it. The tank's texture also contrasts with the current landscape; the tank is sharp against the smooth angles of

the existing landscape, whereas the landscape texture is smooth. The visual simulation for KOP 06 shows that the short-term storage tank conforms to the colors of the landscape, where the dominant colors are earth toned and in a similar chroma, or color saturation, as the short-term storage tank.

There are no overhead electrical lines within view of KOP 13, so the additional overhead electrical lines' form, line, color, and texture would contrast with the surroundings. The radio antenna poles would have similar visual characteristics as the overhead electrical lines, including a vertical form, straight line, monotone color, and smooth texture; thus, they would contrast in the same manner as the overhead electrical lines when compared to existing features in the surroundings.

KOP 08

As shown in **Figure D-16**, Key Observation Point 08—Simulated Condition: Alternatives C and D (**Appendix D**), facilities visible within view of KOP 08 are El Rancho water treatment plant, filter press, air chamber building, clear well, El Rancho short-term storage tank, two gravity filters, two radio antenna poles and overhead electrical lines. The water treatment plant site design would be similar to that described under Alternative B; however, an existing berm would be extended, which would reduce visibility of the water treatment plant and limit changes to the visual landscape. Form, line, color, and texture would all be affected, as described under Alternative B, for the water treatment plant.

There are already overhead electrical lines within view of KOP 08, so additional lines would not add contrasting features, since such features already exist. The radio antenna poles would have similar visual characteristics to the overhead electrical lines, including a vertical form, straight line, monotone color, and smooth texture; thus, they would not contrast to existing features in the surroundings.

KOP 09

Impacts at KOP 09 would be the same as those described at this KOP under Alternative B. The Pojoaque Industrial Park short-term storage tank in Alternative C would be slightly larger and farther away than Alternative B's Jacona HKM short-term storage tank (see **Figure D-19**, Key Observation Point 09—Simulated Condition: Alternatives C and D [**Appendix D**]); however, this would not change the visual impacts between the alternatives.

There are already overhead electrical lines within view of KOP 08, so additional lines would not add contrasting features since such features already exist. The radio antenna poles would have similar visual characteristics to the overhead electrical lines, including a vertical form, straight line, monotone color, and smooth texture; thus, they would not contrast to existing features in the surroundings.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.18.3.3**, Alternative B—HKM Implementable.

4.18.3.5 Alternative D

The same nature and type of short-term impacts described for Alternative B would apply to Alternative D. However, the extent of short-term disturbance and locations and type of some of the proposed project features would be different. Impacts from artificial lighting during construction, as described under Alternative B, would also apply to this alternative. **Table 2-4** provides acres of short-term disturbance associated with construction for this alternative, which quantifies of the area where there would likely be direct short-term impacts on the visual landscape. Under this alternative, there would be approximately 1,146 acres of short-term disturbance.

The same nature and type of long-term impacts described for Alternative B would apply to Alternative D. Adding RWS features to the general project area would change the visual landscape by adding human-made modifications to the landscape; these features would have direct long-term impacts on the visual character by changing the form, line, color, or texture of the landscape.

Table 2-4 describes the acreage where there would be permanent RWS facilities, including access roads. If external lighting is included in any of these features, this could change the daytime and nighttime visual landscape by adding unnatural (human-made) illumination of areas. The use of shrouding and timers would reduce this impact

An indirect impact would be from the possible increased OHV and vehicle use along project access roads. This would increase ground scarring and leave a visible disturbance on the ground surface, vegetation, and color. Under Alternative D, approximately 2 miles of new or improved access roads would be constructed.

Appendix D contains visual simulations of some of these features on the landscape. **Table 4-49**, Alternative D: Proposed Project Features Visible from Key Observation Points, describes proposed RWS project features that would be visible from the KOPs under Alternative D. These would be direct long-term impacts.

Impacts under Alternative D at KOPs 07, 11, 13, and 17 would be the same as those described under Alternative B; impacts at KOPs 06, 08, and 09 would be the same as those described under Alternative C.

KOP 02

Under Alternative D, the surface water diversion structure (the infiltration gallery) would be underground and therefore not visible at KOP 02. However, the pumping plant and radio antenna pole would be within view of KOP 02, as shown in the simulation in **Figure D-4**, Key Observation Point 02—Simulated Condition: Alternatives C and D (**Appendix D**). The impacts of the pumping plant and radio antenna pole at this KOP would be the same as those described under Alternative B.

KOP 14a

The Flea Market short-term storage tank radio antenna pole and overhead electrical lines would be within view of KOP 14a, as shown in **Figure D-29**, Key Observation Point 14a—Simulated Condition: Alternative D (**Appendix D**). The visual impacts for both these structures would be the same as described under Alternative B; however, the

Table 4-49. Alternative D: Proposed Project Features Visible from Key Observation Points

KOP Number[1]	Direction of View	Reason(s) for the KOP	Proposed Project Features Observed from the KOP	Approximate Distance of KOP to Feature (feet)	Simulation Figure Number
02	East	Views from bridge over the Rio Grande	Pumping plant,	320	D-4 Key Observation Point 02—Simulated Condition: Alternatives C and D
			radio antenna pole	320	
06	Northwest	Views from highway	Surge tank,	290	D-11 Key Observation Point 06—Simulated Condition: Alternatives C and D
			overhead electrical lines,	170	
			radio antenna pole	290	
07	South	Views from community	El Rancho short-term storage tank,	950	D-13 Key Observation Point 07—Simulated Condition: Alternatives B, C, and D
			two overhead electrical lines,	310 and 340	
			radio antenna pole	950	
08	South	Views from community	El Rancho water treatment plant,	680	D-16 Key Observation Point 08—Simulated Condition: Alternatives C and D
			filter press,	550	
			air chamber building,	420	
			clear well,	390	
			short-term storage tank,	1,250	
			two gravity filters,	530 and 610	
			two overhead electrical lines	580 and 610	
			two radio antenna poles	680 and 1,250	

Table 4-49. Alternative D: Proposed Project Features Visible from Key Observation Points (cont.)

KOP Number[1]	Direction of View	Reason(s) for the KOP	Proposed Project Features Observed from the KOP	Approximate Distance of KOP to Feature (feet)	Simulation Figure Number
09	South	Views from community and highway	Pojoaque Industrial Park pumping plant,	1,900	D-19 Key Observation Point 09—Simulated Condition: Alternatives C and D
			air chamber building,	1,900	
			forebay tank,	1,430	
			Pojoaque Industrial Park short-term storage tank,	1,430	
			overhead electrical lines	970	
			two radio antenna poles	1,900 and 1,430	
11	Southeast	Views from El Camino Real National Scenic Byway and Camel Rock	Overhead electrical lines,	2,900	D-22 Key Observation Point 11—Simulated Condition: Alternatives B, C, and D
13	South	Views from County Road 73	Tesuque pumping plant,	150	D-26 Key Observation Point 13—Simulated Condition: Alternatives B, C, and D
			air chamber building,	150	
			forebay tank,	50	
			access road,	20	
			two radio antenna poles	150 and 50	
14a	North	Views from Crosby Theatre—Opera Club—Turner Family Lounge	Flea Market short-term storage tank,	780	D-29 Key Observation Point 14a—Simulated Condition: Alternative D
			overhead electrical lines,	770	
			radio antenna pole	780	

Table 4-49. Alternative D: Proposed Project Features Visible from Key Observation Points (cont.)

KOP Number[1]	Direction of View	Reason(s) for the KOP	Proposed Project Features Observed from the KOP	Approximate Distance of KOP to Feature (feet)	Simulation Figure Number
14b	Northwest	Views from Opera Drive	Flea Market short-term storage tank,	130	D-32 Key Observation Point 14b—Simulated Condition: Alternative D
			overhead electrical lines,	60	
			radio antenna pole	130	
17	West	Views from community	Overhead electrical lines	5,300	D-36 Key Observation Point 17—Simulated Condition: Alternatives B, C, and D

Source: Field inventory, September 28-30, 2015 and March 16, 2017; Appendix D
[1] There are no proposed project features visible from KOPs 01, 03, 04, 05, 10, 12, 15, or 16.

short-term storage tank under Alternative D would be shorter, with a greater diameter and total volume, compared with the Flea Market short-term storage tank under Alternative B.

KOP 14b

The Flea Market short-term storage tank, radio antenna pole, and overhead electrical lines would be within view of KOP 14b, as shown in **Figure D-32**, Key Observation Point 14b—Simulated Condition: Alternative D (**Appendix D**). The visual impacts for both these structures would be the same as described under Alternative B; however, the short-term storage tank under Alternative D would be shorter, with a greater diameter and total volume, compared with the Flea Market short-term storage tank under Alternative B.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.18.3.3**.

4.18.3.6 Alternative E (Preferred Alternative)

The same nature and type of short-term impacts described for Alternative B would apply under Alternative E. However, the extent of short-term disturbance and locations and type of some of the proposed project features would be different. Impacts from artificial lighting during construction, as described under Alternative B, would also apply under Alternative E.

Table 2-4 provides acres of short-term disturbance associated with construction under this alternative. The table's data quantify the area where there would likely be direct short-term impacts on the visual landscape. Under Alternative E, there would be approximately 856 acres of short-term disturbance.

The same nature and type of long-term impacts described for Alternative B would apply under Alternative E. Adding RWS features to the general project area would change the visual landscape by adding human-made modifications; these features would have direct long-term impacts on the visual character by changing the form, line, color, or texture of the landscape.

Table 2-4 describes the acreage where there would be permanent RWS facilities, including access roads. If external lighting is included in any of these features, this could change the daytime and nighttime visual landscape by adding unnatural (human-made) illumination. The use of shrouding and timers would reduce this impact.

Alternative E would also add willows and native species to the riverbank that would restore the natural visual character over the long term.

An indirect impact would be from the possible increased OHV and vehicle use along project access roads. This would increase ground scarring and leave a visible disturbance on the ground surface, vegetation, and color. Under this alternative, approximately 2 miles of new or improved access roads would be constructed.

Appendix D displays visual simulations of some of these features on the landscape. **Table 4-50**, Alternative E: Proposed Project Features Visible from Key Observation Points, describes proposed RWS project features that would be visible from the KOPs under Alternative E. These would be direct long-term impacts.

Impacts at KOP 06would be the same as those described under Alternative B, and those at KOP 14a and 14b would be the same as those described under Alternative D.

KOP 02

The horizontal radial well collectors and two roads would be in view of KOP 02, as shown in **Figure D-5**, Key Observation Point 02—Simulated Condition: Alternative E (**Appendix D**). The only portion of the horizontal radial well collectors that would be visible from the surface would be the top caisson. It would be installed either slightly above the ground surface or flush with the ground. Since this feature is close to the ground, its form, line, and texture would not contrast with the landscape. Line is also preserved, as it mimics the circular lines of the surrounding vegetation; however, as shown in the simulation, this feature would have somewhat contrasting color with the surroundings. The caisson is gray, and, while grays appear in the existing landscape, they do not appear in the caisson's location; thus, it contrasts with the greens and blues of the surrounding vegetation.

The new access roads would contrast with the existing conditions, because there are currently no roads vistible from this vantage of this KOP. Indirect impacts could occur from the possible increased OHV and vehicle use along access roads associated with project infrastructure. This would increase ground scarring and leave a visible disturbance on the ground surface, vegetation, and color.

Table 4-50. Alternative E: Proposed Project Features Visible from Key Observation Points

KOP Number[1]	Direction of View	Reason(s) for the KOP	Proposed Project Features Observed from the KOP	Approximate Distance of KOP to Feature (feet)	Simulation Figure Number
02	East	Views from bridge over Rio Grande	Two horizontal radial well collectors	740 and 330	D-5 Key Observation Point 02—Simulated Condition: Alternative E
			Two roads	740 and 330	
06	Northwest	Views from highway	Surge tank,	190	D-12 Key Observation Point 06—Simulated Condition: Alternative E
			Overhead electrical lines	170	
			radio antenna pole	190	
07	South	Views from community	El Rancho short-term storage tank,	970	D-14 Key Observation Point 07—Simulated Condition: Alternative E
			County Road 101D West water treatment plant,	490	
			detention basin,	320	
			pumping plant,	390	
			two clear wells,	420 and 450	
			two raw water tanks,	750 and 760	
			residual treatment building,	450	
			access road,	270	
			two overhead electrical lines,	330 and 340	
			three radio antenna poles	970, 490, and 390	

Table 4-50. Alternative E: Proposed Project Features Visible from Key Observation Points (cont.)

KOP Number[1]	Direction of View	Reason(s) for the KOP	Proposed Project Features Observed from the KOP	Approximate Distance of KOP to Feature (feet)	Simulation Figure Number
08	South	Views from community	El Rancho short-term storage tank,	1,650	D-17 Key Observation Point 08—Simulated Condition: Alternative E
			County Road 101D West water treatment plant,	860	
			pumping plant,	830	
			two clear wells,	820 and 880	
			two raw water tanks,	1,080 and 1,110	
			residual treatment building,	930	
			access road,	650	
			two overhead electrical lines,	710 and 820	
			three radio antenna poles	1,650, 860, and 830	
11	Southeast	Views from El Camino Real National Scenic Byway and Camel Rock	Camel Rock Casino short-term storage tank,	5,400	D-23 Key Observation Point 11—Simulated Condition: Alternative E
			pumping plant	3,150	
			overhead electrical lines	2,900	
13	South	Views from County Road 73	Tesuque pumping plant,	120	D-27 Key Observation Point 13—Simulated Condition: Alternative E
			air chamber building,	120	
			forebay tank,	20	
			access road	20	
			two radio antenna poles	120 and 20	

Table 4-50. Alternative E: Proposed Project Features Visible from Key Observation Points (cont.)

KOP Number[1]	Direction of View	Reason(s) for the KOP	Proposed Project Features Observed from the KOP	Approximate Distance of KOP to Feature (feet)	Simulation Figure Number
			overhead electrical lines,	60	
			radio antenna pole	130	

Source: Field inventory, September 28–30, 2015, and March 16, 2017; Appendix D
[1] There are no proposed project features visible from KOPs 01, 03, 04, 05, 09, 10, 12, 15, 16, or 17.

KOP 07

As shown in **Figure D-14**, Key Observation Point 07—Simulated Condition: Alternative E (**Appendix D**), the proposed facilities visible within view of KOP 07 are the El Rancho short-term storage tank, County Road 101D West water treatment plant, detention basin, pumping plant, two clear wells, two raw water tanks, residual treatment building, access road, three radio antenna poles, and overhead electrical lines.

Under this alternative, no earthwork would be constructed to conceal the water treatment plant from the nearby highway; therefore, these facilities would be fairly visible from the highway. The water treatment plant, pumping plant, and residual treatment building would have rectangular forms and hard and straight lines, in contrast to the smooth, curving, and round existing landscape. However, these facilities, as well as the short-term storage tank, two clear wells, and two raw water tanks, would have an earth color tone and smooth texture, corresponding to the existing conditions of the site.

The short-term storage tank, two clear wells, two raw water tanks, and filtered water tank would have a cylindrical form and straight lines, contrasting to the smooth, curving, and round existing landscape, but in a slightly different manner from the rectangular structures described above.

The detention basin would modify the existing topography of the site, but it would do so in a way that conforms to the existing form, line, color, and texture of the landscape. The access road would not contrast with existing conditions, because there is already a paved road within view of this KOP.

There are existing overhead electrical lines within view of KOP 07; additional lines would not add contrasting features, since such features already exist. The radio antenna poles have visual characteristics similar to those of the overhead electrical lines, including a vertical form, straight line, monotone color, and smooth texture; thus, they would not contrast to existing features in the surroundings.

KOP 08

As shown in **Figure D-17**, Key Observation Point 08—Simulated Condition: Alternative E (**Appendix D**) KOP 08 displays several of the same facilities as KOP 07, including the El Rancho short-term storage tank, County Road 101D West water treatment plant,

pumping plant, two clear wells, two raw water tanks, residual treatment building, access road, three radio antenna poles, and two overhead electrical lines. The principle differences between the two KOPs is that KOP 08 is in the community, rather than along the highway, and it is farther from the proposed infrastructure, when compared to KOP 07. For this reason, KOP 08 would have visual impacts similar to KOP 07 under Alternative E, but the impacts would be decreased in the foreground and increased in the background.

KOP 11

As shown in **Figure D-23**, Key Observation Point 11—Simulated Condition: Alternative E (**Appendix D**), facilities visible from KOP 11 are the Camel Rock Casino short-term storage tank, pumping plant, and two overhead electrical lines. The short-term storage tank is cylindrical, while the pumping plant is rectangular, and both have straight lines and a smooth texture.

All these visual characteristics are unlike the existing landscape, which has a more rugged form, irregular lines, and a rougher overall texture; however, both the short-term storage tank and pumping plant are in earth-tone colors that harmonize with the colors of the landscape.

There are no existing overhead electrical lines within view of KOP 11; therefore, these overhead electrical lines' form, line, color, and texture would contrast with the surroundings.

KOP 13

As shown in **Figure D-27**, Key Observation Point 13—Simulated Condition: Alternative E (**Appendix D**), the Tesuque pumping plant, air chamber building, forebay tank, and two radio antenna poles are visible from KOP 13. The visual impacts under Alternative E would be similar to those described under Alternatives B, C, and D, because they show the same facilities; however, the facilities under Alternative E are closer to KOP 13 than the facilities under Alternatives B, C, and D; therefore, the impacts under Alternative E would be increased in the foreground and decreased in the background.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.18.3.3**.

4.18.3.7 Summary of Impacts

The visual landscape would be changed in the short term by construction activities, which would disturb the ground surface. This would change the visual landscape by removing or disturbing the top layers of soil or vegetation to reveal colors that contrast with the surrounding landscape. Surface disturbance would return to natural conditions over time. This would occur faster with restoration.

The visual landscape would be changed in the long term by aboveground RWS features. This would change the visual landscape by adding human-made features that would contrast with form, line, color, and texture of the landscape.

4.18.4 Rio Pojoaque Irrigation Improvement Project

4.18.4.1 Alternative RP-A—No Action

Under Alternative RP-A, No Action, there would be no construction or operation of the Rio Pojoaque irrigation improvement project facilities or infrastructure; therefore, there would be no impact on the current visual landscape or on views from any of the KOPs.

Mitigation and Residual Impacts

There would be no mitigation or residual impacts associated with Alternative RP-A, No Action.

4.18.4.2 Impacts Common to All Action Alternatives

The types of direct impacts under each alternative are the same, but the extent of impacts on visual resources varies with each alternative. Therefore, there are no direct impacts common to all action alternatives.

Mitigation and Residual Impacts

Although there are no direct impacts on visual resources common to all action alternatives, the minimization and mitigation of the various direct visual impacts from the action alternatives are generally similar.

Direct short-term visual impacts caused by construction could be reduced through restoration. Dirt removed for construction could be stockpiled and used to restore the disturbed area; this would preserve the naturally occurring color of the soil. Surface restoration, including revegetation, of areas where surface disturbance was caused by development of underground features would reduce these impacts.

4.18.4.3 Alternative RP-B

Alternative RP-B would extend the existing Rio Pojoaque Barrier Dam to the north bank of the Rio Pojoaque. Construction of this extension would be similar to the original dam, which consists of a steel sheet pile next to concrete-capped gabions. The similarity of the construction would therefore result in short-term visual impacts during construction; however, there would be no long-term visual impacts, because the form, line, and texture of the visual landscape would be consistent with the existing topography and features.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.18.4.2**, Impacts Common to All Action Alternatives.

4.18.4.4 Alternative RP-C (Preferred Alternative)

Under Alternative RP-C, Reclamation would construct a 9,300-foot-long system to convey water downstream of the Acequia de Los Indios to the existing Pueblo de San Ildefonso irrigation system. This conveyance system would be similar to the existing irrigation canals and lateral ditches that convey water to fields on both sides of the Rio Pojoaque. The similarity of the construction would result in short-term visual impacts during construction; however, there would be no long-term visual impacts because the

form, line, and texture of the visual landscape would be consistent with the existing topography and features.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.18.4.2**, Impacts Common to All Action Alternatives.

4.18.4.5 Alternative RP-D

Alternative RP-D would improve infiltration to the Pueblo de San Ildefonso irrigation system by installing additional gravel and a new perforated pipe with a larger diameter than the existing pipe, although the exact nature and extent of the disturbance would depend on the location and condition of the existing perforated pipe. The proposed improvements would be below the surface and similar to the existing infrastructure; therefore, they would result in short-term visual impacts during construction. There would be no long-term visual impacts, because the form, line, and texture of the visual landscape would be consistent with the existing topography and features.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.18.4.2**, Impacts Common to All Action Alternatives.

4.18.4.6 Alternative RP-E

Alternative RP-E would improve infiltration to the Pueblo de San Ildefonso irrigation system by installing roughly 2,543 feet of 18-inch-diameter perforated pipe and engineered gravel. The proposed improvements would be below the surface and similar to the existing infrastructure; therefore, they would result in short-term visual impacts during construction. There would be no long-term visual impacts, because the form, line, and texture of the visual landscape would be consistent with the existing topography and features.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.18.4.2**, Impacts Common to All Action Alternatives.

4.18.4.7 Summary of Impacts

The action alternatives include a variety of proposed improvements, ranging from extending a barrier dam (Alternative RP-B) to constructing a new concrete-lined canal to convey water up to 9,300 feet between existing irrigation systems (Alternative RP-C). Common to all of these alternatives, however, is that the proposed improvements would be similar to existing conditions or infrastructure; therefore, the action alternatives would result in short-term visual impacts during construction. There would be no long-term visual impacts, because the form, line, and texture of the visual landscape would be consistent with the existing topography and features.

4.18.5 Rio Tesuque Channel Modification Project

4.18.5.1 Alternative RT-A—No Action

Under Alternative RT-A, No Action, there would be no construction or operation of the Rio Tesuque channel modification project facilities or infrastructure; therefore, there would be no impact on the current visual landscape or on views from any KOPs.

Mitigation and Residual Impacts

There would be no mitigation or residual impacts associated with Alternative RT-A, No Action.

4.18.5.2 Impacts Common to All Action Alternatives

The types of direct impacts under each alternative are the same, but the extent of impacts on visual resources varies with each alternative. Therefore, there are no direct impacts common to all action alternatives.

Mitigation and Residual Impacts

Although there are no direct impacts on visual resources common to all action alternatives, the minimization and mitigation of the various direct visual impacts from the action alternatives are generally similar.

Direct short-term visual impacts caused by construction could be reduced through restoration. Dirt removed for construction could be stockpiled and used to restore the disturbed area; this would preserve the naturally occurring color of the soil. Surface restoration, including revegetation, of areas where surface disturbance was caused by development of underground features would reduce these impacts.

4.18.5.3 Alternative RT-B

Alternative RT-B would restore the incised channel of the Rio Tesuque by clearing vegetation and destabilizing or excavating banks, by widening the channel and raising its elevation, and by constructing grade control features and detention ponds. These improvements would include clearing approximately 2 acres of vegetation, excavating about 4,600 cubic yards of material from the channel margins, and using staging areas for construction.

The proposed improvements would be similar to natural conditions in nearby, non-incised portions of the Rio Tesuque; therefore, they would result in no long-term visual impacts, because the form, line, and texture of the visual landscape would be consistent with the existing topography and features following restoration and remediation. There would, however, be short-term visual impacts during construction, due to vegetation removal, use of staging areas, and other channel improvements that would temporarily change the form, line, and texture of the visual landscape.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.18.5.2**, Impacts Common to All Action Alternatives.

4.18.5.4 Alternative RT-C

Alternative RT-C would restore the existing incised channel of the Rio Tesuque with certain elements similar to those associated with Alternative RT-B. These elements are vegetation clearing, bank destabilization, and excavation, along with construction of grade control features and detention ponds. Alternative RT-C would, however, involve excavating a new channel in the existing floodplain (east of the existing incised channel). This would be similar to what the original, non-incised channel may have looked like. Approximately 3 acres of vegetation would be cleared from the new channel site, and roughly 5,300 cubic yards of sand and gravel would be excavated. Approximately 3,000 cubic yards of this excavated material would be compacted and placed in the existing incised channel; the excess material would be hauled to an off-site stockpile for later use by the Pueblo of Tesuque.

The proposed improvements include refilling and restoring the incised channel and excavating for the new channel to mimic previous conditions along the Rio Tesuque. These improvements would be similar to natural conditions in nearby, non-incised portions of the Rio Tesuque. Alternative RT-C, therefore, would result in no long-term visual impacts, because the form, line, and texture of the visual landscape would be consistent with the existing topography and features. There would, however, be short-term visual impacts during construction, due to vegetation removal, use of staging areas, and other channel improvements that would temporarily change the form, line, and texture of the visual landscape.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.18.5.2**, Impacts Common to All Action Alternatives.

4.18.5.5 Alternative RT-D (Preferred Alternative)

Alternative RT-D would restore the Rio Tesuque channel flow by removing a sediment spoil pile from the east side of the Rio Tesuque, just upstream of the TP-806 Bridge. This spoil pile would be removed to increase the capacity of the river to carry water and sediment past this bridge during high water flows. Approximately 1,320 cubic yards of material would be excavated from the spoil pile and hauled to a nearby stockpile for later use by the Pueblo of Tesuque.

The proposed improvements, including the removal of 1,320 cubic yards of material, would eventually result in natural conditions similar to nearby portions of the Rio Tesuque. Alternative RT-D, therefore, would result in no long-term visual impacts, because the form, line, and texture of the visual landscape would be consistent with the existing topography and features. There would, however, be short-term visual impacts during construction that would temporarily change the form, line, and texture of the visual landscape. This would be due to vegetation and sediment removal associated with moving the sediment spoil pile located upstream of the TP 806 Bridge to a nearby stockpile for later use by the Pueblo of Tesuque.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.18.5.2**, Impacts Common to All Action Alternatives.

4.18.5.6 Alternative RT-E

Alternative RT-E would improve the Rio Tesuque flow into the existing Pueblo of Tesuque irrigation system by constructing an infiltration gallery upstream of the Upper Ponds Diversion Dam to collect and transmit water. This would involve excavating approximately 2,700 cubic yards of material to install a main carrier pipe, three perforated collector pipes, and a gravel layer surrounding all pipes.

The proposed improvements and infrastructure, which would be buried, would result in no long-term visual impacts. This is because the form, line, and texture of the visual landscape would be consistent with the existing topography and features following restoration. There would, however, be short-term visual impacts during construction that would temporarily change the form, line, and texture of the visual landscape. This would be from excavating approximately 2,700 cubic yards of material and subsequently installing a main carrier pipe, three perforated collector pipes, and a gravel layer surrounding all pipes.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.18.5.2**, Impacts Common to All Action Alternatives.

4.18.5.7 Summary of Impacts

The action alternatives include a variety of proposed improvements, ranging from constructing a new channel on the Rio Tesuque and filling in the old incised channel (Alternative RT-C) to installing a buried infiltration gallery on the river to collect and transmit water for the Pueblo of Tesuque irrigation system (Alternative RT-E). Common to all of these alternatives, however, is that the proposed improvements are similar to existing conditions or infrastructure. Therefore, the action alternatives would result in short-term visual impacts during construction. There would be no long-term visual impacts, because the form, line, and texture of the visual landscape would be consistent with the existing topography and features once restoration is complete.

4.18.6 Pueblo de San Ildefonso Future Projects Alternatives

4.18.6.1 Alternative SI-A—No Action

Under Alternative SI-A, No Action, there would be no construction or operation of wastewater and water infrastructure; therefore, there would be no impact on the current visual landscape or views from KOPs.

Mitigation and Residual Impacts

There would be no mitigation or residual impacts associated with Alternative SI-A, No Action.

4.18.6.2 Alternative SI-B—Proposed Wastewater and Water Infrastructure

The proposed wastewater system improvements and other water-related infrastructure would change the visual landscape under Alternative SI-B. Construction would disturb the ground surface, which would produce direct, short-term, localized changes to the visual landscape. This would come about by removing or disturbing the top layers of soil or vegetation to reveal colors that contrast with the surrounding landscape; however, direct and indirect impacts of the wastewater system improvements would be on a smaller scale than for the RWS project. This is because the project's direct short-term impacts would affect only 59 acres. The magnitude of direct and indirect impacts from the other water-related infrastructure projects would be analyzed as the details of those projects are further developed.

Construction would include building all the features described in **Section 2.9**, Pueblo de San Ildefonso Future Projects Alternatives. External artificial lighting used to illuminate construction sites would cause additional visual impacts. However, since construction would occur only during daylight, there would be no such impacts at night. Also, since construction lighting would be shrouded and directed downward so as to illuminate only the project areas, impacts would be fairly localized.

Additional direct impacts on the visual landscape would be caused by the long-term presence of the treatment and disposal facilities for the wastewater system improvements and other potential aboveground features for the additional water-related infrastructure. The addition of a new wastewater treatment facility could change the visual landscape, if its form, line, color, or texture were to contrast with the landscape; however, since the facility would be on previously disturbed lands, this could minimize the contrast. Additionally, external artificial lighting used to illuminate the treatment and disposal facilities would cause additional visual impacts. Repaving existing roads would have minimal visual impacts, since these modifications would not contrast with existing developments.

Indirect impacts could occur from the possible increased OHV and vehicle use along access roads associated with project infrastructure. This would increase ground scarring and leave a visible disturbance on the ground surface, vegetation, and color.

Mitigation and Residual Impacts

Although the nature and extent of the direct impacts on visual resources are not known, the minimization and mitigation of the various direct visual impacts from the action alternatives are generally similar.

Direct short-term visual impacts from construction could be reduced through restoration. Dirt removed for construction could be stockpiled and used to restore the disturbed area; this would preserve the natural color of the soil. Surface restoration, including revegetation, of areas where surface disturbance was caused by development of underground features would reduce these impacts.

Direct long-term impacts on form, line, and texture of the visual landscape could be reduced by partially or completely burying tanks, considering natural topography for placing aboveground features (e.g., behind hills), and using vegetation as screens or installing berms around aboveground features.

4.19 Traffic

This section addresses potential impacts on traffic from actions associated with each alternative.

4.19.1 Impact Indicators

The indicator, as described in **Table 3-1**, used to analyze impacts on traffic is the change in traffic patterns and volume in the road network.

4.19.2 Analysis Methods and Assumptions

This section discusses the method used to determine potential impacts that could result from construction, operation, and maintenance under each alternative.

Because the number of construction vehicles, deliveries, and workers cannot be estimated at this time, a qualitative analysis is used to describe impacts on traffic, including access and congestion. This analysis examines existing traffic levels on state and U.S. highways to determine whether any of the alternatives would create congestion. Likewise, impacts on access to Pueblo, County, state, and federal roads and highways are addressed qualitatively. Impacts on access can include lane and roadway closures and detours.

The number of locations where construction would occur would influence the intensity of impacts. For each alternative, the number of proposed water treatment plants, short-term water storage tanks, primary source water collection facilities, pumping plants and forebay tanks, and surge tanks is used to determine the number of construction sites. This provides a context for the number of work sites that would receive traffic from workers, equipment, and deliveries.

Operation and maintenance, including hauling solids (classified as special waste) generated at the water treatment plant and delivering chemicals and other materials, would require a very small number of vehicles and would not impede traffic flow or access; as a result impacts on traffic would be negligible.

This analysis is made based on the following assumptions:

- No existing roads would be permanently closed to public access under any action alternative.
- Private roads associated with construction and operation would be off limits to public access.
- Construction would be phased over approximately 6 years.
- The number of construction vehicles, including those used to commute to the project site and those delivering materials and supplies, is not currently available.
- Under all action alternatives, impacts on passenger vehicles and North Central Region Transit District buses would be the same, because both would be subjected to possible delays and detours.

4.19.3 RWS Alternatives

4.19.3.1 Alternative A—No Action

Under Alternative A, no construction, operation, or maintenance would occur, so there would be no impacts on traffic.

Mitigation and Residual Impacts

There would be no mitigation or residual impacts associated with the No Action Alternative.

4.19.3.2 Impacts Common to All Action Alternatives

Construction

Congestion

Under each action alternative, short-term localized impacts would include potential congestion during construction. This would be most noticeable during peak commute times, when more vehicles are on the roads. These impacts would occur over the duration of construction and would be focused on primary commuting routes for workers and the public, and along primary construction material delivery routes. The exact location of these impacts would change as construction is completed in one area and moves to another. Congestion would likely result in delays and detours at intersections and along primary roads in the general project area.

U.S. Highway 84/285 and SHs 30, 502, and 503 would likely be primary routes used for worker commutes and equipment deliveries. This is because these routes connect local population centers and because a large percentage of facilities would be constructed near these roads. Mean AADT on these roads varies from 4,947 on SH 503 to 14,930 on U.S. Highway 84/285 (NMDOT 2015a, 2015b). Construction-related traffic would introduce additional vehicles over the approximately 6-year construction period. Short-term congestion may be most noticeable at intersections, where queuing could occur.

The increase in the number of vehicles on the roads, especially during the peak construction worker arrival and departure time frames, could increase the potential for vehicular accidents in the general project area. This increased potential would be confined to the construction time frame and would be most pronounced during those times of the day when project-related traffic is at its highest.

Access

Impacts on access would be most noticeable if construction activities either block or reduce access to public roads. For example, access could be temporarily restricted, especially on narrower two-lane roads, if equipment used to install pipelines were placed in a road lane or on the shoulder. Transmission line construction could result in similar impacts. For example, access may be constrained during construction of crossings over public roadways. These impacts would be more likely to occur on Pueblo and County roads. This is because many construction sites are closest to these types of roads. It is also because the narrower width of these roads makes them less capable of accommodating traffic while construction equipment is operating on or next to the roadway. Impacts

would be temporary and intermittent and would follow the progress of construction across the project site.

Operation and Maintenance

Because there would be a very small number of operations- and maintenance-related vehicles used during these activities, congestion and access impacts during operation and maintenance are expected to be negligible. For example, the treatment plant would employ an estimated eight full-time employees, which would likely result in six to eight additional round trips each workday, compared with current conditions. It is likely that this increase would not be noticeable, would not affect access, and would not result in congestion. In addition, solid waste generated at the water treatment plant would be hauled to the Caja del Rio landfill, located approximately 26 miles from the proposed treatment plant. The addition of up to three daily round-trip tractor-trailer trips on U.S. Highway 84/285 and SH 599 would have a negligible impact on local and regional traffic.

Mitigation and Residual Impacts

Mitigation includes the development of traffic control plans consistent with New Mexico Department of Transportation, local, and county regulations to minimize impacts on traffic during construction. The traffic control plans would include, but are not limited to, the following components and requirements that the contractor would implement:

- Define the locations of project access points and location and timing of any temporary lane closures
- Identify and make provisions for circumstances requiring the use of flag persons, warning signs, lights, barricades, cones, and other protective measures to provide safe work areas in the vicinity of the project site and to warn, control, protect, and expedite vehicular and pedestrian traffic
- Implement traffic control with flag persons, signs, barricades, and cones, along all roadway segments that have substandard width (less than 18 feet)
- Place signs along all proposed construction haul routes and alternate haul routes at appropriate intervals, notifying drivers of the presence of construction traffic on those roadways
- Limit construction material and equipment deliveries requiring pilot cars to travel along Pueblo and County roads during daylight hours
- Inform all construction truck drivers and require them to adhere to the designated traffic haul routes
- Implement a public communications plan to keep road users informed about road closures, lane closures, and detours

To alleviate traffic impacts, Reclamation will publish a GIS website displaying upcoming road closures. It will also coordinate with NMDOT to disseminate the information through their public notifications.

Localized congestion and reductions in access would still be experienced, but the measures in the traffic control plans would improve safety and better facilitate the flow of vehicles in the general project area.

Reclamation would implement traffic safety plans to minimize the potential for vehicular accidents. This plan would include measures to mitigate potential impacts on emergency response agencies and to ensure the safety of the public and project-related traffic. Implementing this measure would minimize risks to the safety of the public and workers in the general project area by promoting safe driving, driver awareness, and avoidance of potentially dangerous areas and situations.

4.19.3.3 Alternative B—HKM Implementable

Construction

Congestion

Compared with Alternative A, No Action, traffic would increase in the general project area during the approximately 6-year construction period. Short-term impacts from congestion would be similar to those under **Section 4.19.3.2**, Impacts Common to All Action Alternatives, and would likely result in delays and detours at intersections and along primary roads in the general project area.

Access

Impacts would be similar to those described under **Section 4.19.3.2**, Impacts Common to All Action Alternatives. However, because there would be fewer construction sites, there would be fewer vehicles traveling on roads in the general project area. As a result, the risk of vehicular accidents would likely be lower as well.

Operation and Maintenance

Impacts during operation and maintenance would be the same as those described under **Section 4.19.3.2**, Impacts Common to All Action Alternatives; however, under Alternative B, an estimated average of 50 cubic yards (or 98,000 pounds) of dried solids per day would be transported from the water treatment plant to the Caja del Rio landfill. Most semi-trailers have a 40,000-pound capacity; therefore, on average, two to three round-trips per day may be required under Alternative B.

Mitigation and Residual Impacts

Recommended mitigation and residual impacts are the same as those described under **Section 4.19.3.2**, Impacts Common to All Action Alternatives.

4.19.3.4 Alternative C

Construction

Congestion

Compared with Alternative A, No Action, there would be an increase in traffic in the general project area, primarily during the approximately 6-year construction period. Short-term impacts from congestion would be similar to those described under

Alternative B – HKM Implementable, above, and would consist of the potential for vehicular accidents, delays, and detours at intersections and along primary roads in the general project area.

One primary source water collection facility would be constructed. Overall, compared with Alternative B, this would likely result in more vehicles accessing construction sites during the approximately 6-year construction period. Construction sites under this alternative would still be situated along all of the major highways in the general project area. This means that impacts from congestion would not be confined to a particular area.

Access

Impacts would be similar to those described under **Section 4.19.3.2**, Impacts Common to All Action Alternatives. However, fewer construction sites would result in fewer impacts on access. Construction sites under this alternative would still be situated along all of the major highways in the general project area. This means that limited access would not be confined to a particular area.

Operation and Maintenance

Impacts during operation and maintenance would be the same as described under **Section 4.19.3.2**, Impacts Common to All Action Alternatives. However, under Alternative C, an estimated average of 3 cubic yards (or 6,400 pounds) of dried solids would be generated per day. Most semi-trailers have a 40,000-pound capacity; therefore, on average, one round-trip to the Caja del Rio landfill per 6-day cycle may be required under Alternative C, if short-term storage of the solids is available.

Mitigation and Residual Impacts

Recommended mitigation and residual impacts are the same as described under **Section 4.19.3.2**, Impacts Common to All Action Alternatives.

4.19.3.5 Alternative D

Construction

Congestion

Compared with the No Action Alternative, there would be an increase in traffic in the general project area, primarily during the approximately 6-year construction period. Short-term impacts from congestion would be similar to those described for Alternative C; however, there would be more construction sites. This would result in more potential for vehicular accidents, delays, and detours at intersections and along primary roads in the general project area. This is because of an increase in the number of short-term storage tanks.

Access

Impacts would be similar to those described under **Section 4.19.3.2**, Impacts Common to All Action Alternatives; however, more construction sites would result in more impacts on access. Construction sites under this alternative would still be situated along all of the major highways in the general project area. This means that limited access would not be confined to a particular area.

Operation and Maintenance

Impacts during operation and maintenance would be the same as described under **Section 4.19.3.2**, Impacts Common to All Action Alternatives; special waste totals and round-trip disposal requirements would be similar to those under Alternative C.

Mitigation and Residual Impacts

Recommended mitigation and residual impacts are the same as described under **Section 4.19.3.2**, Impacts Common to All Action Alternatives.

4.19.3.6 Alternative E (Preferred Alternative)

Construction

Congestion

Impacts would be similar to those described above for Alternative C; however, because construction under Alternative E would be phased, construction-related impacts would be minimized and distributed over a longer period.

Access

Impacts related to access would be the same as those under **Section 4.19.3.2**, Impacts Common to All Action Alternatives.

Operation and Maintenance

Impacts during operation and maintenance would be the same as described under **Section 4.19.3.2**, Impacts Common to All Action Alternatives; special waste totals and round-trip disposal requirements would be similar to Alternative C.

Mitigation and Residual Impacts

Recommended mitigation and residual impacts are the same as described under **Section 4.19.3.2**, Impacts Common to All Action Alternatives.

4.19.3.7 Summary of Impacts

Construction

Congestion would be most noticeable on roads used to access construction sites, including larger roads, such as U.S. Highway 84/285 and SHs 30, 502, and 503. This would result in temporary delays and detours at specific locations and an increased potential for vehicular accidents.

Reduced access to roads would be temporary and intermittent at specific locations.

Impacts on congestion and access may be most noticeable on narrower Pueblo and County roads.

Short-term impacts would be similar across all action alternatives.

Operations and Maintenance

The impacts from congestion and reduction in access during operation and maintenance would be negligible.

4.19.4 Rio Pojoaque Irrigation Improvement Project

4.19.4.1 Alternative RP-A—No Action

Under Alternative RP-A, No Action, the Rio Pojoaque irrigation improvement project would not be completed; therefore, the objectives of the project described in **Section 1.4** would not be realized.

Mitigation and Residual Impacts

There would be no mitigation or residual impacts associated with Alternative RP-A, No Action.

4.19.4.2 Impacts Common to All Action Alternatives

Construction

Congestion

Under each action alternative, short-term local impacts could include potential delays during construction, although the scale, scope, and location of the proposed improvements should minimize the intensity of the impacts.

Access

Impacts on access would be most noticeable if construction activities either temporarily block or reduce access to public roads near the proposed improvements. For example, access could be temporarily restricted if equipment or supplies were placed near a road or if boring under a road were required. Impacts would be temporary and limited, because most proposed activities would occur outside of roadways.

Operation and Maintenance

Because there would be very few operations- and maintenance-related vehicles, congestion and access impacts would be negligible.

Mitigation and Residual Impacts

Recommended mitigation includes the development of traffic control plans to minimize impacts on traffic during construction. The traffic control plans would have the following components and requirements, which the contractor would implement:

- Define the locations of project access points and location and timing of any temporary lane closures
- Identify and make provisions for circumstances requiring the use of flag persons, warning signs, lights, barricades, cones, and other protective measures to provide safe work areas in the vicinity of the project site and to warn, control, protect, and expedite vehicular and pedestrian traffic

- Implement traffic control with flag persons, signs, barricades, and cones along all roadway segments with substandard widths of less than 18 feet
- Place signs along all proposed construction segments, notifying drivers of the presence of construction traffic

4.19.4.3 Alternative RP-B

Direct and indirect impacts would similar to those described under **Section 4.19.4.2**, Impacts Common to All Action Alternatives. However, because Alternative RP-B would be limited to the extending the barrier dam and installing riprap or gabions, limited construction-related activities in roadways would occur; therefore, no measurable transportation-related impacts are anticipated, either during construction or during future operations and maintenance.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.19.4.2**, Impacts Common to All Action Alternatives.

4.19.4.4 Alternative RP-C (Preferred Alternative)

Direct and indirect impacts would be similar to those described under **Section 4.19.4.2**, Impacts Common to All Action Alternatives; however, the extended conveyance system would block off currently used, but illegal, access to private properties from the river road in the short and long term. This would change traffic patterns slightly.

Also constructing the 9,300-foot-long conveyance canal could take more time and could lead to more short-term local delays; however, as with Alternative RP-B, no measurable transportation-related impacts are anticipated. This is because legal access to properties would not be lost, either during construction or during future operations and maintenance.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.19.4.2**, Impacts Common to All Action Alternatives.

4.19.4.5 Alternative RP-D

Direct and indirect impacts would be similar to those described under **Section 4.19.4.2**, Impacts Common to All Action Alternatives. However, because Alternative RP-D would be limited to potential improvements to the in-stream infiltration gallery, limited construction-related activities in roadways would occur; therefore, no measurable transportation-related impacts are anticipated, either during construction or during future operations and maintenance.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.19.4.2**, Impacts Common to All Action Alternatives.

4.19.4.6 Alternative RP-E

Direct and indirect impacts would be similar to those described under **Section 4.19.4.2**, Impacts Common to All Action Alternatives. However, because Alternative RP-E would be limited to the installation of 2,543 feet of perforated pipe to the in-stream infiltration gallery, limited construction-related activities in roadways would occur; therefore, no measurable transportation-related impacts are anticipated, either during construction or during future operations and maintenance.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.19.4.2**, Impacts Common to All Action Alternatives.

4.19.4.7 Summary of Impacts

Under each action alternative, short-term and local impacts could include potential delays during construction; however, the scale, scope, and location of the proposed improvements should minimize the intensity of impacts. Under Alternative RP-C, currently used, but illegal, access to private properties from the river road would be lost in the long term; however, legal access to properties would not be affected.

4.19.5 Rio Tesuque Channel Modification Project

4.19.5.1 Alternative RT-A—No Action

Under Alternative RT-A, No Action, the Rio Tesuque channel modification project would not be undertaken. The objectives of the project described in **Section 1.4** would not be realized.

Mitigation and Residual Impacts

There would be no mitigation or residual impacts associated with Alternative RT-A, No Action.

4.19.5.2 Impacts Common to All Action Alternatives

Construction

Congestion

Under each action alternative, short-term and local impacts could include potential delays during ingress and egress to the Rio Tesuque work site; however, the scale, scope, and location of the proposed restoration activities should minimize the intensity of impacts.

Access

Impacts on access would be most noticeable if the channel modification activities were to either temporarily block or reduce access to public roads near the restoration site or staging area. For example, access could be temporarily restricted if heavy equipment or supplies were placed near a road. Also, sand and gravel excavated from the work sites would be hauled a short distance and stockpiled on Pueblo lands. Impacts would be temporary and limited, because most of the proposed activities would occur outside the roadways.

Operation and Maintenance

Congestion and access impacts would be negligible. This is because there would be a small number of construction-related vehicles and little to no future maintenance.

Mitigation and Residual Impacts

Recommended mitigation includes the development of traffic control plans to minimize impacts on traffic during construction. This plan would include the following components and requirements, which the contractor would implement:

- Define the locations of restoration access points and the location and timing of any temporary lane closures
- Identify and make provisions for circumstances requiring the use of flag persons, warning signs, lights, barricades, cones, and other protective measures to provide safe work areas in the vicinity of the restoration site or staging area and to warn, control, protect, and expedite vehicular and pedestrian traffic
- Place signs along all proposed construction segments, notifying drivers of the construction traffic

4.19.5.3 Alternative RT-B

Direct and indirect impacts would be the same as those described under **Section 4.19.5.2**, Impacts Common to All Action Alternatives. However, Alternative RT-B would involve 2 acres of vegetation clearing, bank destabilization, and excavation and hauling of 4,600 cubic yards of material; this would raise the main channel bed elevation, grade control features, and detention ponds. This would involve a longer project timeline and potentially more short-term traffic-related impacts from heavy equipment, construction vehicles, and staging areas.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.19.5.2**, Impacts Common to All Action Alternatives.

4.19.5.4 Alternative RT-C

Direct and indirect impacts would be the same as those described under **Section 4.19.5.2**, Impacts Common to All Action Alternatives. However, because Alternative RT-C would excavate 5,300 cubic yards of sand and gravel for a new river channel, it would involve a longer project timeline. Moreover, there could be more short-term traffic-related impacts from heavy equipment, construction vehicles, and staging areas.

Mitigation and Residual Impacts

Direct and indirect impacts would be the same as those described under **Section 4.19.5.2**, Impacts Common to All Action Alternatives.

4.19.5.5 Alternative RT-D (Preferred Alternative)

Direct and indirect impacts would be the same as those described under **Section 4.19.5.2**, Impacts Common to All Action Alternatives. However, Alternative RT-D is limited to removing 1,320 cubic yards of material from an existing sediment spoil pile on the east side of the Rio Tesuque; this would involve a shorter project timeline and fewer short-term, noise-related impacts from heavy equipment, construction vehicles, and staging areas.

Mitigation and Residual Impacts

Direct and indirect impacts would be the same as those described under **Section 4.19.5.2**, Impacts Common to All Action Alternatives.

4.19.5.6 Alternative RT-E

Direct and indirect impacts would be the same as those described under **Section 4.19.5.2**, Impacts Common to All Action Alternatives. However, Alternative RT-E is limited to removing 2,700 cubic yards of material associated with excavating and installing a main carrier pipe running longitudinally to the river, three perforated collector pipes running perpendicular (laterally) to the river, and a gravel filter layer surrounding all pipes. Because of these factors, Alternative RT-E would involve a shorter project timeline and fewer short-term noise-related impacts from heavy equipment, construction vehicles, and staging areas.

Mitigation and Residual Impacts

Direct and indirect impacts would be the same as those described under **Section 4.19.5.2**, Impacts Common to All Action Alternatives.

4.19.5.7 Summary of Impacts

Under each action alternative, short-term and local impacts could include potential delays during ingress and egress to the Rio Tesuque work site. However, the scale, scope, and location of the proposed restoration activities should minimize the intensity of impacts.

4.19.6 Pueblo de San Ildefonso Future Projects Alternatives

4.19.6.1 Alternative SI-A—No Action

Under the Alternative SI-A, No Action, no construction, operation, or maintenance activities would occur; therefore, there would be no impacts on traffic.

Mitigation and Residual Impacts

There would be no mitigation or residual impacts associated with Alternative SI-A, No Action.

4.19.6.2 Alternative SI-B—Proposed Wastewater and Water Infrastructure

Construction

Congestion

Impacts would be similar to those described under **Section 4.19.3.2**, Impacts Common to All Action Alternatives, except that potential congestion and temporary delays and

detours would likely be limited to local roads on the Pueblo de San Ildefonso, along with SHs 30 and 502. Construction would also occur over a shorter time frame, resulting in fewer periods of congestion, and fewer delays or detours. For the same reason, the potential for vehicular accidents would be lower as well.

Access

Impacts related to access would be similar to those under **Section 4.19.3.3,** Alternative B—HKM Implementable; however, because there would be fewer construction sites covering a smaller area, there would likely be fewer reductions in access to roads in the project area.

Mitigation and Residual Impacts

Recommended mitigation and residual impacts are the same as those under **Section 4.19.3.2**, Impacts Common to All Action Alternatives.

4.20 Noise

This section addresses potential impacts on noise from actions associated with each alternative.

4.20.1 Impact Indicators

The indicator, as described in **Table 3-1**, used to analyze impacts on noise is the change in ambient noise level in the general project area and near sensitive receptors.

4.20.2 Analysis Methods and Assumptions

The long- and short-term areas of analysis were determined by creating buffers around project features, where noises from operations and construction would be most prominent.

The long-term area of analysis is the area within 0.5 miles (2,640 feet) of the proposed locations of water treatment plants and pumping plants. This area was chosen to account for proposed RWS facilities that would make noise during operation. The short-term area of analysis encompasses and extends the long-term area of analysis to a 0.5-mile buffer around the RWS facilities. This area was chosen for the same reason. Because of the nature of the Rio Pojoaque irrigation improvement project and the Rio Tesuque channel modification project, potential noise levels are analyzed more broadly.

For analysis of short-term impacts, **Table 2-4**, RWS Surface Disturbance Comparison, **Table 2-32**, Rio Pojoaque Irrigation Improvement Project Surface Disturbance, and **Table 2-34**, Rio Tesuque Channel Modification Project Surface Disturbance, indicate where there would likely be increased noise from construction. **Figure 4-4**, Noise Inventory Sites and Proposed Infrastructure, shows a general distribution of the short-term disturbance areas under the alternatives.

For analysis of long-term impacts, the permanent noise-making RWS features were identified for each alternative (either water treatment plant or pumping plants). The magnitude of the impact depends on the distance between the sensitive receptor and the

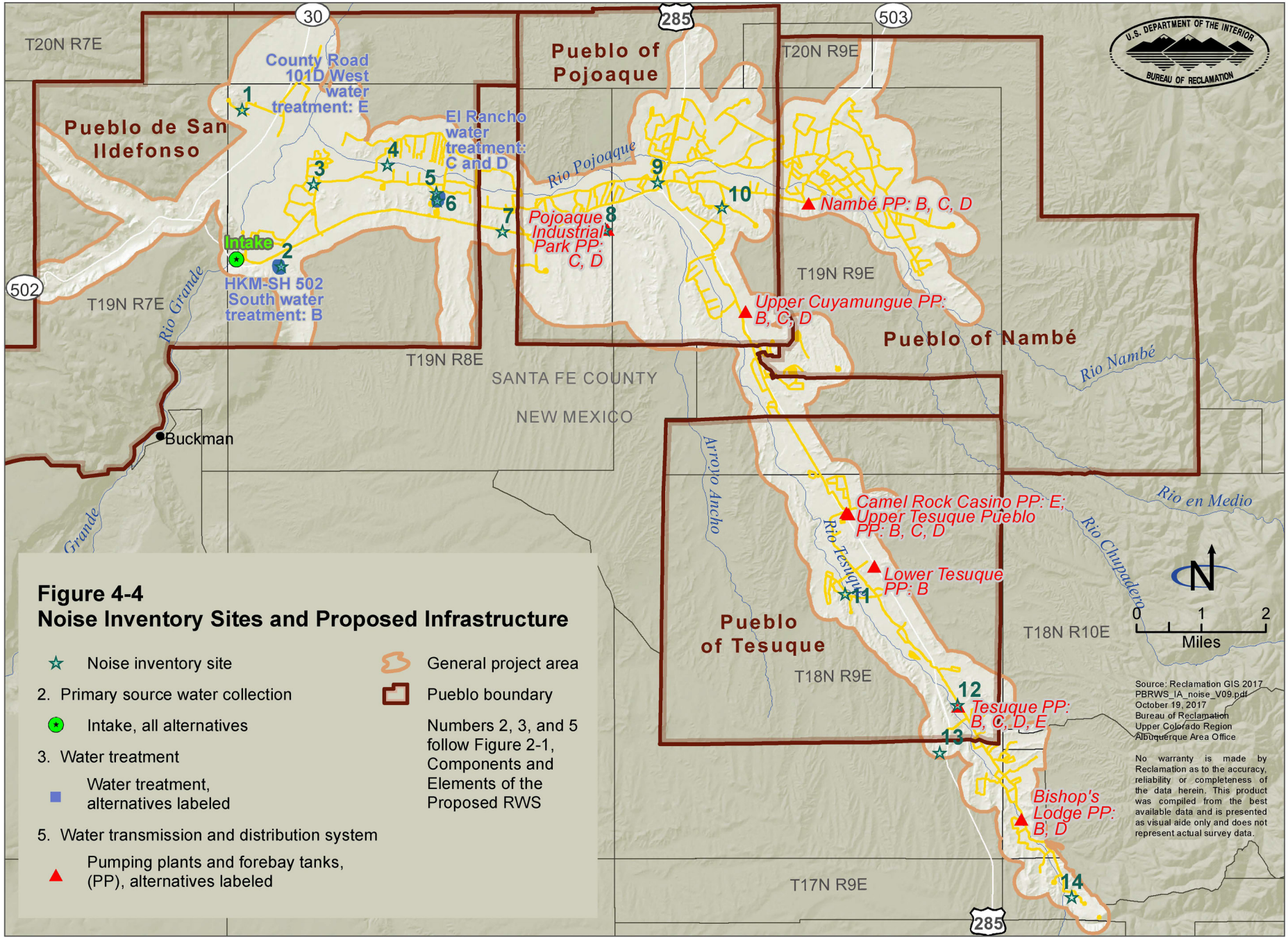


Figure 4-4
Noise Inventory Sites and Proposed Infrastructure

- Noise inventory site
- 2. Primary source water collection
- Intake, all alternatives
- 3. Water treatment
- Water treatment, alternatives labeled
- 5. Water transmission and distribution system
- Pumping plants and forebay tanks, (PP), alternatives labeled
- General project area
- Pueblo boundary
- Numbers 2, 3, and 5 follow Figure 2-1, Components and Elements of the Proposed RWS

noise source. Because no long-term impacts are anticipated from the Rio Pojoaque irrigation improvement project or the Rio Tesuque channel modification project, there was no detailed analysis of sensitive receptors.

4.20.2.1 Assumptions

The following assumptions were used in analyzing noise impacts:

- The magnitude of the impact depends on the duration and frequency of the noise and the time at which the noise occurs (noise is viewed as more disruptive when it occurs at night). The duration, frequency, and time of construction are not known, so this analysis does not account for these factors. For the purposes of this analysis, the assumption is that these factors would have similar impacts.
- Individuals react differently to changes in ambient noise levels and to various types of sound; therefore, the perceived level of impact may vary by receptor. Noise levels that meet maximum permissible noise levels may still be perceived as a noise impact for some sensitive receptors. For this analysis, the assumption is that all sensitive receptors at NISs react the same to changes in noise levels.
- For this analysis, more acres of short-term disturbance (as indicated in **Table 2-4**, **Table 2-32**, and **Table 2-34**) means larger areas of construction, and thus more areas with noise impacts from construction. Such types of equipment as bulldozers (107 dB), cranes (102 dB), chainsaws (89-93 dB), and air compressors (85 dB) are among some of the noisier equipment that would be used during construction; however, since the spatial extent of short-term disturbance varies by alternative, the acres of short-term disturbance are used as an indicator of noise intensity; that is, more acres of short-term disturbance means larger areas where there would be noise during construction (Work Safe 2015).
- Ten-hour work days were assumed for construction and that construction would occur during daytime.
- Because there are no noise ordinances for the Settlement Pueblos, Reclamation would consult with them to determine applicable noise limits. In the interim, the assumption is that the thresholds established in the Santa Fe County Noise Control and Public Nuisance Ordinance (Ordinance No. 2009-11) apply.
- The threshold for acceptable and unacceptable noise levels is based on the Santa Fe County Noise Control and Public Nuisance Ordinance (Ordinance No. 2009-11). The daytime threshold, between 7 a.m. and 10 p.m., is 75 dB, and the evening threshold, between 10 p.m. and 7 a.m., is 60 dB.
- The Rio Pojoaque irrigation improvement project and the Rio Tesuque channel modification project would generate only short-term, construction-related noise.

4.20.3 RWS Alternatives

4.20.3.1 Alternative A—No Action

Under Alternative A, there would be no construction or operation of sound-producing RWS facilities; therefore, there would be no impacts on the current soundscape or NISs.

Mitigation and Residual Impacts

There would be no mitigation or residual impacts under the No Action alternative.

4.20.3.2 Impacts Common to All Action Alternatives

The types of impacts under each action alternative are the same, but the extent of impacts varies with each alternative. In general, any area where new project features would be constructed would have direct, localized, intermittent, and short-term noise impacts. Construction would require the use of earth-moving equipment, such as bulldozers, graders, and backhoes; heavy trucks, such as dump trucks, cranes, and concrete trucks; generators; and pile drivers (see also **Table 2-2**, Heavy Equipment for the RWS). All of this equipment would emit noise. For access roads, electrical lines, and pipelines, the construction equipment would not remain in one location for a long time, given the linear nature of this type of development.

Noise would be emitted outward from these areas. The distance that noise would travel depends on the loudness of the noise, topography, and other features in the landscape that might block noise. Noise would fade with increasing distance from these areas.

In the short term, heavy trucks and personal vehicles would increase along roadways to bring personnel and supplies to construction sites. This would increase in the noise from motor vehicles. In the long term, maintenance and operation personnel using these roads—including those using off-highway vehicles—would directly increase noise.

Mitigation and Residual Impacts

The direct, short-term, construction noise impacts could be reduced by keeping construction equipment, such as compressors and generators, as far as possible from noise-sensitive receptors and by requiring all construction equipment to be muffled and well maintained. Notifying and educating nearby landowners of noisy construction beforehand would also be used as a mitigation measure. These mitigation measures would serve to avoid and minimize noise impacts on noise receptors; however, they would not completely eliminate the possibility of temporary noise impacts.

4.20.3.3 Alternative B—HKM Implementable

The same nature and type of direct and indirect impacts described under **Section 4.20.3.2**, Impacts Common to All Action Alternatives, would apply to Alternative B. Under this alternative there would be approximately 1,203 acres of short-term disturbance. **Figure 4-4** generally shows the surface areas where construction would occur and indicates the distribution where noise impacts would be perceived in relation to the NISs. Construction noise would likely be emitted from these disturbance areas.

As with **Section 4.20.3.2**, Impacts Common to All Action Alternatives, heavy truck and personal vehicle construction traffic would increase in the short term along roadways.

This would increase vehicle noise. Also, there is the potential for increased OHV and vehicle use, and any associated vehicle-related noises, along project access roads over the long term.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.20.3.2**, Impacts Common to All Action Alternatives.

4.20.3.4 Alternative C

The same nature and type of direct and indirect impacts described under **Section 4.20.3.2**, Impacts Common to All Action Alternatives, would apply under Alternative C. However, the extent of short-term disturbance and locations of some of the proposed project features would be different, and the area of short-term disturbance would be less. Under this alternative, there would be approximately 1,140 acres of short-term disturbance; therefore, there would likely be fewer impacts on the soundscape and NISs in the general project area from construction-related noise.

As with **Section 4.20.3.2**, Impacts Common to All Action Alternatives, heavy truck and personal vehicle construction traffic would increase along roadways in the short term. This would increase motor-vehicle noise. Also, there is the potential for increased OHV and vehicle use, and any associated vehicle-related noises, along project access roads in the long term.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.20.3.2**, Impacts Common to All Action Alternatives.

4.20.3.5 Alternative D

The same nature and type of direct and indirect impacts described under **Section 4.20.3.2**, Impacts Common to All Action Alternatives, would apply to Alternative D. However, the extent of short-term disturbance and locations of some of the proposed project features would be different, and the area of short-term disturbance would be less. Under this alternative, there would be approximately 1,146 acres of short-term disturbance. Impacts on the soundscape and NISs in the general project area from construction-related noise would likely be similar to Alternative C.

As with **Section 4.20.3.2**, Impacts Common to All Action Alternatives, heavy truck and personal vehicle construction traffic would increase along roadways in the short term. This would increase vehicle noise. Also, there is the potential for increased OHV and vehicle use, and any associated vehicle-related noises, along project access roads in the long term.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.20.3.2**, Impacts Common to All Action Alternatives.

4.20.3.6 Alternative E (Preferred Alternative)

The same nature and type of direct and indirect impacts described under **Section 4.20.3.2**, Impacts Common to All Action Alternatives, would apply to Alternative E. However, the extent of short-term disturbance and locations of some of the proposed project features would be different, and the area of short-term disturbance would be less. Under this alternative, there would be approximately 856 acres of short-term disturbance. Impacts on the soundscape and NISs in the general project area from construction-related noise would likely be similar to those under Alternative B.

As with **Section 4.20.3.2**, Impacts Common to All Action Alternatives, heavy truck and personal vehicle construction traffic would increase along roadways in the short term. This would increase vehicle noise. Also, there is the potential for increased OHV and vehicle use, and any associated vehicle-related noises, along project access roads in the long term.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.20.3.2**, Impacts Common to All Action Alternatives.

4.20.3.7 Summary of Impacts

The following is a summary of RWS impacts related to noise:

- All direct RWS construction-related noise impacts would be short term and would cease as soon as the construction in those areas is complete. Impacts on sensitive receptors within hearing range of construction would be intermittent and temporary.
- There is the potential for increased OHV and vehicle use in the long term from operation and maintenance, and any associated vehicle-related noises, along project access roads; however, these noises would likely comply with the Santa Fe County Noise Control and Public Nuisance Ordinance.

4.20.4 Rio Pojoaque Irrigation Improvement Project

4.20.4.1 Alternative RP-A—No Action

Under Alternative RP-A, No Action, there would be no construction or operation of additional irrigation facilities; therefore, there would be no impacts on the current soundscape or NISs.

Mitigation and Residual Impacts

There would be no mitigation or residual impacts under Alternative RP-A, No Action.

4.20.4.2 Impacts Common to All Action Alternatives

In areas of proposed irrigation improvements, construction would have direct, localized, intermittent, and short-term noise impacts. Construction would require the use of earth-moving equipment, such as bulldozers, graders, and backhoes; heavy trucks, such as dump trucks; generators; and pile drivers, all of which would emit noise.

Noise would be emitted outward from these areas; the distance that noise would travel depends on the loudness of the noise, the topography, and other features in the landscape that might block noise. Noise would fade with increasing distance from these areas.

In the short term, heavy truck and personal vehicle traffic associated with the irrigation improvements would increase along roadways to bring personnel and supplies to the project site. This would result in a temporary increase in motor-vehicle noise. In the long term, there would be no measurable impacts during operation and maintenance.

On August 20, 2017, technicians used the Sound Pressure Level Meter by Studio 6 (shown to be an accurate sound level meter application; Fawver and Britten 2012) to take readings at various Buckman Direct Diversion (BDD) project facilities. The highest reading taken at the entrance to the BDD water treatment plant was 55 dB under light breezy conditions; readings typically were approximately 45 dB. Pumping booster and lift station readings averaged around 33 to 36 dB, with a single high reading of 45 dB under breezy conditions. Readings taken on the Rio Grande at the BDD surface intake structure averaged 34 to 36 dB and peaked at 51 dB during occasional 10-second periods of backflow to clear the inlet.

All readings taken at each BDD Project facility fell well within noise thresholds in the Santa Fe County Noise Control and Public Nuisance Ordinance (Ordinance No. 2009-11).[2] The assumption is that the RWS's infrastructure would be similarly designed, but the RWS water treatment plant would be smaller than the BDD plant and would therefore create less noise. Pumps would be enclosed and housed in baffled buildings; therefore, RWS infrastructure would also be within the Santa Fe County Noise Control and Public Nuisance Ordinance. (Noise impacts from operating the RWS infrastructure are not analyzed below, because noise levels under each alternative would comply with this ordinance.)

Mitigation and Residual Impacts

The direct, short-term, construction noise impacts could be reduced by requiring construction equipment, such as compressors and generators, to be as far as possible from noise-sensitive receptors. Moreover, all construction equipment should be required to be muffled and well maintained. These mitigation measures would serve to avoid and minimize noise impacts on noise receptors; however, they would not completely eliminate the possibility of temporary noise impacts.

4.20.4.3 Alternative RP-B

Direct and indirect impacts would similar to those described under **Section 4.20.4.2**, Impacts Common to All Action Alternatives. But because Alternative RP-B would be limited to extending the barrier dam and installing riprap or gabions, limited construction-related noise would occur in the short term. There would be no measurable long-term impacts during operation and maintenance.

[2]Rick Carpenter, Water Resources and Conservation Manager, City of Santa Fe, personal communication with Nick Parker, EMPSi environmental planner, February 23, 2016.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.20.4.2**, Impacts Common to All Action Alternatives.

4.20.4.4 Alternative RP-C (Preferred Alternative)

Direct and indirect impacts would be the same as those described under **Section 4.20.4.2**, Impacts Common to All Action Alternatives. However, constructing the 9,300-foot-long conveyance canal could take more time and lead to more short-term, construction-related noise. There would be no measurable long-term impacts during operation and maintenance.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.20.4.2**, Impacts Common to All Action Alternatives.

4.20.4.5 Alternative RP-D

Direct and indirect impacts would be similar to those described under **Section 4.20.4.2**, Impacts Common to All Action Alternatives. However, because Alternative RP-D would be limited to potential improvements to the in-stream infiltration gallery, there would limited construction-related noise in the short term. There would be no measurable long-term impacts during operation and maintenance.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.20.4.2**, Impacts Common to All Action Alternatives.

4.20.4.6 Alternative RP-E

Direct and indirect impacts would be similar to those described under **Section 4.20.4.2**, Impacts Common to All Action Alternatives. However, because Alternative RP-E would install only 2,543 feet of perforated pipe to the in-stream infiltration gallery, limited construction-related noise would occur in the short term. There would be no measurable long-term impacts during operations and maintenance.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.20.4.2**, Impacts Common to All Action Alternatives.

4.20.4.7 Summary of Impacts

Under each action alternative, short-term and localized impacts are construction-related noise from heavy equipment, trucks, and generators. However, the scale, scope, and location of the proposed improvements should minimize the intensity of the impacts. There would be no measurable long-term impacts during operation and maintenance.

4.20.5 Rio Tesuque Channel Modification Project

4.20.5.1 Alternative RT-A—No Action

Under Alternative RT-A, there would be no modifications to the Rio Tesuque; therefore, there would be no impacts on the current soundscape or NISs.

Mitigation and Residual Impacts

There would be no mitigation or residual impacts associated with Alternative RT-A, No Action.

4.20.5.2 Impacts Common to All Action Alternatives

In the area where the Rio Tesuque channel modifications would occur, project activities would have direct, localized, intermittent, and short-term noise impacts. The channel modification project would require the use of earth-moving equipment, such as bulldozers and backhoes; heavy trucks, such as dump trucks; generators; and pile drivers, all of which would emit noise.

Noise would be emitted outward from these areas; the distance that noise would travel depends on the loudness of the noise, the topography, and other features in the landscape that might block noise. Noise would fade with increasing distance from these areas.

In the short term, heavy truck and personal vehicle traffic associated with the channel modifications would increase along roadways to bring personnel and supplies to the project site. This would temporarily increase motor-vehicle noise. In the long term, there would be no measurable impacts during operation and maintenance or from monitoring the impacts of the channel modifications.

Mitigation and Residual Impacts

The direct short-term construction noise impacts could be reduced by requiring that construction equipment, such as compressors and generators, be kept as far as possible from noise-sensitive receptors and by requiring all construction equipment to be muffled and well maintained. These mitigation measures would avoid and minimize noise impacts on noise receptors; however, they would not completely eliminate the possibility of temporary noise impacts.

4.20.5.3 Alternative RT-B

Direct and indirect impacts would be the same as those described under **Section 4.20.5.2**, Impacts Common to All Action Alternatives. However, it would involve more short-term noise-related impacts from heavy equipment, construction vehicles, and staging areas due to a longer project timeline. This is because Alternative RT-B would involve 2 acres of vegetation clearing, bank destabilization and excavation of 4,600 cubic yards of material, raising the main channel bed elevation, grade control features, and detention ponds.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.20.5.2**, Impacts Common to All Action Alternatives.

4.20.5.4 Alternative RT-C

Direct and indirect impacts would be the same as those described under **Section 4.20.5.2**, Impacts Common to All Action Alternatives. However, because Alternative RT-C would involve the excavation of 5,300 cubic yards of sand and gravel for a new river channel, it would involve more short-term noise-related impacts from heavy equipment, construction vehicles, and staging areas, due to a longer project timeline.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.20.5.2**, Impacts Common to All Action Alternatives.

4.20.5.5 Alternative RT-D (Preferred Alternative)

Direct and indirect impacts would be the same as those described under **Section 4.20.5.2**, Impacts Common to All Action Alternatives. However, it would involve less short-term noise-related impacts from heavy equipment, construction vehicles, and staging areas due to a shorter project timeline. This is because Alternative RT-D is limited to removing 1,320 cubic yards of material from an existing sediment spoil pile on the east side of the Rio Tesuque.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.20.5.2**, Impacts Common to All Action Alternatives.

4.20.5.6 Alternative RT-E

Direct and indirect impacts would be the same as those described under **Section 4.20.5.2**, Impacts Common to All Action Alternatives. However, it would involve less short-term noise-related impacts from heavy equipment, construction vehicles, and staging areas. This would be due to a shorter project timeline and because Alternative RT-E is limited to removing 2,700 cubic yards of material for excavation and installing a main carrier pipe running longitudinally to the river, three perforated collector pipes running perpendicular to the river, and a gravel filter layer surrounding all pipes.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.20.5.2**, Impacts Common to All Action Alternatives.

4.20.5.7 Summary of Impacts

Under each action alternative, short-term and localized impacts would include noise from heavy equipment, trucks, and generators, although the scale, scope, and location of the proposed improvements should minimize the intensity of impacts. In the long term, there would be no measurable impacts during operation and maintenance or when monitoring the impacts of the channel modifications.

4.20.6 Pueblo de San Ildefonso Future Projects Alternatives

4.20.6.1 Alternative SI-A—No Action

Under the Alternative SI-A, No Action, there would be no sound-producing features; therefore, there would be no impacts on the current soundscape or NISs.

Mitigation and Residual Impacts

There would be no mitigation or residual impacts associated with the No Action alternative.

4.20.6.2 Alternative SI-B—Proposed Wastewater and Water Infrastructure

Noise would occur from construction and increased traffic to project sites. Construction and associated increased traffic would produce direct, short-term, localized, and intermittent increases in ambient noise levels. The type of equipment used during construction and the related impacts from equipment would be the same as described under **Section 4.20.3.3**, Alternative B—HKM Implementable. However, direct and indirect impacts of the wastewater system improvements would be on a smaller scale. This is because the project's direct short-term impacts would affect only 59 acres. The magnitude of direct and indirect impacts from the other water-related infrastructure projects would be analyzed as the details of those projects are further developed.

In the long term, maintenance and operation personnel using roads would directly increase vehicle-related noises.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.20.3.2**, Impacts Common to All Action Alternatives.

4.21 Solid and Hazardous Materials

This section addresses potential impacts from hazardous materials exposure, and solid waste generation and disposal associated with each alternative. It also considers the overall health and safety of residents and potential workers.

4.21.1 Impact Indicators

The indicator, as described in **Table 3-1**, used to analyze impacts on health and safety is hazardous materials over reportable quantities being used, stored, or potentially released in the general project area.

4.21.2 Analysis Methods and Assumptions

The analysis of hazardous sites reflects the methods detailed by JGMS (JGMS 2014, **Appendix E**). Included in the analyses are sites with "high" or "medium" rankings that potentially intersect or fall within a 50-foot buffer of any proposed infrastructure. Sites with "low" rankings were not considered any further in this EIS (JGMS 2014).

Of particular importance to both RWS construction and operation, along with the other proposed actions, is the potential presence of hazardous waste or toxic materials in areas proposed for ground disturbance, including such infrastructure as holding tanks, water lines, and pumping plants. If encountered, hazardous waste and toxic materials could pose a risk to worker safety and the integrity of the piping and bedding.

The analysis includes the following assumptions:

- The RWS and other proposed actions would be designed, constructed, and operated to meet or exceed the requirements of the U.S. Department of Labor, OSHA, and local, state, and Pueblo-specific requirements for safety and protection of residents and workers. Compliance with safety requirements, including the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA), would guide chemical use, transportation, and storage associated with the proposed RWS water treatment facilities.
- Construction-related fuels, fuel storage, chemicals, metals, and any potentially hazardous materials would be addressed during the implementation process.
- Staging areas, construction yards, refueling areas, and other sites would comply with Pueblo, state, and federal regulations.
- Solids generation from the water treatment process would be designated as special waste, which is subject to periodic sampling and testing to ensure that the materials do not contain regulated contaminants. Solids would be transported to an off-site landfill permitted to accept the quantity and type of special waste generated.
- Settling lagoons and byproducts of the Pueblo de San Ildefonso's future projects alternative wastewater treatment process are not considered hazardous; this is because the treated waste would be disinfected.

4.21.3 RWS Alternatives

4.21.3.1 Alternative A—No Action

As described in **Chapter 3**, there are numerous sites of concern in the general project area. These could be cleaned up or remediated over time, although there are no known plans to do so at this time. Some area residents would continue to be exposed through local wells to hazardous chemicals in the groundwater exceeding federal and state standards (see **Section 3.21**, Solid and Hazardous Materials) if the RWS were not built. There would be no potential for additional exposure to hazardous materials and solid waste generation and disposal associated with the RWS construction or operation.

Mitigation and Residual Impacts

There would be no mitigation or residual impacts associated with the No Action Alternative.

4.21.3.2 Impacts Common to All Action Alternatives

All four action alternatives would involve the chemical treatment of raw water and the generation of solid waste from water treatment. Because of these actions, most public

health and safety impacts from hazardous material exposure and solid waste generation and disposal would be the same under all RWS action alternatives.

There would be potential short-term direct impacts on the health and safety of construction workers and general public at construction sites from fuel and chemical spills or hazardous materials used during construction. These potential impacts would be similar across the action alternatives.

Under the RWS action alternatives, river water would be treated to meet all applicable drinking water standards before being distributed as potable water to the RWS service area. There would be long-term direct improvements in water quality, such as the removal of chemicals and total dissolved solids, for Settlement Pueblo members and some County residents.

Numerous chemicals are commonly used to treat drinking water. Such chemicals would be stored and used at the water treatment plant under all action alternatives. The transportation and storage of sodium hypochlorite and other hazardous materials for water treatment is a relevant health and safety issue. However, these risks are minimized and mitigated by following local, state, and national standards for transport, storage, and use by certified operators. Based on this, it is unlikely that there would be direct or indirect impacts on public health and safety from exposure to chemicals during operation of the RWS water treatment plant.

Sodium hypochlorite stored in injection buildings next to short-term storage tanks would not trigger reporting requirements under EPCRA. This is because the amount stored at each site would be less than the threshold amount under EPCRA. Section 312 requires reporting of hazardous chemicals stored in excess of 10,000 pounds at a single facility. No injection building is anticipated to store more than 440 gallons (4,513 pounds) of sodium hypochlorite at any one time.

Chemicals would be stored in larger quantities at the water treatment plant, which may trigger reporting requirements under Section 312 of EPCRA. Because Reclamation and all entities operating the RWS would comply with EPCRA and other safety requirements, no direct or indirect impacts on public health and safety from these chemicals are anticipated.

Solid residual generation is a component of the water treatment process under all action alternatives. Solids would consist mainly of fine river sediments, plus iron or aluminum salts from the addition of a primary coagulant. These solids would be filtered from the water, would be treated with ozone and ferric chloride, and would be further thickened in drying lagoons or pressed mechanically. The thickened solids would be hauled and disposed of at the Caja del Rio landfill, located in Santa Fe approximately 26 miles from the proposed treatment plant. As with other water treatment projects such as the BDD, these solids would be designated as special waste, which is subject to periodic sampling and testing to ensure that the materials do not contain regulated contaminants. Before any land transaction, Phase I and, where necessary, Phase II environmental site assessments would be conducted, in accordance with ASTM E-1527-13 standards.

Mitigation and Residual Impacts

No residual impacts are anticipated under any of the action alternatives. The following measures would be used as mitigation to minimize direct and indirect impacts on health and safety:

- Construction of any RWS facility within 50 feet of a known hazardous waste site, underground storage tank, or leaking underground storage tank would be coordinated with the site or tank owners to minimize the risk of worker or public exposure to hazardous substances.
- Construction contractors for the RWS would generate a hazardous materials management plan. Hazardous materials would not be drained onto the ground or into streams or drainage areas.
- Totally enclosed containment would be provided for all trash. All construction waste, including trash and litter, garbage, other solid waste, petroleum products, and other potentially hazardous materials, would be removed to an authorized disposal facility.
- The RWS would be designed, constructed, and operated to meet or exceed the requirements of the U.S. Department of Labor, OSHA, and local, state, and Pueblo-specific requirements for safety.
- The water treatment facilities, associated chemical agents, pumping plants, tanks, and conveyance systems would be operated in accordance with applicable state and federal regulations and the operation and maintenance manuals that would be developed for each facility. These manuals would include health and safety plans and emergency response procedures.
- Regulated materials, such as hazardous chemicals, would be transported in accordance with all applicable U.S. Department of Transportation and State of New Mexico regulations.
- Regulated substances, such as chemicals used at the water treatment plant, would be stored in accordance with applicable state regulations and county and Pueblo ordinances.
- Solid waste generated from the water treatment process would be handled as special waste and would be periodically tested to ensure that the materials do not contain regulated contaminants.
- A Phase I environmental site assessment would be conducted along areas designated for short- and long-term impacts from the RWS.

4.21.3.3 Alternative B—HKM Implementable

Under Alternative B, the proposed infrastructure would be within 50 feet of three sites with a hazard rating of medium; none ranked as high (**Table 4-51**, Alternative B: Hazardous Sites; Reclamation GIS 2017). All other sites from NMED and IHS were either ranked low or were outside of the analysis corridor.

Table 4-51. Alternative B: Hazardous Sites

Site	Location	Classification	Impact	Description
Pojoaque bus maintenance shop	Pueblo of Pojoaque	EDR-medium	Short- and long-term	The Pojoaque bus maintenance shop is on Camino del Ojito; it includes a former 2,000-gallon diesel underground storage tank.
Ortiz Transportation	Pueblo of Pojoaque	EDR-medium	Short- and long-term	Ortiz Transportation is at 4 Rancho Enrique and contains a 2,000-gallon diesel fuel aboveground storage tank.
Mino & Greg's Automotive	Pueblo of Pojoaque	EDR, orphan sites-medium	Short- and long-term	Mino & Greg's Automotive is an automotive repair shop listed in the Resource Conservation and Recovery- Conditionally Exempt Small Quantity Generator database. It is at 1761 SH 502, on the Pueblo of Pojoaque.

Source: Reclamation GIS 2017

The water would be chemically treated under Alternative B, as would the solids generated from the water treatment process. Since Alternative B includes a direct river intake, more fine sediments are anticipated in the treatment process. As such, more chemicals may be necessary for coagulants to manage the special waste. Under Alternative B, an estimated average of 50 cubic yards (or 98,000 pounds) of dried solids each day would be transported from the water treatment plant to the landfill. This works out to approximately 49 tons per day, or 17,885 tons annually. As the Caja del Rio landfill currently handles approximately 150,000 tons annually, this would increase their processing by more than 10 percent. Acceptance of such a large quantity of material by the landfill may exceed permitted levels and capacities.

In addition to generating solid waste, the water treatment process would generate an average of approximately 5,729 gpd of sanitary waste and membrane cleaning wastes and 149,000 gpd of brine at full future demand. Under this alternative, sanitary waste would be pumped to an on-site holding tank, and brine would be discharged into the Rio Grande. Because Reclamation would obtain any necessary permits under the CWA for this discharge, impacts would be minimized.

No Superfund sites or Voluntary Remediation Program sites are in the general project area; as such, the impacts analyses focused on EDR, EDR orphan sites, IHS dump sites, NMED groundwater discharge permits, individual residences, and other potential sources of hazardous or toxic materials. Two EDR sites and one EDR orphan site are the only known hazardous areas in the alternative infrastructure area (Reclamation GIS 2017). The alternative infrastructure area includes the area next to the Rio Grande, the treatment site, storage tanks, transmission and distribution pipelines, and the electrical power system.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.21.3.2**, Impacts Common to All Action Alternatives.

4.21.3.4 Alternative C

Direct and indirect impacts would be the same as those described under Alternative B. However there would be less chemical use in the coagulation process and less overall special waste; under Alternative C, an estimated average of 3 cubic yards (or 6,400 pounds) of dried solids would be generated daily and would be transported from the water treatment plant to the landfill. This works out to approximately 4.4 tons per day, or 1,606 tons annually. Because the Caja del Rio landfill currently handles approximately 150,000 tons annually, this would increase the annual processing by approximately 1 percent.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.21.3.2**, Impacts Common to All Action Alternatives.

4.21.3.5 Alternative D

Direct and indirect impacts would be the same as those described under Alternative B; special waste totals would be similar to Alternative C.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.21.3.2**, Impacts Common to All Action Alternatives.

4.21.3.6 Alternative E (Preferred Alternative)

Direct and indirect impacts would be similar to those described under Alternative B; special waste totals would be similar to Alternative C. Under this alternative, sanitary waste would be transported in a pipeline to a wastewater treatment plant on the Pueblo de San Ildefonso. This waste would increase annual processing at the wastewater treatment plant, but hazards from this waste are not anticipated. Additionally, the water treatment process would generate an average of 149,000 gpd of brine at full future demand. Under this alternative, brine would be discharged into the Rio Grande. Because Reclamation would obtain any necessary permits under the CWA for this discharge, impacts would be minimized.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.21.3.2**, Impacts Common to All Action Alternatives.

4.21.3.7 Summary of Impacts

There could be short-term, direct impacts on the health and safety of construction workers and the general public at construction sites from fuel and chemical spills and hazardous materials used during construction. Implementing mitigation stipulations would minimize potential impacts.

River water would be treated to meet all applicable drinking water standards before being distributed as potable water to the RWS service area. There would be long-term direct improvements in water quality (e.g., chemicals and total dissolved solids) for Settlement Pueblo members and some County residents.

Risks from exposure to chemicals used in treating drinking water would be minimized and mitigated by following local, state, and national standards for transport, storage, and use by trained professionals.

Direct and indirect impacts from identified hazardous or toxic sites are similar across the four action alternatives. The short- and long-term sites and facilities identified by JGMS that may be encountered during construction are the same across all action alternatives (Reclamation GIS 2017).

Indirect impacts could occur if the proposed RWS results in hazardous releases or exposure to hazardous materials by inducing erosion at other locations or inundation outside of the general project area during major storms. Potential impacts are speculative and would require further investigation along the proposed RWS to determine potential risks. Mitigation stipulations would be implemented to minimize potential impacts on the health and safety of construction workers, Settlement Pueblo members, County residents, and operations and maintenance personnel when working near such potentially hazardous sites and chemicals.

4.21.4 Rio Pojoaque Irrigation Improvement Project

4.21.4.1 Alternative RP-A—No Action

Under Alternative RP-A, No Action, the Rio Pojoaque irrigation improvement project would not be completed. The objectives of the project described in **Section 1.4** would not be realized.

Mitigation and Residual Impacts

There would be no mitigation or residual impacts associated with Alternative RP-A, No Action.

4.21.4.2 Impacts Common to All Action Alternatives

The action alternatives would involve ground disturbance in and next to the Rio Pojoaque and improvements designed to increase irrigation water availability to the Pueblo de San Ildefonso.

Because of the nature and location of the proposed improvements, public health and safety impacts from hazardous materials exposure and solid waste generation and disposal would be the same under all action alternatives. There are no known sites within 50 feet of proposed improvements with a hazard rating of medium or high (Reclamation GIS 2017). Also, no Superfund sites or Voluntary Remediation Program sites are in the area.

There would be potential short-term direct impacts on the health and safety of construction workers and the general public at construction sites from fuel and chemical spills or hazardous materials used during construction. These potential impacts would be similar across the action alternatives.

Mitigation and Residual Impacts

No residual impacts are anticipated with the implementation of any of the action alternatives. Mitigation to minimize direct and indirect impacts on health and safety include the following measures:

- Construction contractors would generate a hazardous materials management plan. Hazardous material would not be drained onto the ground or into streams or drainage areas. All trash would be totally contained. All construction waste, including trash and litter, garbage, other solid waste, petroleum products, and other potentially hazardous materials, would be removed to an authorized disposal facility.
- The Rio Pojoaque irrigation improvement project would be designed, constructed, and operated to meet or exceed the requirements of the U.S. Department of Labor, OSHA, and local, state, and Pueblo-specific requirements for safety.
- A Phase I preconstruction investigation of hazardous sites would be conducted along areas designated for direct impacts from implementing the irrigation improvement project.

4.21.4.3 Alternative RP-B

Direct and indirect impacts would be the same as those described under **Section 4.21.4.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Mitigation measures and residual impacts would be the same as those identified under **Section 4.21.4.2**, Impacts Common to All Action Alternatives.

4.21.4.4 Alternative RP-C (Preferred Alternative)

Direct and indirect impacts would be the same as those described under **Section 4.21.4.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Mitigation measures and residual impacts would be the same as those identified under **Section 4.21.4.2**, Impacts Common to All Action Alternatives.

4.21.4.5 Alternative RP-D

Direct and indirect impacts would be the same as those described under **Section 4.21.4.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Mitigation measures and residual impacts would be the same as those identified under **Section 4.21.4.2**, Impacts Common to All Action Alternatives.

4.21.4.6 Alternative RP-E

Direct and indirect impacts would be the same as those described under **Section 4.21.4.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Mitigation measures and residual impacts would be the same as those identified under **Section 4.21.4.2**, Impacts Common to All Action Alternatives.

4.21.4.7 Summary of Impacts

There could be short-term, direct impacts on the health and safety of construction workers and the general public at construction sites from fuel and chemical spills and hazardous materials used during construction. Implementing mitigation stipulations would minimize potential impacts.

4.21.5 Rio Tesuque Channel Modification Project

4.21.5.1 Alternative RT-A—No Action

Under Alternative RT-A, the Rio Tesuque channel modification project would not be completed. The objectives of the project described in **Section 1.4** would not be realized.

Mitigation and Residual Impacts

There would be no mitigation or residual impacts associated with Alternative RT-A, No Action.

4.21.5.2 Impacts Common to All Action Alternatives

The action alternatives would involve ground disturbance in and next to the Rio Tesuque and improvements designed to protect, preserve, restore, and improve many natural and cultural aspects of the Rio Tesuque. These improvements would benefit wetlands, springs, wildlife, native vegetation, agriculture, and Pueblo residents.

Because of the nature and location of the proposed improvements, public health and safety impacts from hazardous materials exposure and solid waste generation and disposal would be the same under all action alternatives. There are no known sites within 50 feet of proposed improvements with a hazard rating of medium or high (Reclamation GIS 2017). Also, no Superfund sites or Voluntary Remediation Program sites are in the area.

There would be potential short-term direct impacts on the health and safety of construction workers and the general public at construction sites from fuel and chemical spills or hazardous materials used during construction. These potential impacts would be similar across the action alternatives.

Mitigation and Residual Impacts

No residual impacts are anticipated under any of the action alternatives. The following measures would minimize direct and indirect impacts on health and safety:

- Construction contractors would generate a hazardous materials management plan. Hazardous material would not be drained onto the ground or into streams or drainage areas. All trash would be totally contained. All construction waste, including trash and litter, garbage, other solid waste, petroleum products, and other potentially hazardous materials would be removed to an authorized disposal facility.
- The Rio Tesuque channel modification project would be designed, constructed, and operated to meet or exceed the requirements of the U.S. Department of Labor, OSHA, and local, state, and Pueblo-specific requirements for safety.
- A Phase I preconstruction investigation of hazardous sites would be conducted along areas designated for direct impacts from the channel improvements.

4.21.5.3 Alternative RT-B

Direct and indirect impacts would be the same as those described under **Section 4.21.5.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Mitigation measures and residual impacts would be the same as those identified under **Section 4.21.5.2**, Impacts Common to All Action Alternatives.

4.21.5.4 Alternative RT-C

Direct and indirect impacts would be the same as those described under **Section 4.21.5.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Mitigation measures and residual impacts would be the same as those identified under **Section 4.21.5.2**, Impacts Common to All Action Alternatives.

4.21.5.5 Alternative RT-D (Preferred Alternative)

Direct and indirect impacts would be the same as those described under **Section 4.21.5.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Mitigation measures and residual impacts would be the same as those identified under **Section 4.21.5.2**, Impacts Common to All Action Alternatives.

4.21.5.6 Alternative RT-E

Direct and indirect impacts would be the same as those described under **Section 4.21.5.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

Mitigation measures and residual impacts would be the same as those identified under **Section 4.21.5.2**, Impacts Common to All Action Alternatives.

4.21.5.7 Summary of Impacts

There could be short-term, direct impacts on the health and safety of construction workers and the general public at construction sites from fuel and chemical spills and hazardous materials used during construction. Implementing mitigation stipulations would minimize potential impacts.

4.21.6 Pueblo de San Ildefonso Future Projects Alternatives

4.21.6.1 Alternative SI-A—No Action

Under Alternative SI-A, No Action, there would be no short-term impacts on health and safety from construction-related fuel and chemical spills or hazardous materials. Pueblo members would remain on individual septic systems, which may limit growth on the Pueblo and contribute to long-term, localized, shallow groundwater pollution.

The regulations governing the reporting and remediation of hazardous sites would continue, and the known sites would not be disturbed by construction. There would also be no potential impacts, such as hazardous releases or exposure resulting from construction. Further, there would be no detailed, Phase I or Phase II, preconstruction investigations of hazardous sites in the project area.

Mitigation and Residual Impacts

There would be no mitigation or residual impacts associated with Alternative SI-A, No Action.

4.21.6.2 Alternative SI-B—Proposed Wastewater and Water Infrastructure

There would be potential short-term direct impacts on the health and safety of construction workers and the general public at construction sites from fuel and chemical spills and hazardous materials used during construction. Direct and indirect impacts on these resources would be the same as those described above for the RWS project; however, direct and indirect impacts from the wastewater system improvements would be on a smaller scale than for the RWS project. This is because the project's direct short-term impacts would affect only 59 acres. The magnitude of direct and indirect impacts from the other water-related infrastructure projects would be analyzed as the details of those projects are further developed.

No Superfund or Voluntary Remediation Program sites are in the Pueblo de San Ildefonso future projects area. As such, impacts analyses focused on EDR, EDR orphan sites, IHS dump sites, NMED groundwater discharge permits, individual residences, and other potential sources of hazardous or toxic materials (Reclamation GIS 2017).

Under Alternative SI-B, the proposed water-related infrastructure would be within 50 feet of one potentially hazardous site that was unranked by JGMS (JGMS 2014; **Table 4-52**, Future Projects Alternatives: Hazardous Sites). This is the Black Mesa power line dump. All other sites from NMED and IHS were either ranked low or were outside of the Pueblo de San Ildefonso future projects area. While there is one EDR-listed site (the San Ildefonso Day School) within 50 feet of the proposed wastewater system improvements, this site is ranked low and is therefore not analyzed further.

Table 4-52. Future Projects Alternatives: Hazardous Sites

Site	Location	Classification	Impact	Description
Black Mesa power line dump	Pueblo de San Ildefonso	IHS-Open dump site; no rating	Short- and long-term	Consists of an inactive open dump site

Source: Reclamation GIS 2017

Indirect long-term impacts could occur if it is reasonably foreseeable that Alternative SI-B would result in hazardous releases or exposure to hazardous materials by inducing erosion at other locations or inundation outside of the Alternative SI-B area during major storms. Potential impacts are speculative and would require further investigation in the water-related infrastructure project area to determine potential risks.

Mitigation and Residual Impacts

Mitigation measures and residual impacts are the same as those identified under **Section 4.21.4.2**, Impacts Common to All Action Alternatives.

4.22 Socioeconomic Resources

This section addresses potential impacts on social and economic conditions from actions associated with each alternative.

4.22.1 Impact Indicators

The following indicators, as described in **Table 3-1**, are used to analyze impacts on social and economic conditions:

- Change in economic activity for key sectors in the local economy, including government, housing, service industry, and construction
- Changes in assessment values for other new water systems that provide an alternative to groundwater
- Cost of individual user rates

In addition, the following indicator was analyzed to assess potential impacts on quality of life: Changes in air quality, such as dust from construction, traffic levels, water quality or other factors affecting local residents over the short or long term.

4.22.2 Analysis Methods and Assumptions

Additional information is provided in **Appendix F**, Economic Impact Analysis Methodology. Social and economic analysis is focused on the Santa Fe County general project area, as defined in **Chapter 3**. Information is provided for Pueblo and non-Pueblo areas of the County, where applicable and available. Although impacts may occur in surrounding counties and throughout the state, most impacts would occur within Santa Fe County, due to the location of the proposed projects. Any impacts on populations outside of the socioeconomics area of analysis are discussed under cumulative impacts.

Direct estimated costs for construction materials, employment, and fuel are provided based on information in cost sheets developed in support of the Technical Service Center Feasibility Study (Reclamation 2015b). The cost estimates were intended to capture the most current pricing (as of October 2014) for materials, wages and salaries, accepted productivity standards, typical construction practices, procurement methods, current construction economic conditions, and site conditions for the current level of design. These cost estimates were prepared with less than complete designs and have inherent levels of risk and uncertainties.

Secondary project spending was analyzed using IMPLAN (impact analysis for planning), an input-output, economic impact analysis software and data (IMPLAN 2014). The model represents the area where local direct economic impacts would occur and where all the local secondary impacts would develop (i.e., Santa Fe County). Secondary impacts are indirect impacts and induced impacts. Indirect impacts occur when related industries gain from purchases by the directly affected businesses, such as the purchase of construction equipment from local firms.

Induced impacts are the results of spending by employees hired due to the business activity. Actual economic impacts and jobs created would vary, based on such factors as the construction schedule, skill level of employees required, market conditions, and budgetary constraints. Modeling provides a comparison of impacts by alternatives, rather than representing a precise forecast of actual economic impacts.

Information on the level of employment needed to support project construction, as compared with the current population, was used to determine the level of impacts on area housing and services.

Estimated changes in property value as a result of connection to the RWS and other projects were addressed by examining literature on the relation between property values and water quality. Also conducted were studies examining the change in property value after being connected to a water system or improvements to an area irrigation system. In addition, the general impact of property easement acquisition on property values is discussed.

Costs to individual users are based on best available data for current water costs and anticipated costs for future water system users. Due to uncertainty related to the distribution of costs of the system to individual uses, quantitative estimates of cost could not be provided for all populations.

The following assumptions were made for socioeconomic impact analysis:

- Total economic output is provided for project components rather than project years due to uncertainty over construction timing and direct costs. Direct costs exclude non-contract costs, overhead and profit costs (such as home office, profit, bonds, insurance, and unassigned items), and contingencies; therefore, they are lower than total anticipated field costs for development, as presented in the feasibility study (Reclamation 2015b). As a result, indirect and induced costs modeled in IMPLAN may not capture the full economic impacts of the proposed activities.

- Total fuel costs are estimated based on gallons required as estimated in the feasibility study (Reclamation 2015b) and current retail fuel prices from Energy Information Administration data (EIA 2016b).
- The time frame for constructing specific project components and an approximate peak construction time are based on information provided in the feasibility study (Reclamation 2015b). Based on the construction time frame, per year estimates of employment were determined for the construction period. The actual level of employment at a given time would vary, depending on the level of concurrent development of project components. The numbers presented are initial estimates only.
- Employment impacts are estimated and presented in job-years (i.e., employment position over 1 year, or 2,000 hours). Cumulative job-year impacts across a multi-year analysis do not necessarily equate to the total number of employed persons over that time frame. This is because they can represent one full-time position, multiple part-time positions, or one position filled by different employees.
- Cost estimates from the feasibility study (Reclamation 2015b) were used to estimate employment and construction costs. All estimates represent costs associated with the El Rancho water treatment plant location. For this analysis, the assumption is that costs and employment needs for a water treatment plant at the HKM – SH 502 South location would be approximately the same. In addition, cost estimates represent project components, as described in the 2015 feasibility study. Despite some modification of project details, feasibly study estimates were determined to provide reasonable estimates for overall component costs, based on available information. Due to the high level of uncertainty, no specific estimates were available for detailed components of project operations, such as the cost per individual storage well or per mile of transmission pipe. As such, cost estimates by project component do not vary across alternatives, with the exception of estimates for the water collection source component and use of ASR wells.
- Economic output impacts are presented in constant 2016 dollars to allow for comparison between various components that may occur throughout the multi-year construction period. Nominal dollar value for total economic impacts and project components will vary, depending on the time frame for project development.
- Project cost data provided from the feasibility study was input in 2014 dollars into the IMPLAN model using 2014 model year data. Output was adjusted to 2016 dollars, using the Bureau of Economic Analysis Consumer Price Index inflation calculator.
- The percent of spending in the local economy was dictated by IMPLAN Social Accounting Model defaults for regional percentage of local spending by sector.
- The analysis assumes the current rate of property taxes and distribution.

4.22.3 RWS Alternatives

4.22.3.1 Alternative A—No Action

Under the Alternative A, there would be no direct or indirect impacts on the area economy, population, property values, or residents' quality of life due to a lack of proposed construction activities.

Population, employment, and housing trends in the analysis area under Alternative A would likely follow trends as described in **Section 3.22**, Socioeconomic Resources, for both Settlement Pueblos and Santa Fe County areas; population is anticipated to increase at reduced levels. Because there would be no project construction, no additional jobs would be directly or indirectly supported by this alternative.

Current costs for domestic water access would be determined based on the costs for groundwater pumping, as discussed in **Section 3.22**. The costs for groundwater pumping would be influenced primarily by electricity costs and depth of wells, as well as the volume of water used. Detailed cost assumption and calculations for groundwater costs are included in the Economic Impact Analysis Methodology (**Appendix F**). In summary, well depth is estimated to be an average of 120 feet, in accordance with the Groundwater Technical Memo (HDR 2014b).

Per capita daily use is estimated at approximately 85 gallons (New Mexico Office of the State Engineer 2013), with a range of 5,000 to 10,000 gallons per month per family. Electricity costs are estimated based on a range of $.08185 to $.1283520 per kWh, with an average of $.105101 per kWh (see **Section 3.22.5**, Public Services, Community Electrical and Gas Utilities).

Based on the assumptions presented, pumping costs are estimated at $.66 to $1.32 a month for an average well in the analysis area. Exact costs would vary across the analysis area, influenced by the size of household and water usage, site-specific well and groundwater depth, and variations in pumping efficiency and electricity costs.

In addition, this cost does not account for costs of well purchase, installation, or maintenance. Capital costs of accessing groundwater can be substantial and depend on local drilling costs, well depth, aquifer conditions, discharge capacity, power source, and pump type. Capital costs for a typical well lie in the range of $3,000 to $20,000, with additional costs required if money is financed. Amortized over 30 years, this capital cost equates to an additional $13.50 to $90.00 per month for domestic well water users (see **Appendix F**, Economic Impact Analysis Methodology).

Well pumps last an average of 15 years, depending on local water quality and sediment levels, and pump cost replacement can cost an average of $1,000 to $2,500 or more.

In addition, poor groundwater quality for much of the socioeconomic area of analysis may necessitate installing a water filtration system. Capital costs and operations and maintenance costs are estimated at an additional $19.80 to $131.67 per month for a whole house filtration system. Single tap filtration systems could represent a less expensive, though less efficient, option (see **Appendix F**, Economic Impact Analysis Methodology).

Using the above assumptions, costs to access domestic groundwater are estimated to be from $33.96 to $223 per month, when a whole house water filtration system is included. Additional pump replacement and maintenance and one-time permit costs would apply.

Based on 1940s to 2000s data, average historical drawdown ranged from 0.2 foot on the Pueblo of Tesuque to 20.4 feet on the Pueblo of Pojoaque, with an average of 5.5 feet total. Drawdown is likely to continue, as population in the areas increases, resulting in potential changes to water quality and quantity and increased pumping costs over time.

Property values would continue to change, based on the regional housing market. Trends observed for the Pueblos and Santa Fe County, as discussed in **Section 3.22**, are likely to continue. Money provided to local communities from property taxes would in turn be influenced by property values.

Mitigation and Residual Impacts

Under Alternative A, due to a lack of proposed construction and direct and indirect impacts, no mitigation is proposed and no residual impacts would occur.

4.22.3.2 Alternative B—HKM Implementable

Construction

Under Alternative B, construction of the proposed project would result in short-term impacts on the quality of life for residents, lasting over the course of construction, which is estimated to be from 2018 to 2024. Direct impacts, as detailed in other sections, are from increased dust (**Section 4.8**, Air Quality), visual impacts (**Section 4.18**, Visual Resources), traffic (**Section 4.19**, Traffic), and noise (**Section 4.20**, Noise). Impacts throughout the analysis area would be variable, based on the timing of construction and would not extend over the entire construction period for any one location. Total short-term disturbance would occur on 1,062 acres of surface within Pueblo boundaries and 141 acres of surface outside of Pueblo boundaries. Applying construction BMPs and project-specific mitigation measures would minimize impacts.

Project construction would also result in direct and indirect impacts on the local economy. Direct impacts include the creation of new jobs for construction workers and labor income generated for these positions. In addition, direct project spending would occur for construction materials. The level of impacts would depend on the number of employees required, the percentage employed from the local area, and the level of and type of supplies purchased in the area. See **Appendix F**, Economic Impact Analysis Methodology, for direct construction employment and cost estimates by the proponent, as based on the feasibility study (Reclamation 2015b) and the draft AMEC Foster Wheeler (2016) ASR cost estimates. Note that estimates here are totals for project components, not annual estimates. Under Alternative B, a high and low cost scenario are displayed, depending on the ASR scenario selected.

Estimated timing of employment based on initial project estimates is shown in **Table 4-53**, Direct Job Estimates by Year. These numbers are based on preliminary information and may differ from the total values displayed in IMPLAN modeling, due to rounding. Exact timing of construction and level of employment at a given time would vary, based on number of construction teams working on a given component and the degree to which component construction overlaps. Phasing the location of some project components would result in phasing of site-specific impacts from construction. The specific timing of employment would in turn affect the overall timing of project spending; highest spending

Table 4-53. Direct Job Estimates by Year

Alternative	2018	2019	2020	2021	2022	2023	2024	2025 and Beyond (Operations and Maintenance)
B high	98	152	132	18	18	18	7	22
B low	38	92	71	18	18	18	7	9
C and D	7	73	40	18	18	18	7	8
E	5	47	30	13	13	13	4	8

Source: Reclamation 2015b

and highest levels of economic contributions are generally within the peak period of construction, estimated here to be in 2019-2020.

In **Table 4-53**, estimates are based on the construction period of 2018 through 2024 and component time frames, as detailed in the feasibility study construction schedule.

ASR well construction is assumed to occur from 2018 to 2020. These employment levels represent estimates only and are intended to identify the likely peak period of employment. Adding these annual estimates is not an accurate representation of total job-years required, due to uncertainty related to level of overlap of project components. The exact level of employment at a given time would depend on the level of concurrent development of different site components and locations. Should more work be conducted concurrently, the total time of employment could be reduced and the level of person-years required at a given time could be increased.

Alternative E reflects a 0.735 reduced level of construction and labor hours, based on budgetary constraints and delay of construction of some project components. Indirect impacts would also occur as a result of the new economic development. These would be new jobs at businesses to support the expanded workforce or provide project materials. These impacts would be short term, as a result of the temporary spending in the construction period. In addition, spending would generate additional income and taxes. The level of indirect impacts would depend on levels of direct spending, and the degree to which the proposed water system and associated projects would result in additional long-term development.

Project components were combined and modeled in IMPLAN to determine total direct, indirect, and induced impacts. The results from the proposed construction by alternative are shown in **Table 4-54**, Economic Impacts-Construction. These estimates use the default regional purchase coefficients from IMPLAN (i.e., estimates of the percent spent locally for a given industry). Should the percent of spending locally on construction materials, supplies, or employment differ from these estimates, the level of local economic impacts would change.

Estimates are provided for employment, labor income associated with the employment, and total value added (the difference between total economic output from such factors as employee compensation and taxes and the cost of intermediate inputs). Impacts are displayed in terms of direct impacts (jobs and income supported by project construction),

Table 4-54. Economic Impacts-Construction

	Alternative B Low ASR Cost Scenario	Alternative B High ASR Cost Scenario	Alternative C and D	Alternative E
		Employment (Person-Years)		
Direct impact	234	415	141	111
Indirect impact	39	88	11	10
Induced impact	80	127	56	44
Total impact	**353**	**630**	**208**	**164**
		Labor Income		
Direct impact	$14,867,700	$22,622,400	$10,962,200	$8,577,800
Indirect impact	$1,541,800	$3,510,300	$439,400	$366,000
Induced impact	$3,446,700	$5,476,500	$2,402,400	$1,884,300
Total impact	**$19,856,200**	**$31,609,200**	**$13,804,000**	**$10,828,100**
		Total Value Added		
Direct impact	$16,877,500	$27,348,300	$11,601,700	$9,111,100
Indirect impact	$2,738,600	$6,203,600	$794,300	$662,000
Induced impact	$6,273,600	$9,966,300	$4,373,800	$3,430,400
Total impact	**$25,889,700**	**$43,518,200**	**$16,769,800**	**$13,203,500**

Source: IMPLAN 2014
Note: 2016 dollars rounded to nearest $100. Alternative E reflects a 0.735 reduced level of construction and labor hours, based on budgetary constraints and delay of construction of some project components.

indirect impacts (spending for activities at local business), and induced impacts (spending at local business by employees).

Detailed methods are in **Appendix F**, Economic Impact Analysis Methodology.

Under Alternative B, an estimated 234 to 415 direct person-years and 353 to 630 total person-years employment would be supported by project activities. In addition, $14,867,700 to $22,622,400 in direct labor income would be generated, and $25,889,700 to $43,518,300 in total value would be added. Direct employment estimates would represent a maximum 9 percent increase in construction employment in Santa Fe County over the total construction period, based on 2014 employment data. Note that this number represents employment needs in person years (work for 2,000 hours) for the entire construction period.

It is likely that some work would be conducted serially by the same individual; that is, one worker over the course of 4 years. As such, total employees hired would be lower than represented here. The level of anticipated labor required would be filled by those currently unemployed, residents in the construction industry, and experts in the field of water system construction from in and outside the region. As demonstrated in **Chapter 3**, current unemployment levels in County communities are similar or higher than that of the state; therefore, workers are likely to be available.

Based on IMPLAN modeling, the sectors of the economy most likely to be affected by proposed project activities construction, restaurants, real estate, wholesale trade,

hospitals, and retail trade, including gasoline stores, clothing, and general merchandise. Detailed tables of impacts by economic sector are included in **Appendix F**, Economic Impact Analysis Methodology.

In addition to direct and increased spending, construction would generate additional money in federal, state, and local taxes. Estimated totals by alternative are shown in **Table 4-55**, Economic Impacts Total Federal Taxes, and **Table 4-56**, Economic Impacts Total State and Local Taxes.

Table 4-55. Economic Impacts Total Federal Taxes

Description	Employee Compensation	Proprietor Income	Tax on Production and Imports	Households	Corporations
Alternative B- low	$2,082,800	$115,900	$118,200	$1,110,900	$323,300
Alternative B- high	$3,136,200	$248,800	$226,100	$1,776,200	$643,300
Alternatives C and D	$1,555,900	$41,900	$60,000	$767,600	$157,600
Alternative E	$1,216,600	$34,300	$48,100	$602,300	$126,200

Source: IMPLAN 2014
Note: 2016 dollars rounded to nearest $100. Alternative E reflects a 0.735 reduced level of construction and labor hours, based on budgetary constraints and delay of construction of some project components.

Table 4-56. Economic Impacts Total State and Local Taxes

Description	Employee Compensation	Tax on Production and Imports	Households	Corporations
Alternative B- low	$98,100	$1,128,400	$348,800	$45,500
Alternative B- high	$147,800	$2,158,300	$557,800	$90,600
Alternatives C and D	$73,300	$572,400	$241,000	$22,200
Alternative E	$57,330	$459,081	$189,116	$17,787

Source: IMPLAN 2014
Note: 2016 dollars rounded to nearest $100. Alternative E reflects a 0.735 reduced level of construction and labor hours, based on budgetary constraints and delay of construction of some project components.

Population levels would be indirectly affected by project activities, should the population in the area increase temporarily or permanently, as a result of labor for project work. Impacts could occur if a large in-migrant workforce, culturally different from the local population, is brought in during construction.

As noted in **Chapter 3** and **Appendix G**, Supplemental Socioeconomic Baseline Information, portions of the analysis area, particularly within the Settlement Pueblos, are composed of a population with a high rate of long-term residence and common cultural identity, as evidenced by ethnicity, and language spoken at home. An influx of workers could result in changes to this population and could strain the community infrastructure and social services. However, under Alternative B, even if all direct and indirect

employees relocated from outside of the area, this would represent a less than 0.5 percent population change in Santa Fe County at maximum employment levels. As noted in the labor discussion, above, it is likely that many of the positions would be filled by current County residents, so actual population increases would be lower.

The levels of any population change for individual communities cannot be predicted, but population changes would likely be spread throughout the County. Levels of population change would be far below the levels found by Smith et al. (2001) in boomtowns to have an impact on the character of an area and to strain public services. Any population change impacts would also likely be limited to the construction phase. This is because short-term employment would likely lead to temporary residency by job-holders instead of permanent immigration.

A small percentage of workers may require temporary area housing during construction. Vacancy rates in the Settlement Pueblos and the non-Pueblo portion of Santa Fe County were lower than the County average, ranging from 9.3 to 13.6 percent (see **Section 3.22**). The vacancy rate for apartments in Santa Fe County, as of the last quarter of 2014, was lower, approximately 5.2 percent (HUD 2014).

Santa Fe County also contains short-term rentals, including over 60 hotels and a recreational vehicle park with 95 spaces, both of which may provide temporary housing (Tripadvisor.com 2016). The length of stay and exact number of employees requiring temporary housing cannot be determined at the analysis level. Based on vacancy rates, no strain on area housing is anticipated as a result of the project. Lodging tax revenues may be increased as a result of temporary workers residing in the area; the exact amount would depend on the number of workers requiring temporary lodging and the location that workers stay in. The lodging tax for the County of Santa Fe is currently 4 percent and the Convention Center tax is 3 percent on hotel rooms (Santa Fe Economic Development 2016).

Area public services, including schools, healthcare, and police and other public safety operations, have the potential to be strained by population increases. As discussed in **Chapter 3**, during previous development projects, some in the analysis area were concerned with the capability of fire and emergency response to meet demand. As discussed above, overall changes in population as a result of project activities are likely to be minimal and would be short term. As a result, impacts on public services would be minimized.

It is likely that a percentage of those employed would not permanently reside in Santa Fe County, due to such factors as housing availability (scarcity of appropriate type or price), lifestyle preferences (invested elsewhere), or economic expectations (job permanence or job mobility). Out-of-town workers would reduce the indirect impacts on the amount of household goods and services consumed and housing investment spent locally.

Operation

Long-term economic impacts from project operations are direct impacts from employment to operate the water system. Based on 8 direct employees to operate the water treatment plant and 1 to 14 direct employees to operate the ASR well, the assumption is that long-term project employment under Alternative B would support 19 to 48 total person-years in Santa Fe County and would result in $666,000 to $1,688,200

in direct labor income and $1,583,600 to $4,014,300 in total value added (see **Appendix F,** Economic Impact Analysis Methodology, for detailed information). The exact level of jobs supported in the County would be affected by the skill level of workers required and the local employment market. Due to the small percentage of change in overall employment and population anticipated, operating the water system is not likely to impact housing availability or to strain public services.

Long-term, indirect impacts on water costs may occur as a result of project operations. The stated purpose of the RWS is to reduce the reliance on groundwater. Once the system is operational in a community, Settlement Pueblo members would transfer to the water system. Costs to individual Pueblo members cannot be determined at this time. Although the overall operational cost estimates are available, the degree to which this cost would be passed on to individual members is not determined and would likely vary by Pueblo.

For Santa Fe County residents in the analysis area, individuals would have the option of connecting to the water system or maintaining their existing wells. Costs for connecting to the water system are anticipated to be in line with current costs for users connected to the Santa Fe County water system. As discussed in **Chapter 3**, for an average household use of 5,000 to 10,000 gallons per month, the costs are approximately $45.10 to $87.25 per month, based on current Santa Fe County rates. Should revenue from fees not be sufficient to cover operational expenses of RWS, additional costs may increase.

As discussed under **Alternative A**, current electricity costs for pumping are less than $2.00 per month. Capital costs range from $13.50 to $90 per month. Costs for whole house water filtration systems could add an additional $19.80 to $131.67 per month (see **Appendix F**, Economic Impact Analysis Methodology).

Using the above assumptions, costs to access domestic groundwater are estimated to range from $33.96 to $ 223, when a whole house water filtration system is included. Additional pump replacement and maintenance and one-time permit costs would apply.

Settlement agreement requirements result in additional cost for groundwater uses. Section 3.1.5 of the Settlement Agreement requires the well owner to pay the County $1,000 for any permit to replace a well.

Section 3.1.6 of the Settlement Agreement requires well owners to install a meter. The Office of the State Engineer would require all well owners in the basin to install meters, regardless of whether they are parties to the settlement agreement. Meter purchase and installation is estimated to be a one-time cost of $500.

Costs to connect to the water system may, therefore, represent decreased, increased, or similar, costs as compared with the highly variable level of current monthly costs, depending on the capital costs of an individual's household use.

In addition, connecting to a water system may result in long-term indirect impacts on property values and related property taxes collected for local communities.

As discussed in **Section 4.5**, Water Quality, connection to the RWS is likely to result in improved domestic water quality as compared with current groundwater use. Improved domestic water quality represents a service that can impact property values.

Hedonic pricing studies and contingent valuation studies are common methods used to estimate economic values for ecosystem or environmental services that directly affect

real estate prices. Hedonic pricing recognizes that the price of a home is affected by both the internal characteristics of the goods being sold and external factors affecting it (e.g., surrounding location, local air, and water quality). Contingent valuation studies examine how much money people would be willing to pay (or willing to accept) to maintain the existence of (or be compensated for the loss of) an environmental feature.

Reclamation examined literature on hedonic pricing and contingent evaluation for impacts of water developments and drinking water quality on property value. The results varied, depending on the location of study and the specifics of the water supply examined. No significant connection was found between rural water supply and house price with a hedonic model in Schultz (2007). Groundwater contamination was found to have no impact on residential property value in Malone and Barrows (1990) and Page and Rabinowitz (1993). However, Des Rosiers, Bolduc, and Thériault (1999) and Epp and Al-Ani (1979) found a correlation between home price and water quality.

A number of studies examined willingness to pay for improved water reliability and quality. These studies indicated that survey respondents were willing to pay between $4.43 to $17.28 per month for improvements to drinking water. Overall, the level of impacts on property values of connecting a water system remains unclear, but literature supports that idea that residents' property value may increase with improved water quality and reliability. Additional details on relevant studies are included in **Appendix F**, Economic Impact Analysis Methodology.

In addition, as discussed in **Section 4.17**, Land Use, use of portions of private property would be required order to support the RWS. The right of an entity to use all or part of the property of another person for some specific purpose is known as an easement.

The acquisition of easements for the RWS would follow the direction provided in the Uniform Act of 1970, as amended. Under the Uniform Act, all property owners whose property would be encumbered by an easement would be notified, would have their property appraised, and would receive just compensation for the easement, based on fair market value. Under the federal rule, the value of the easement would be based on the difference between the value of the whole property before (or without) the easement and the value of the property with the easement in place.

Valuation of the easement is variable, based on the level of the impacts of the easement on other surface uses. Easements with a high degree of impacts on other surface uses, such as access roads and irrigation canals, would command a high percentage of the total property value of the property as compensation payment; those with minimal surface impacts, such as pipelines at the edge of a property, would result in a lesser compensation payment (Sherwood 2014).

In total, 48 acres would be required for permanent RWS facilities under Alternative B, including 3 acres on private lands, which require compensation as described above. During construction of the RWS, there would be additional short-term conflicts with existing residential, commercial, and public land uses from approximately 23 to 26 miles of water transmission and distribution pipelines. This includes 2 to 7 miles on private lands, depending on the alternative. Specific compensation amounts for these properties would be determined based on site-specific appraisal and market values. (See an additional discussion in **Appendix F**, Economic Impact Analysis Methodology.)

Water system construction may also impact water availability for fighting fires in the community, and in turn, may impact property insurance rates. The Insurance Service Organization (ISO) collects such information as nearest water supply, fire station, station staffing, number of personnel, number and type of fire trucks, pumping capacity, and emergency communications on municipal fire protection. Based on the information, a Public Protection Classification (PPC) numerical rating is given to the area, which insurance companies use to determine fire insurance premiums. The PPC rating is from 10 to 1, with 1 being the best. Currently, the ISO rating for properties beyond 1,000 feet of a fire hydrant is 7 for the Pojoaque Fire District and 10 for the Tesuque Fire District (Santa Fe County Volunteer Fire District 2016). Under Alternatives B, fire hydrants would be tied into distribution lines, providing water available for fighting fires, helping to lower PPC ratings and control insurance costs.

Long term, the development of the RWS would improve water quality and reliability for all populations in the analysis area. As a result, the potential for water-quality-related health issues is likely to decrease. Reliable water would support current sectors of development; bringing in clean water enhances the chances for heritage tourism in the Northern Rio Grande National Heritage Area. This is an important economic driver in the socioeconomic area of analysis and supports traditional cultural values and uses of water (see **Section 3.22**). In addition, a reliable water source is likely to support opportunities for further development, such as construction and expansion of Pueblo casino and hotel enterprises.

Mitigation and Residual Impacts

No specific mitigation measures are proposed for socioeconomic impacts. Impacts from constructing the RWS and associated projects would result in short-term disturbance of local communities, due to the increased dust, noise, and traffic. Impacts would be mitigated by the construction BMPs proposed in the Air Quality, Noise, and Traffic sections of this EIS. Some costs may increase for domestic water users in the areas, but the amount would vary by specific location and individual user.

4.22.3.3 Alternative C

Construction

Under Alternative C, impacts from constructing the RWS would be similar to that discussed under Alternative B. Short-term construction disturbance would occur on approximately 999 acres of surface in Settlement Pueblo boundaries and 141 acres of surface outside of Pueblo boundaries; therefore, the potential for disturbance would be slightly reduced. As under Alternative B, applying construction BMPs and project-specific mitigation measures would minimize impacts.

Although the total length of distribution pipeline, the location of storage tanks and pumping plants, as well as the location of the treatment plant vary from that proposed under Alternative B, general estimates of economic impacts for these project proponents would remain the same. This is because of the uncertainty of costs and project implementation. Under Alternative C, no supplemental water system of ASR wells would be required, thereby reducing overall capital costs and employment levels and secondary employment numbers and economic impacts.

Economic modeling indicates project activities would support 141 direct person-years employment and 208 person-years employment. Direct labor impacts are estimated at $10,962,200, and total value added is estimated at $16,769,700 (see **Table 4-54**, Economic Impacts-Construction, and **Appendix F**, Economic Impact Analysis Methodology).

Operation

Based on 8 direct employees for operating the water treatment plant, it is estimated that long-term project employment would support 18 annual person-years in Santa Fe County. This would result in $619,000 in direct labor income and $1,472,000 in total value added (see **Appendix F**, Economic Impact Analysis Methodology).

Connection to the RWS would result in potential impacts on residential property values, as discussed under Alternative B. Under Alternative C, 3 acres of private land would be required for permanent RWS facilities, comparably with 3 acres under Alternative B. Specific compensation amounts for these properties would be determined based on site-specific appraisal and market values.

As under Alternative B, fire hydrants would be tied into distribution lines, providing water available for fighting fires and helping to lower PPC ratings and control insurance costs.

Mitigation and Residual Impacts

Mitigation and residual impacts would be the same as those discussed under Alternative B.

4.22.3.4 Alternative D

Construction

Under Alternative D, impacts from constructing the RWS would be similar to that discussed under Alternative B. Alternative D would disturb approximately 1,002 acres of surface within Settlement Pueblo boundaries and 144 acres of surface outside of Pueblo boundaries.

Economic impacts would be the same as those discussed under Alternative C, due to similar costs for the water intake system.

Operation

Impacts would be similar to those described under Alternative C. Connection to the RWS would result in potential impacts on residential property values, as discussed under Alternative B. Under Alternative D, 4 acres of private land would be required for permanent RWS facilities, compared with 3 acres under Alternative B. Specific compensation amounts for these properties would be determined based on site-specific appraisal and market values.

Mitigation and Residual Impacts

Mitigation and residual impacts would be the same as those discussed under Alternative B.

4.22.3.5 Alternative E (Preferred Alternative)

Construction

Under Alternative E, impacts from constructing the RWS would be similar to that discussed under Alternative B. Alternative E would disturb approximately 743 acres of surface within Settlement Pueblo boundaries and 113 acres of surface outside of Pueblo boundaries. This represents the lowest level of disturbance of all the action alternatives.

Under Alternative E, Reclamation has proposed reducing labor and construction to 73.5 percent of the total estimated in the feasibility study. This is the result of delaying some project components in the short-term construction period analyzed here. Specifically, supplementary water transmission and distribution systems and associated structures would be constructed as needed to supply individuals and communities as they connect to the operational RWS. When constructed, these structures would represent additional economic contributions, as well as short-term construction impacts. Timing of this activity has not been determined, but it would likely occur following the initial construction period.

Economic modeling indicates project activities would support 111 direct person-years employment and 164 person-years employment during the short-term construction period. Direct labor impacts are estimated at $8,577,800, and total value added is estimated at $13,203,600 (see **Table 4-54**, Economic Impacts-Construction, and **Appendix F**, Economic Impact Analysis Methodology). As under Alternative C, no supplemental water system of ASR wells would be required; the estimates for costs of the distribution pipeline, short-term storage tanks, pumping plants, and treatment plant would remain the same as under Alternative B.

Operation

Impacts would be similar to those discussed under Alternatives C and D. Under Alternative E, fewer fire hydrants may be installed, depending on implementation costs. As a result, the distance to hydrants and water availability for communities may be affected, potentially increasing PPC ratings and resulting property insurance costs.

Connection to the RWS would result in potential impacts on residential property values, as discussed under Alternative B.

Mitigation and Residual Impacts

Mitigation and residual impacts would be the same as those discussed under Alternative B.

4.22.3.6 Summary of Impacts

Impacts from constructing the RWS and associated projects would result in short-term disturbance of local communities, due to increased dust, noise, and traffic. Impacts would be mitigated by construction BMPs.

Economic impacts from constructing the proposed action are the direct and indirect increases in jobs, income, and total value for the local economy. Alternative B, with the high ASR cost scenario, represents the largest contribution for the local economy. It would have a maximum of 9 percent increase in person-years construction employment, when total impacts over 2018 to 2024 are examined.

Alternatives C, D, and E would have reduced contributions to the local economy in terms of jobs supported and total value added. Total employment generated and economic impacts would vary by alternative only, due to water source collection method. This is because other project components were determined to represent similar costs across all alternatives. Under all action alternatives, economic sectors most likely to be affected are construction, retail gas station, clothing and other merchandise, restaurants, real estate, and hospitals.

Under all action alternatives, much of the workforce would likely be hired from the local population or would commute from surrounding areas. A minimal increase in area population is anticipated, so minimal impacts on area public services and housing availability and cost are expected.

Economic impacts from project operations would be reduced, as compared with project construction, due to the low level of permanent employment required. However, operating the RWS would support improved water quality and reliability, which could support long-term development potential in the area.

Costs for domestic water in the Santa Fe County non-Pueblo portion of the analysis area vary, due to such factors as the level of use and the depth of wells. As a result, connecting to the water system and paying Santa Fe County rates represents increased costs for residents; these costs would be variable. Costs for Settlement Pueblo residents would depend on the level that costs for connection to the water system would be passed along to individuals; these costs cannot be determined here.

The level of impacts on property values and related property taxes from connecting to the RWS remains unclear. Based on previous studies, changes in property values as a result of connection to a water system or as a result of improved water quality are likely to vary. Site-specific impacts on property values would occur as a result of temporary and long-term easements required on private lands for constructing and operating the RWS. Owners of affected property would be compensated for loss in value, in accordance with the requirements of the Uniform Act, based on appraisal and fair market value estimates.

Long term, the development of the RWS would improve water quality and reliability for all populations in the analysis area. As a result, the potential for water quality-related health problems is likely to decrease. Reliable water would support current sectors of development and traditional cultural values.

4.22.4 Rio Pojoaque Irrigation Improvement Project

4.22.4.1 Alternative RP-A—No Action

Under Alternative RP-A, No Action, the Rio Pojoaque irrigation improvement project would not be undertaken. Therefore, no additional construction and no direct or indirect impacts would occur on the local area economy.

Mitigation and Residual Impacts

No mitigation or residual impacts have been identified.

4.22.4.2 Impacts Common to All Action Alternatives

Construction

As discussed under the RWS, the short-term temporary impacts related to all action alternatives would be temporary changes to the quality of life, including increased traffic, noise, dust, and visual impacts. Impacts would also include temporary employment opportunities and related economic impacts. Due to the lack of project-specific information on costs and employee requirements, quantitative estimates for the number of employees and direct and indirect economic impacts from construction are not available.

Operation

As for project construction, due to the lack of project-specific detail on direct operational costs and employees, no quantitative analysis of direct and indirect impacts of project operations is available. It is unlikely that project operations would result in long-term employment opportunities or population changes.

Long-term impacts on the irrigation system under all action alternatives would include greater access to dependable subsistence and commercial agriculture. This would further support a traditional cultural use and would provide the potential for increased economic activity. The level of impacts would vary; this would depend on the quantity of water available, the number of users, and the level of agricultural products available for consumption or sale, which cannot be determined at this planning stage.

Mitigation and Residual Impacts

No mitigation or residual impacts have been identified.

4.22.4.3 Alternative RP-B

Impacts would be the same as those described under **Section 4.22.4.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No mitigation or residual impacts have been identified.

4.22.4.4 Alternative RP-C (Preferred Alternative)

Impacts would be the same as those described under **Section 4.22.4.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No mitigation or residual impacts have been identified.

4.22.4.5 Alternative RP-D

Impacts would be the same as those described under **Section 4.22.4.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No mitigation or residual impacts have been identified.

4.22.4.6 Alternative RP-E

Impacts would be the same as those described under **Section 4.22.4.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No mitigation or residual impacts have been identified.

4.22.4.7 Summary of Impacts

Under all action alternatives, short-term temporary impacts from construction would include temporary changes to the quality of life, such as increased traffic, noise, dust, and visual impacts. Impacts would also include temporary employment opportunities and related economic impacts.

Due to the lack of project-specific information on costs and employee requirements, quantitative estimates for the number of employees and direct and indirect economic impacts from construction are not available by alternative.

4.22.5 Rio Tesuque Channel Modification Project

4.22.5.1 Alternative RT-A—No Action

Under Alternative RT-A, No Action, the Rio Tesuque channel modification project would not be undertaken. As a result, no additional construction and no direct or indirect impacts would occur on the local area economy. Existing conditions of the river and infrastructure to store water would not be improved.

Mitigation and Residual Impacts

No mitigation or residual impacts have been identified.

4.22.5.2 Impacts Common to All Action Alternatives

Construction

As discussed under the RWS, short-term temporary impacts related to all action alternatives are the temporary changes to the quality of life, including increased traffic, noise, dust, and visual impacts. Impacts also include temporary employment opportunities and related economic impacts. Due to the lack of project-specific information on costs and employee requirements, quantitative estimates for the number of employees and direct and indirect economic impacts from construction are not available.

Operation

As for project construction, due to the lack of project-specific detail on direct operational costs and employees, no quantitative analysis of direct and indirect impacts of project operations is available. It is unlikely that project operations would result in long-term employment opportunities or population changes.

Under all action alternatives, management would aim to restore the Rio Tesuque and to improve water storage infrastructure. As such, project operation would help to maintain the traditional social setting of the analysis area. This would support traditional cultural practices of the Pueblo population.

Mitigation and Residual Impacts

No mitigation or residual impacts have been identified.

4.22.5.3 Alternative RT-B

Construction

Under Alternative RT-B, the Rio Tesuque channel modification project would allow flows in the Pueblo of Tesuque reach of the Rio Tesuque to infiltrate and recharge the alluvium along the riverbank.

Overall, a total direct cost of $200,000 is estimated for project construction (Reclamation 2016a). Spending and employment would result in additional indirect economic benefit to the local economy. Due to the lack of project-specific information on costs for individual project components and employee requirements, quantitative estimates are not available for the number of employees and indirect economic impacts from construction. As discussed under RWS impacts, a portion of direct and indirect spending would occur in the local community, but much would be spread through the county and the region.

Operation

As for project construction, due to the lack of project-specific detail on direct operational costs and employees, no quantitative analysis is available for direct and indirect impacts of project operations.

Mitigation and Residual Impacts

No mitigation or residual impacts have been identified.

4.22.5.4 Alternative RT-C

Under Alternative RT-C, a new channel would be excavated in the existing floodplain to the east of the current channel alignment in order to restore natural geomorphic processes and flow. Impacts would be similar to those discussed under Alternative RT-B and **Section 4.22.5.2**, Impacts Common to All Action Alternatives. Overall, a total direct cost of $210,000 is estimated for project construction (Reclamation 2016a). Quantitative estimates are not available for the number of employees and indirect economic impacts from construction.

Mitigation and Residual Impacts

No mitigation or residual impacts have been identified.

4.22.5.5 Alternative RT-D (Preferred Alternative)

Under Alternative RT-D, a sediment spoil pile would be removed in order to increase the capacity of the river to carry water and sediment during a high water flows. Impacts would be similar to those discussed under Alternative RT-B and **Section 4.22.5.2**, Impacts Common to All Action Alternatives, but at a lower level of intensity, due to the smaller scale of construction. Overall, a total direct cost of $43,000 is estimated for project construction (Reclamation 2016a). Quantitative estimates are not available for the number of employees and indirect economic impacts from construction.

Mitigation and Residual Impacts

No mitigation or residual impacts have been identified.

4.22.5.6 Alternative RT-E

Under Alternative RT-E, the Rio Tesuque channel modification project would construct an infiltration gallery upstream of the Upper Ponds Diversion Dam. Its purpose would be to collect water from the Rio Tesuque and transmit it to the Pueblo of Tesuque irrigation system. The goals of this alternative are to allow for low-flow collection so that water can be collected over an extended period of time and to minimize sediment delivery to the Pueblo of Tesuque irrigation ponds.

Impacts would be similar to those discussed under Alternative RT-B and **Section 4.22.5.2**, Impacts Common to All Action Alternatives, but at an increased scale, due to the larger construction effort. Overall, a total direct cost of $420,000 is estimated for project construction (Reclamation 2016a). Quantitative estimates are not available for the number of employees and indirect economic impacts from construction.

Mitigation and Residual Impacts

No mitigation or residual impacts have been identified.

4.22.5.7 Summary of Impacts

Under all action alternatives, short-term temporary impacts of construction would include temporary changes to the quality of life, including increased traffic, noise, dust, and visual impacts. Impacts would also include temporary employment opportunities and related economic impacts. Due to the lack of project-specific information on project component costs and employee requirements, quantitative estimates are not available for the number of employees and indirect economic impacts from construction. Impacts would vary based on the level and timing of construction employment. Based on initial project estimates, direct economic impacts would be highest under Alternative RT-E and lowest under Alternative RT-D, due to the scale of the proposed construction.

Due to the lack of project-specific detail on direct operational costs and employees, no quantitative analysis is available for direct and indirect impacts of project operations. In the long term, all action alternatives would help to maintain and improve the river

channel and water supply for the Pueblo of Tesuque, supporting the traditional social setting of the analysis area.

4.22.6 Pueblo de San Ildefonso Future Projects Alternatives

4.22.6.1 Alternative SI-A—No Action

Under the Alternative SI-A, No Action, no additional wastewater and water infrastructure projects would be completed. No additional construction or direct or indirect impacts would occur on the local area economy as a result. Existing conditions limiting the distribution of water and the wastewater system for the Pueblo de San Ildefonso would remain.

Mitigation and Residual Impacts

No mitigation or residual impacts have been identified.

4.22.6.2 Alternative SI-B—Proposed Wastewater and Water Infrastructure

The proposed Pueblo de San Ildefonso preliminary wastewater system design could affect socioeconomics. Direct and indirect impacts on these resources would be the same as those described above for the RWS project; however, direct and indirect impacts would be on a smaller scale than for the RWS project. This is because the project is of a smaller scale. Because the wastewater treatment building would completely contain any odor resulting from the treatment process, no odor impacts on nearby residences or other areas are anticipated.

Due to the lack of project-specific information on costs and the number of employees needed, quantitative estimates of direct and indirect economic impacts from construction are not available. It is likely that connecting to the wastewater system would increase costs for non-Pueblo members, both for the initial connection cost and in the form of monthly fees. Impacts would be determined at implementation. It is unknown whether Pueblo members would be charged a monthly fee.

Impacts of additional water-related infrastructure will be assessed when the details of that proposed infrastructure are developed.

Mitigation and Residual Impacts

Because project-specific information is lacking on costs and number of employees, mitigation and residual impacts cannot be determined at this time.

4.23 Environmental Justice

This section addresses potential impacts on environmental justice from actions associated with each alternative.

4.23.1 Impact Indicators

The indicator, as described in **Table 3-1**, used to analyze impacts on environmental justice is a disproportionately high and adverse human health or environmental impacts on minority and low-income populations.

4.23.2 Analysis Methods and Assumptions

As discussed in **Chapter 3**, all Settlement Pueblos and the non-Pueblo areas of Santa Fe County contain minority populations, based on CEQ definitions. In addition, of the key communities examined, all but the Tesuque CDP contained minority populations.

The poverty level for area populations was generally at or above the New Mexico comparison levels, with the exception of the Peak Place CDP, on the Pueblo of Tesuque, which was 10 percentage points higher than state levels. As a result, any activities in the analysis area would have the potential to directly or indirectly impact minority populations throughout the socioeconomic area of analysis and low-income populations on the Pueblo of Tesuque's Peak Place CDP.

4.23.3 RWS Alternatives

4.23.3.1 Alternative A—No Action

Under Alternative A, current concerns over impaired water quality would continue to impact minority and low-income populations in the socioeconomic area of analysis. This would be due to water quality issues from the use of groundwater for the domestic water supply (see also **Section 3.5**, Water Quality). Impaired water quality could result in exposure to trace elements, which may include arsenic and uranium, at levels exceeding federal and state standards (see **Section 3.21**, Solid and Hazardous Materials); there could be impacts on human health. In addition, water shortages are anticipated over the long term in the absence of a water system project. Water shortages could inhibit the ability of Settlement Pueblo communities to develop economic opportunities and bring in additional income.

Mitigation and Residual Impacts

No mitigation or residual impacts have been identified for Alternative A.

4.23.3.2 Alternative B—HKM Implementable

The short-term temporary impacts of construction dust, noise, and traffic, as discussed in **Section 4.22**, Socioeconomic Resources, may cause disproportionate adverse impacts on the minority and low-income populations in the analysis area. Using construction BMPs and project mitigation measures would minimize impacts on all, including minority and low-income populations.

Temporary impacts could occur on area populations from an influx of workers for project construction. As discussed in **Section 4.22**, proposed population increases would be minimal overall under the current construction schedule. In addition, impacts on low-income or minority populations from operating the water system and associated projects include increased economic opportunities in the form of jobs and direct and indirect spending, as discussed under **Section 4.22.3.2**, Alternative B—HKM Implementable. While the level at which jobs would be available for specific communities and populations cannot be determined at this time, these impacts would represent a benefit to local individuals and communities.

Public involvement for the RWS has included outreach and coordination with affected populations. There was extensive coordination with Settlement Pueblo leaders to

minimize impacts on community members (see full coordination and consolation records in **Chapter 5**, Consultation and Coordination). As a result, minority and low-income populations in the analysis area have had opportunities to provide input into the planning process, and modifications have been made to lessen impacts, such as phasing of development.

As noted in **Chapter 3** and under Alternative A, residents in the analysis area, including minority and low-income populations, currently use groundwater as the primary domestic water source. Concerns include water quality issues and long-term reliability. In the long term, connecting to the RWS may represent an increase in costs for domestic water, as detailed in **Section 4.22**, Socioeconomic Resources, and **Appendix F**, Economic Impact Analysis Methodology. However, the specific difference in cost, as compared with current conditions, would vary throughout the planning area and for individual users. In addition, for Pueblo communities, the costs passed on to individual users cannot be determined at this time. As a result of operating the RWS and associated projects, long-term improvements in water quality and reliability are anticipated for affected minority and low-income populations, supporting traditional cultural uses and values in the National Heritage Area; therefore, no disproportionate impacts are anticipated over the long term.

Mitigation and Residual Impacts

No specific mitigation measures are proposed for environmental justice impacts. Impacts from constructing the RWS and associated projects, in the short term, would disturb identified minority and low-income populations, due to increased dust, noise, and traffic. Impacts would be mitigated by using the construction BMPs proposed in the Air Quality, Noise, and Traffic sections of this EIS. Some costs may increase for domestic water users in the areas; however, the amount would vary by specific location and individual user.

4.23.3.3 Alternative C

Although the exact level of jobs created and the timing of development would vary slightly, impacts would generally be the same as those discussed under Alternative B.

Mitigation and Residual Impacts

Mitigation and residual impacts would be the same as those discussed under Alternative B.

4.23.3.4 Alternative D

Although the exact level of jobs created and the timing of development would vary slightly, impacts would generally be the same as those discussed under Alternative B.

Mitigation and Residual Impacts

Mitigation and residual impacts would be the same as those discussed under Alternative B.

4.23.3.5 Alternative E (Preferred Alternative)

Although the exact level of jobs created and the timing of development would vary slightly, impacts would generally be the same as those discussed under Alternative B.

Mitigation and Residual Impacts

Mitigation and residual impacts would be the same as those discussed under Alternative B.

4.23.3.6 Summary of Impacts

As discussed in **Chapter 3**, all populations and communities in the analysis area, with the exception of the Tesuque CDP, qualify as minority populations for environmental justice analysis, based on CEQ definitions. One low-income population was also identified.

Under Alternative A, current public health concerns for low-income or minority populations related to groundwater contamination would continue.

Under all action alternatives, short-term impacts from construction, including increased noise, dust, and traffic, may adversely impact the identified minority and low-income populations. Use of construction BMPs and mitigation measures would reduce impacts.

Employees required for construction would be found in the local population and from those relocating to the area. Construction employment would represent economic opportunities for all area residents, including minority and low-income populations. Long-term operation of the proposed water system is likely to result in minimal population changes and related impacts on low-income or minority populations. In the long term, operating the water system and associated projects would improve water quality and reliability. This would benefit identified minority and low-income populations and support traditional cultural uses and values in the National Heritage Area. In the long term, the cost of domestic water could change; however, impacts on individual users would vary.

4.23.4 Rio Pojoaque Irrigation Improvement Project

4.23.4.1 Alternative RP-A—No Action

Under Alternative RP-A, No Action, the Rio Pojoaque irrigation improvement project would not be undertaken. As a result, there would be no additional construction. Existing conditions would still limit the collection of irrigation water, with potential indirect impacts for the Pueblo de San Ildefonso and minority populations in the area

Mitigation and Residual Impacts

No mitigation or residual impacts have been identified.

4.23.4.2 Impacts Common to All Action Alternatives

Construction

As discussed under the RWS, short-term temporary impacts under all action alternatives would be the temporary changes to the quality of life, including increased traffic, noise, dust, and visual impacts. Impacts also include temporary employment opportunities and related economic impacts for all populations, including minority populations. Due to the lack of project-specific information on costs and employee requirements, no quantitative estimates are available for the number of employees and direct and indirect economic

impacts from construction. No disproportionate adverse impacts are anticipated over the long term for identified minority populations.

Operation

As for project construction, due to the lack of project-specific detail on direct operational costs and employees, no quantitative analysis of direct and indirect impacts of project operations is available. It is unlikely that project operations would result in long-term employment opportunities or population changes. No disproportionate adverse impacts are anticipated over the long term for identified minority populations.

In the long term impacts on the irrigation system under all action alternatives would include greater access to dependable subsistence and commercial agriculture. This would further support a traditional cultural use and would provide the potential for increased economic activity for the identified minority populations on the Pueblo de San Ildefonso. The level of impacts would vary, depending on the quantity of water available, the number of users, and the level of agricultural products available for consumption or sale. These numbers cannot be determined at this planning stage. No disproportionate adverse impacts are anticipated over the long term.

Mitigation and Residual Impacts

No mitigation or residual impacts have been identified.

4.23.4.3 Alternative RP-B

Impacts would be the same as those described under **Section 4.23.4.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No mitigation or residual impacts have been identified.

4.23.4.4 Alternative RP-C (Preferred Alternative)

Impacts would be the same as those described under **Section 4.23.4.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No mitigation or residual impacts have been identified.

4.23.4.5 Alternative RP-D

Impacts would be the same as those described under **Section 4.23.4.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No mitigation or residual impacts have been identified.

4.23.4.6 Alternative RP-E

Impacts would be the same as those described under **Section 4.23.4.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No mitigation or residual impacts have been identified.

4.23.4.7 Summary of Impacts

Under all action alternatives, short-term temporary impacts from construction would be temporary changes to the quality of life for all populations, including minority populations, from increased traffic, noise, dust, and visual impacts. Impacts also include temporary employment opportunities and related economic impacts.

Due to the lack of project-specific information on costs and employee requirements, quantitative estimates for the number of employees and direct and indirect economic impacts from construction are not available by alternative. In the long term, all action alternatives would help provide greater access to irrigation waters, which would support the traditional agricultural uses of the analysis area, along with cultural practices of the Pueblo members. No disproportionate impacts are anticipated over the long term for identified low-income or minority populations.

4.23.5 Rio Tesuque Channel Modification Project

4.23.5.1 Alternative RT-A—No Action

Under Alternative RT-A, the Rio Tesuque channel modification project would not be undertaken. Existing conditions of the river and infrastructure to store water would not be improved. As a result, indirect impacts could occur on minority or low-income populations from water shortages.

Mitigation and Residual Impacts

No mitigation or residual impacts have been identified.

4.23.5.2 Impacts Common to All Action Alternatives

Construction

As discussed under the RWS, short-term temporary impacts related to all action alternatives are temporary changes to the quality of life, including increased traffic, noise, dust, and visual impacts. Impacts also include temporary employment opportunities and related economic impacts for all, including minority populations. Due to the lack of project-specific information on costs and employee requirements, quantitative estimates for the number of employees and direct and indirect economic impacts from construction are not available. No disproportionate adverse impacts are anticipated over the long term for identified minority populations.

Operation

Due to the lack of project-specific detail on direct operational costs and employees, no quantitative analysis of direct and indirect impacts of project operations is available. It is unlikely that project operations would result in long-term employment opportunities or population changes. No disproportionate adverse impacts are anticipated over the long term for identified minority populations.

Under all action alternatives, management would aim to restore the Rio Tesuque and to improve infrastructure used to store water. As such, operation of this project would help to maintain the traditional social setting of the analysis area, supporting traditional cultural practices of the Pueblo population.

Mitigation and Residual Impacts

No mitigation or residual impacts have been identified.

4.23.5.3 Alternative RT-B

Impacts would be the same as those described under **Section 4.23.5.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No mitigation or residual impacts have been identified.

4.23.5.4 Alternative RT-C

Impacts would be the same as those described under **Section 4.23.5.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No mitigation or residual impacts have been identified.

4.23.5.5 Alternative RT-D (Preferred Alternative)

Impacts would be the same as those described under **Section 4.23.5.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No mitigation or residual impacts have been identified.

4.23.5.6 Alternative RT-E

Impacts would be the same as those described under **Section 4.23.5.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No mitigation or residual impacts have been identified.

4.23.5.7 Summary of Impacts

Under all action alternatives, short-term impacts of construction are temporary changes to the quality of life for identified minority and low-income populations, including increased traffic, noise, dust, and visual impacts. Impacts also include temporary employment opportunities and related economic impacts. Due to the lack of project-specific information on specific project component costs and employee requirements, quantitative estimates are not available for the number of employees and indirect economic impacts from construction. Impacts would vary, based on the level and timing of construction employment.

Due to the lack of project-specific detail on direct operational costs and employees, no quantitative analysis is available for direct and indirect impacts of project operations. In the long term, all action alternatives would help to maintain and improve the river channel and water supply for Pueblo of Tesuque, supporting the traditional social setting of the analysis area, along with cultural practices of the Pueblo population. No disproportionate impacts are anticipated over the long term for identified low-income or minority populations.

4.23.6 Pueblo de San Ildefonso Future Projects Alternatives

4.23.6.1 Alternative SI-A—No Action

Under Alternative SI-A, No Action, no additional wastewater and water infrastructure projects would be completed. Existing conditions limiting the distribution of water and the wastewater system for the Pueblo de San Ildefonso would remain. As a result, indirect impacts could occur on minority or low-income populations from impaired water quality or lack of access to water.

Mitigation and Residual Impacts

No mitigation and residual impacts have been identified.

4.23.6.2 Alternative SI-B—Proposed Wastewater and Water Infrastructure

Direct and indirect impacts of the proposed Pueblo de San Ildefonso wastewater system improvements would be the same as those described above for the RWS project; however, direct and indirect impacts would be on a smaller scale than for the RWS project. This is because the project's direct short-term impacts would affect only 59 acres.

Impacts from this project would differ for Pueblo and non-Pueblo members. Pueblo members would see long-term, disproportionate beneficial impacts, due to the connection to a sanitary sewer system. For non-Pueblo members, there would likely be costs for connecting to the system in the form of monthly fees.

Impacts of additional water-related infrastructure will be assessed when the details of that proposed infrastructure are developed.

Mitigation and Residual Impacts

Due to the lack of project-specific information, mitigation and residual impacts cannot be determined at this time.

4.24 Energy and Utilities

This section summarizes the energy generation and consumption in the Pojoaque Basin and the projected loads from each RWS alternative. The Rio Pojoaque irrigation improvement project and Rio Tesuque channel modification project would have no long-term operational energy requirements. The Pueblo de San Ildefonso future projects are still in the early stages of design and load projections; therefore, its energy sources, including the use of possible renewables, has yet to be determined.

4.24.1 Impact Indicators

The indicator used to analyze impacts on energy availability and area utilities is the peak power load (**Table 3-1)**.

4.24.2 Analysis Methods and Assumptions

The area of analysis for direct and indirect impacts on energy and utilities, and use of these resources in particular, is the general project area, which includes the RWS, Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and the Pueblo de San Ildefonso future projects. The consumption of energy in the general project area would increase under each RWS action alternative—and under the Pueblo de San Ildefonso future projects—and could impact the functioning of the overall utilities system.

4.24.3 RWS Alternatives

4.24.3.1 Alternative A—No Action

Under Alternative A, area residents would continue to be served by JMEC, Tri-State, PNM and NMGC, with no anticipated changes to the electrical distribution grid or natural gas system in the general project area.

Mitigation and Residual Impacts

There would be no mitigation or residual impacts associated with Alternative A.

4.24.3.2 Impacts Common to All Action Alternatives

Under all action alternatives, the proposed RWS would require the use of Pueblo land on the four Settlement Pueblos, and possibly privately owned land, for easements and ROWs associated with electrical distribution lines and other RWS infrastructure. These facilities would require power from electrical utilities for proper functioning, with potential loads varying by action alternative.

Short-term construction-related impacts on the utility system would be minimal under all action alternatives, with most energy usage not related to JMEC or PNM and instead supplied by generators or other discrete localized power sources. Long-term impacts on the utility network and energy usage would come from any potential system upgrades that may be necessary to accommodate the increase in peak power load on the relevant PNM and JMEC circuits from facilities operations.

Increases in peak power loads from the action alternatives, however, would be distributed across the four JMEC and PNM circuits serving the general project area, thereby minimizing the impact on any individual component of the utility system. Additional long-term impacts from alternatives with proposed solar generation (or the potential for solar generation [Alternatives C, D, and E]) would come from the upgrades potentially required in the system. This is because distributed energy resources (solar generation) at RWS facilities could introduce issues with reverse-flow loading and voltage control in the electrical grid.

Introducing other distributed energy resources across the general project area is on-going, albeit limited, and JMEC and PNM are already adapting their utility system to respond to these resources, thereby minimizing the potential for impacts from the action alternatives on energy use and the network.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementation of any of the action alternatives. No mitigation has been identified.

4.24.3.3 Alternative B—HKM Implementable

Under Alternative B, approximately 14.7 miles of new electrical distribution lines would be constructed to reach RWS facilities. The estimated electricity load would be approximately 4,215 kVA (3,372 kW). This alternative does not include any distributed generation or opportunities for renewable energy. Direct and indirect impacts would be the same as those described under **Section 4.24.3.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementation of any of the action alternatives. No mitigation has been identified.

4.24.3.4 Alternative C

Under Alternative C, approximately 7 miles of new electrical distribution lines would be constructed to reach RWS facilities. The estimated electricity load would be approximately 2,995 kVA (2,396 kW). This alternative would be supplemented by solar-distributed generation. Direct and indirect impacts would be the same as those described under **Section 4.24.3.2**.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementation of any of the action alternatives. No mitigation has been identified.

4.24.3.5 Alternative D

Under Alternative D, approximately 7 miles of new electrical distribution lines would be constructed to reach RWS facilities. The estimated electricity load would be approximately 2,875 kVA (2,300 kW). This alternative includes solar-ready facilities with small solar-distributed generation for nonessential functions. Direct and indirect impacts would be the same as those described under **Section 4.24.3.2**.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementation of any of the action alternatives. No mitigation has been identified.

4.24.3.6 Alternative E (Preferred Alternative)

Under Alternative E, approximately 7 miles of new electrical distribution lines would be constructed to reach RWS facilities. The estimated electricity load would be approximately 2,865 kVA (2,292 kW). This alternative includes solar-ready facilities with small solar-distributed generation for nonessential functions. Direct and indirect impacts would be the same as those described under **Section 4.24.3.2**.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementation of any of the action alternatives. No mitigation has been identified.

4.24.3.7 Summary of Impacts

The action alternatives would have some potential impacts on the utility system and energy use in the general project area if upgrades to the electrical grid are required to accommodate the increased peak power load from RWS facilities operations. Further, there would be the potential for impacts from the alternatives with proposed solar generation (or the potential for solar generation)—Alternatives C, D, and E—as those RWS-related distributed energy resources could introduce issues with reverse-flow loading and voltage control in the electrical grid.

4.24.4 Rio Pojoaque Irrigation Improvement Project

4.24.4.1 Alternative RP-A—No Action

Under Alternative RP-A, No Action, the Rio Pojoaque irrigation improvement project would not be completed. The objectives of the project described in **Section 1.4** would not be realized. There would be no impacts on energy use or utilities systems.

Mitigation and Residual Impacts

There would be no mitigation or residual impacts associated with Alternative RP-A, No Action.

4.24.4.2 Impacts Common to All Action Alternatives

Under all action alternatives, the proposed Rio Pojoaque irrigation improvement project would not require energy use for operation and would therefore have no long-term impacts on utilities systems. Short-term construction-related impacts on the utility system would be minimal with most energy usage not related to JMEC or PNM and instead supplied by generators or other discrete localized power sources.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementation of any of the action alternatives. No mitigation has been identified.

4.24.4.3 Alternative RP-B

Direct and indirect impacts for the Rio Pojoaque irrigation improvement project would be the same as those described in **Section 4.24.4.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementation of any of the action alternatives. No mitigation has been identified.

4.24.4.4 Alternative RP-C (Preferred Alternative)

Direct and indirect impacts for the Rio Pojoaque irrigation improvement project would be the same as those described in **Section 4.24.4.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementation of any of the action alternatives. No mitigation has been identified

4.24.4.5 Alternative RP-D

Direct and indirect impacts for the Rio Pojoaque irrigation improvement project would be the same as those described in **Section 4.24.4.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementation of any of the action alternatives. No mitigation has been identified.

4.24.4.6 Alternative RP-E

Direct and indirect impacts for the Rio Pojoaque irrigation improvement project would be the same as those described in **Section 4.24.4.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementation of any of the action alternatives. No mitigations have been identified.

4.24.4.7 Summary of Impacts

The Rio Pojoaque irrigation improvement project would have minimal short-term impacts on the utility system with most energy usage not related to JMEC or PNM and instead supplied by generators or other discrete localized power sources. Facilities operations would have no long-term impacts on energy use or utilities systems.

4.24.5 Rio Tesuque Channel Modification Project

4.24.5.1 Alternative RT-A—No Action

Under Alternative RT-A, No Action, the Rio Tesuque channel modification project would not be completed. The objectives of the project described in **Section 1.4** would not be realized. There would be no impacts on energy use or utilities systems.

Mitigation and Residual Impacts

There would be no mitigation or residual impacts associated with Alternative RT-A.

4.24.5.2 Impacts Common to All Action Alternatives

Under all action alternatives, the proposed Rio Tesuque channel modification project would not require energy use for operation and would therefore have no long-term impacts on utilities systems. Short-term construction-related impacts on the utility system would be minimal with most energy usage not related to JMEC or PNM and instead supplied by generators or other discrete localized power sources.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementation of any of the action alternatives. No mitigation has been identified.

4.24.5.3 Alternative RT-B

Direct and indirect impacts for the Rio Tesuque channel modification project would be the same as those described in **Section 4.24.5.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementation of any of the action alternatives. No mitigation has been identified.

4.24.5.4 Alternative RT-C

Direct and indirect impacts for the Rio Tesuque channel modification project would be the same as those described in **Section 4.24.5.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementation of any of the action alternatives. No mitigation has been identified.

4.24.5.5 Alternative RT-D (Preferred Alternative)

Direct and indirect impacts for the Rio Tesuque channel modification project would be the same as those described in **Section 4.24.5.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementation of any of the action alternatives. No mitigation has been identified.

4.24.5.6 Alternative RT-E

Direct and indirect impacts for the Rio Tesuque channel modification project would be the same as those described in **Section 4.24.5.2**, Impacts Common to All Action Alternatives.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementation of any of the action alternatives. No mitigation has been identified.

4.24.5.7 Summary of Impacts

The Rio Tesuque channel modification project would have minimal short-term impacts on the utility system with most energy usage not related to JMEC or PNM and instead supplied by generators or other discrete localized power sources. Facilities operations would have no long-term impacts on energy use or utilities systems.

4.24.6 Pueblo de San Ildefonso Future Projects Alternatives

4.24.6.1 Alternative SI-A—No Action

Under the Alternative SI-A, No Action, the Pueblo de San Ildefonso future projects would not be constructed. The objectives of the project described in **Section 1.4** would not be realized. There would be no new construction of facilities requiring the use of Pueblo land for easements or ROWs, and no resulting potential direct or indirect impacts on energy use or utilities systems.

Mitigation and Residual Impacts

There would be no mitigation or residual impacts associated with Alternative SI-A, No Action.

4.24.6.2 Alternative SI-B—Proposed Wastewater and Water Infrastructure

The Pueblo de San Ildefonso wastewater system improvements and other water-related infrastructure projects would require the use of Pueblo land for constructing or expanding wastewater facilities and other infrastructure. These facilities would require power from electrical utilities for proper functioning.

Short-term construction-related impacts on the utility system would be minimal with most energy usage not related to JMEC or PNM and instead supplied by generators or other discrete localized power sources. Long-term impacts on the utility network and energy usage would come from any potential system upgrades that may be necessary to accommodate the increase in peak power load on the relevant JMEC circuits from wastewater facilities operations. Increases in peak power loads from the Pueblo de San Ildefonso future projects, however, could be distributed across multiple JMEC circuits serving the project area, thereby minimizing the impact on any individual component of the utility system.

Mitigation and Residual Impacts

No residual impacts are anticipated from implementation of the proposed wastewater and water infrastructure. No mitigation has been identified.

4.25 Cumulative Impacts

The CEQ defines a cumulative impact as "the impact on the environment that results from the incremental impact of [an] action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or nonfederal) or person undertakes such other actions" (40 CFR, Subpart 1508.7). The assessments summarized in this section place the direct and indirect impacts of the alternatives, presented in the preceding **Chapter 4**, into a broader context.

The cumulative impacts area of analysis is Santa Fe County and neighboring areas. This area was selected because it includes actions that could impact the Rio Grande watershed in conjunction with the RWS, Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and Pueblo de San Ildefonso future projects. This general area of analysis applies to all resources, unless an alternate area of analysis is provided.

Past and present (ongoing) actions in the general project area have been accounted for in the baseline conditions described for each resource in **Chapter 3**. Ongoing and reasonably foreseeable future actions considered in the cumulative impact analysis include the projects, programs, and plans of various federal agencies and other entities, as described in **Table 4-57**, below. Many of these actions reflect shared management objectives and cooperation among federal and state agencies, American Indian Tribes, and stakeholder groups. These are intended to facilitate stronger influence on and efficient management of the resources in the general project area.

Relevant projects with a medium to high potential to contribute to the RWS, Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and Pueblo de San Ildefonso future projects were included in the table. The designations refer to the potential of the action to contribute negative or positive impacts that may be relevant to assessing the cumulative impact scenario. It is not an assessment of the intensity of impacts. Project information was gathered from the following sources: Reclamation, City of Santa Fe, Santa Fe County, Los Alamos County, BIA, IHS, Northern Pueblos Housing Authority, the Settlement Pueblos, USACE, FEMA, U.S. Forest Service, and the BLM.

Cumulative impacts can result from individually minor, but collectively significant actions taking place over time. The following cumulative impacts analysis includes impacts from all proposed projects, in addition to those described in **Table 4-57**. The cumulative impacts discussions are organized by the resources discussed in **Chapters 3** and **4**.

4.25.1 Surface Water

4.25.1.1 No Action Alternatives

The Los Alamos County future groundwater fields at White Rock Canyon would deplete Rio Grande flows approximately 6.6 miles downstream of the Otowi Bridge. While Los Alamos County is outside of the general project area, this project is included in this cumulative analysis due to its potential impacts on Rio Grande flows above Cochiti Reservoir. The potential depletion from the development of the White Rock Canyon

Table 4-57. Potential Affecting Factors Associated with Past, Present, and Reasonably Foreseeable Future Actions and Basin-Wide Trends

Cumulative Projects	Summary Information
BDD Project	The BDD provides a safe, reliable, and sustainable source of excellent drinking water for the City of Santa Fe and Santa Fe County and between 450 and 600 afy of raw river water to a residential/golf development called Las Campanas. The BDD improves the regional water supply under drought conditions, replaces current groundwater pumping that cannot be sustained long-term, and makes a drought reserve possible. It also improves day-to-day base-load or peaking capacity, reliability, and redundancy to the existing water systems. Ongoing projects include NEPA-required habitat restoration and operation of BDD-dedicated solar power facilities. Possible future BDD-related projects being evaluated by the City or County may include some form of wastewater reuse or ASR wells. ASR wells may receive surplus water from the BDD or may use treated wastewater from the City of Santa Fe's wastewater treatment plant.[3,4]
Los Alamos County, Department of Public Utilities: San Juan-Chama Water Utilization (40-year water plan); fiscal year 2018 to fiscal year 25	The Department of Public Utilities received approval from its Board of Public Utilities to explore the viability of drilling one to three groundwater wells along the edge of White Rock Canyon to capture groundwater flowing into the Rio Grande. Water would then be conveyed through pipelines in White Rock and tied into the White Rock distribution system. The water would be disinfected at the wellhead, thus avoiding costs for a water treatment plant. To offset the captured groundwater, surface water from the County's stored share of San Juan-Chama Project water would be released into the Rio Grande. This project is on hold while the County negotiates with Department of Energy on the 40-year water plan. The environmental analysis is expected to commence in fiscal year 2018, and the project, if permitted, would be constructed by fiscal year 2025.[5]
IHS Pueblo of Tesuque Sewer Main Rehabilitation	Project scope is to rehabilitate or replace sewer mains on the Pueblo of Tesuque.

[3] Rick Carpenter, Water Resources and Conservation Manager, City of Santa Fe, personal communications with Nicholas Parker, EMPSi, February 2, 2016.
[4] Kyle Harwood, Consultant for the Buckman Direct Diversion, personal communications with Nicholas Parker, EMPSi, February 2, 2016.
[5] Jack Richardson, Los Alamos County Department of Public Utilities Project Manager, personal communications with Nicholas Parker, EMPSi, February 2, 2016.

Table 4-57. Potential Affecting Factors Associated with Past, Present, and Reasonably Foreseeable Future Actions and Basin-Wide Trends (cont.)

Cumulative Projects	Summary Information
IHS Tesuque Housing water lines associated with new Department of Housing and Urban Development (HUD) housing subdivision	Project scope is to provide individual hookups and septic for isolated housing on the Pueblo of Tesuque. Twenty-three new housing units will be constructed by end of summer 2016. All new units will be integrated into the Pueblo of Tesuque's water system.
San Ildefonso, Phased Housing 2016-2026	The Pueblo de San Ildefonso, with primary funding from the HUD and oversight from the Northern Pueblos Housing Authority, is planning to construct 12 new units over the next 5 years and another 12 units within 10 years. The 24 new housing units will tie into the Pueblo's water system.[6]
Pueblo de San Ildefonso Wastewater Systems Improvement Project	The Pueblo de San Ildefonso owns and operates three wastewater systems within its boundaries. Due to concern about the contamination of the groundwater from septic tank effluent, it is reasonably foreseeable that the Pueblo de San Ildefonso will expand the collection, treatment, and discharge system for its Northwest and Northeast Service Areas.
Pueblo de San Ildefonso Road and Utility Project	The Pueblo de San Ildefonso plans to construct a road in the vicinity of El Rancho. The Pueblo also plans to install natural gas pipeline, fiber optic line, and wastewater pipeline along the road and in other areas throughout the Pueblo.
IHS Pojoaque White Sands Project, Phase 3: Categorical Exclusion Under construction for past 5 years—no completion date known	This will provide community water and wastewater facilities for White Sands Phase 3's 26 homes. Water will be provided via an 8-inch-diameter PVC water main extension. Wastewater will be collected via an 8-inch-diameter gravity sewer main, treated by an Advantex treatment system, and then discharged to a drip irrigation system.[7]
Santa Fe National Forest Permit Renewal: City of Santa Fe Water System	The City of Santa Fe has requested that the U.S. Forest Service issue a new permit so it can continue to operate its municipal water supply system. The current permit was issued in 1995 and expired December 31, 2015. The City of Santa Fe is currently working with the Santa Fe National Forest on renewing this permit.[8]

[6] Scott Beckman, Northern Pueblos Housing Authority, personal communications with Nicholas Parker, EMPSi, January 20, 2016.
[7] Christen Glime, Engineer with IHS, personal communications with Nicholas Parker, EMPSi, January 20, 2016.
[8] Rick Carpenter, Water Resources and Conservation Manager, City of Santa Fe, personal communications with Nicholas Parker, EMPSi, February 2, 2016.

Table 4-57. Potential Affecting Factors Associated with Past, Present, and Reasonably Foreseeable Future Actions and Basin-Wide Trends (cont.)

Cumulative Projects	Summary Information
Española Valley, Rio Grande, and Tributaries Feasibility Study and Environmental Assessment: Finding of no significant impact expected soon	The Pueblos of Ohkay Owingeh and Santa Clara and the Pueblo de San Ildefonso, in partnership with USACE, are conducting this feasibility study to identify and define ecological degradation, flood risk management, and incidental passive recreation resource problems and to develop solutions to rehabilitate the riparian environment, minimize flood risk, increase human safety, and improve passive recreation.
Rio Nambé Debris Flow Barriers and Sediment Removal	The USACE and the Pueblo of Nambé Environment Department are evaluating an application for the Rio Nambé debris flow barriers on the Pueblo of Nambé. This project would impact approximately 3.1 acres, or 615 linear feet, of Waters of the U.S. in the Rio Nambé. FEMA is the federal funding agency for the proposed project and is also funding the removal of sediment from Nambé Falls Reservoir. The reservoir provides water for municipal and irrigation use in the Pojoaque Valley Irrigation District.
Verde Transmission Line	Verde Transmission, LLC, is developing the Verde Transmission Project, a proposed approximately 30-mile-long, 345 kilovolt transmission line in southern Rio Arriba County and Santa Fe County, New Mexico. The project would interconnect the existing Public Service Company of New Mexico Ojo station on the north to the existing Public Service Company of New Mexico Norton station on the south.

Sources: FEMA 2015; Hunt Power 2015; Santa Fe County 2016; USACE 2015, 2016; Forest Service 2016

groundwater fields will be required to be mitigated by use of Los Alamos County's San Juan-Chama contract flows, which would pass through the general project area (and under the Otowi Bridge), and could alter the flow regime.

The Española Valley, Rio Grande, and Tributaries Flood Risk Management and Ecosystem Restoration Project proposes to restore 256 acres of the floodplain on the Pueblo of Ohkay Owingeh and the Pueblo of Santa Clara (USACE 2015). This project would impact the floodplains, overbank flooding, and geomorphology of these upstream river reaches. No long-term impacts on the flows downstream of this reach are anticipated. This project would influence the deposition of coarser suspended sediment. The feasibility study preparers could not estimate the potential impacts of sediment transport on downstream reach, due to modeling limitations (Reclamation 2015a). They concluded that there would be no major risks in sediment, because no change in flows are anticipated and because of the relative stability in the reaches over the past few decades. Construction of the project could have short-term impacts on sediment transport.

The Pueblo of Nambé, USACE, and FEMA have planned a project to dredge the Nambé Falls Reservoir and install debris flow barriers in the upstream contributing drainage. The reservoir, constructed in 1976, had captured sediment, filling 106 af of storage capacity by 2004. Flooding in September 2013 increased sediment in the reservoir. The project would restore this lost storage capacity.

Upstream of the reservoir, sediment and debris-capture BMPs would improve future sediment management of the reservoir. Short-term sediment may become entrained in reservoir releases, depending on the implemented dredging approach. Long-term geomorphologic impacts downstream of the reservoir are not expected to differ from past impacts under this project.

Under Alternative A, new sources of water from the Top of the World water rights may not be brought into the Rio Grande above Otowi. Flows in the Rio Grande at Otowi would be influenced by San Juan-Chama operations and depletions from groundwater, with the RWS contract for San Juan-Chama reallocated to other uses. The annual flows resulting from the San Juan-Chama contracts at Otowi generally remain the same as with the project.

Without the RWS project, water demands would continue to be met with groundwater pumping from private wells. The future water demands would increase depletions of surface water in the Pojoaque Basin. Similar impacts could occur if the Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and Pueblo de San Ildefonso future projects were not implemented.

4.25.1.2 Impacts Common to All Action Alternatives

Implementation of the RWS, Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and Pueblo de San Ildefonso future projects would fit with the theme of other regional projects, such as the BDD. For example, the RWS would improve the Rio Grande and tributary surface flows upstream of the project surface diversion location by transferring existing and future demands from groundwater to surface water supplies derived from new sources or imported water. The RWS project, depending on alternative, could change the timing of when water from the new or imported sources enters the reach above the Otowi Bridge. Implementing the RWS project would not result in cumulative changes to the annual flows below the Otowi Bridge (INTERA 2016a).

4.25.2 Groundwater

4.25.2.1 No Action Alternatives

For the Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and Pueblo de San Ildefonso future projects, no changes to groundwater are anticipated under the No Action Alternatives.

For the RWS, under Alternative A, groundwater would continue to be the source of water in the Pojoaque Basin service area. Future groundwater levels may decrease from 1 to 82 feet from current conditions (Balleau 2003). This, in turn, could affect the water availability in 64 of the existing Rio Pojoaque wells, because drawdowns may decline below the drilled depth of the wells.

4.25.2.2 Impacts Common to All Action Alternatives

The RWS would transfer portions of the existing and future water demands in the service area from groundwater to surface water. Groundwater use in the service area is projected to decline by up to 1,884 afy after full project buildout of the RWS. Groundwater levels are projected to increase on average of 3 feet up to 28 after full buildout of the RWS. Groundwater use depleting surface water resources is likewise projected to be reduced. No data on groundwater level changes are available for the Pueblo de San Ildefonso future projects due to its early planning stages. The Rio Pojoaque irrigation improvement project and Rio Tesuque channel modification project may have minor impacts on groundwater due to potential changes to river seepage, depending on the alternative implemented. Increased groundwater levels as a result of the RWS could also help achieve the goals of these two projects.

4.25.3 Water Quality

4.25.3.1 No Action Alternatives

All of the Settlement Pueblos have current or planned wastewater projects, as follows:

- The Pueblo of Nambé has developed three lagoon systems, with a fourth lagoon planned (**Appendix I**).
- The Pueblo of Tesuque is undertaking a project to rehabilitate the sewer mains servicing the Tesuque Trailer Village, with a population of 400 (NMED 2016). It has also scoped septic systems for a future housing development that would have a population of 500.
- The Pueblo of Pojoaque has been constructing a wastewater system for the White Sands Phase 3 Project, serving a population of 1,907.
- The Pueblo de San Ildefonso is developing integrated water systems for phased future housing development. The first phase is constructing 12 housing units for a population of 50; up to 24 new housing units are projected over the next 10 years.

These projects would contribute to the improvement of water quality on the Settlement Pueblos.

Under the RWS and Pueblo de San Ildefonso future projects No Action Alternatives, drinking water would continue to come from existing wells; the quality of this drinking water varies, depending on location and depth. Future area demands would increase groundwater use, depleting surface water resources. In-stream water quality could be degraded with reduced surface water flows.

For the Rio Pojoaque irrigation improvement project and Rio Tesuque channel modification project, no changes to water quality are anticipated under the No Action Alternatives.

4.25.3.2 Impacts Common to All Action Alternatives

The impacts on water quality from the planned wastewater projects on the Settlement Pueblos would occur under the action alternatives. These projects would collectively contribute to improving the quality of water in the area of analysis.

Implementing the RWS and Pueblo de San Ildefonso future projects would result in consistent drinking water quality in the service area. Results from the RWS pilot water treatment plant study (Reclamation 2016b) indicate that expected finished water quality would exceed the overall water quality of the existing well-produced water.

The expected reduction in groundwater use in the service area and the introduction of new native Rio Grande surface waters would result in increased surface water flows. This, in conjunction with existing and planned wastewater systems, could maintain water quality in Rio Pojoaque watercourses, compared with current conditions.

The short- and long-term impacts from the other cumulative projects described under the No Action Alternative would occur under all action alternatives. There would likely be short-term sediment impacts from project construction, but there would likely be no long-term impacts.

Short-term construction impacts from the RWS, Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and Pueblo de San Ildefonso future projects could distribute soils and contribute to increased sediment transport. This sediment transport could be cumulative with other simultaneous construction projects. Long-term, near-bank stress may increase, due to project facilities, such as the RWS primary source water collection facility and arroyo crossings of pipelines or buried electrical lines. This near-bank stress would be mitigated with riprap or other approaches to limit stream scour and bank erosion.

4.25.4 Geology and Soils

4.25.4.1 No Action Alternatives

Potential short- and long-term impacts from the projects listed in **Table 4-57** could disturb sensitive soils. Project-related activities would disturb surface areas containing these soils during the construction of facilities and by the physical presence of project facilities overlying these soils. During the short term, construction would expose erosive soils to wind and water as a result of the intentional or incidental removal of vegetation during site clearing. Eroded soils would be transported from their present location, and their loss may inhibit the remediation of disturbed areas and post-construction revegetation efforts. Other possible impacts on soils from the other cumulative projects include potential erosion at other locations or inundation outside their project areas during major storms.

The potential changes in geological characteristics from the other cumulative projects that influence geologic hazards risks are largely unknown at this time. While certain construction activities may increase the risk of geologic hazards, the extent of the risk is subject to factors that are unknown at this time.

Under the various No Action Alternatives, facilities would not be constructed, and there would be no impacts on geology and soil. Therefore, the RWS, Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and Pueblo de San Ildefonso future projects would not contribute to potential cumulative impacts on geology and soils under the No Action Alternatives.

4.25.4.2 Impacts Common to All Action Alternatives

The same impacts from the other cumulative projects described under the no action alternatives could occur under the action alternatives, including disturbing sensitive soils. The potential changes to geological characteristics from these projects are unknown at this time.

Impacts on soils resulting from the RWS—and potentially from the Pueblo de San Ildefonso future projects alternatives—would include both short-term and long-term disturbance to sensitive soils. This is because project-related activities would disturb surface areas containing these soils during the construction of project facilities. The project facilities overlying these soils also would disturb them. During the short term, construction-related activities would expose erosive soils to wind and water, as a result of the intentional or incidental removal of vegetation during site clearing for RWS and Pueblo de San Ildefonso future projects facilities. Construction of the Rio Pojoaque irrigation improvement project and Rio Tesuque channel modification project may also result in short-term impacts on sensitive soils.

The RWS, Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and Pueblo de San Ildefonso future projects would include efforts to mitigate overall disturbance of soils and to restore areas disturbed during the construction phase; therefore, the proposed projects would negligibly contribute to the cumulative impacts on soils in the area of analysis.

The potential changes in geological characteristics from the other cumulative projects that influence geologic hazard risks are largely unknown at this time. While certain construction activities may increase the possibility of geologic hazards, the extent of the risk is subject to factors that are unknown at this time. Therefore, the overall cumulative impacts on geology from other cumulative projects, combined with the action alternatives, are unknown.

4.25.5 Paleontological Resources

4.25.5.1 No Action Alternatives

Based on the cumulative projects listed in **Table 4-57** and future trends, there would be continued growth, residential and commercial development, and demand for water supply and delivery infrastructure in the area of analysis. Construction from these future projects could result in direct impacts on paleontological resources, including disturbing or revealing bedrock, weathered bedrock, or unconsolidated alluvial deposits that contain significant fossils. Construction and controlled excavation could reveal previously undiscovered resources and potentially allow research and interpretive uses. Indirect impacts include the erosion of fossil locations due to slope regrading and vegetation clearing and the unauthorized collection of scientifically important fossils due to increased access to fossil localities.

Under the No Action Alternatives, RWS, Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and Pueblo de San Ildefonso future projects facilities would not be constructed and would not impact paleontological resources. Therefore, the no action alternatives would not contribute to potential cumulative impacts on paleontological resources in the area of analysis.

4.25.5.2 Impacts Common to All Action Alternatives

The same direct impacts from the other cumulative projects described above occur under the action alternatives, including disturbing or revealing bedrock, weathered bedrock, or unconsolidated alluvial deposits that contain significant fossils. Indirect impacts from these projects could include erosion or unauthorized collection.

Under the action alternatives, the RWS has the potential to impact paleontological resources because each alternative would require ground disturbance within high potential geological units. Implementing the Rio Pojoaque irrigation improvement project or Rio Tesuque channel modification project would also require ground disturbance, but in much lower probability areas; more information is required to assess the Pueblo de San Ildefonso future projects. With implementation of mitigation measures, such as potential discovery and recovery of fossils for scientific study, the RWS, Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and Pueblo de San Ildefonso future projects would not likely contribute to any cumulative impacts on paleontological resources.

4.25.6 Air Quality

4.25.6.1 No Action Alternatives

For air quality, the past, present, and reasonably foreseeable projects listed in **Table 4-57,** along with future trends of this area indicate that air pollutant emissions related to using groundwater as the primary source of drinking water would continue under the no action alternatives. Surface disturbance caused by construction projects in **Table 4-57** would impact air quality by generating fugitive dust and emitting criteria pollutants through the combustion of fuel in commute vehicles, trucks, and construction equipment.

Under the No Action Alternatives, RWS, Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and Pueblo de San Ildefonso future projects facilities would not be constructed and therefore would not contribute to potential cumulative impacts on air quality in the area of analysis.

4.25.6.2 Impacts Common to All Action Alternatives

The proposed RWS project, in combination with the Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and the Pueblo de San Ildefonso future projects, in combination with the projects listed in **Table 4-57** would result in minimal short-term localized increases in air pollutant emissions during construction. There also would be a minimal increase in stationary and mobile source emissions over the long term, after construction is completed.

As compared with emissions sources under the No Action Alternative and described in **Table 4-57**, there would be additional backup generators for the RWS, and likely for the Pueblo de San Ildefonso future projects alternatives, no new stationary sources under the other proposed projects, and a minimally higher number of vehicles on the local roads to inspect, maintain, and service the projects. This would result in a small increase in cumulative impacts on the local ambient air quality.

4.25.7 Climate Change

4.25.7.1 No Action and All Action Alternatives

Current scientific technology makes it difficult to link a specific action to a specific climate change-related impact. Emissions of GHGs from construction and operation under all of the alternatives would be small, in the context of broader spatial-scale emissions. The duration of these activities, particularly construction-related activities, would be shorter than predicted changes in climatic conditions. Short-term direct and indirect impacts on climate from any of the alternatives would be negligible. However, over the long term, GHG emissions do contribute to total global emission levels. These, in turn, could contribute to future long-term, anticipated climate changes to a very minor degree. Overall, the contribution would be a very small portion of the total from other regional and global sources.

In 2013, Reclamation and Lewis et al. evaluated, respectively, the regional future climate change impacts on the Upper Rio Grande Basin and the Santa Fe watershed within this basin. Several of the climate change scenarios examined indicate the potential of reduced availability of both native Rio Grande and imported San Juan-Chama waters.

Reclamation calculated runoff reductions by one-third by the end of the twenty-first century in Rio Grande, Rio Chama, and Rio Grande tributaries, such as the Rio Nambé (Reclamation 2013b). For example, while located downstream of the general project area, Santa Fe River runoff above McClure Reservoir is projected to decline by 11 to 18 percent by the middle of the century (Lewis et al. 2013). San Juan tributaries providing supply to the San Juan-Chama Project are projected to decline by one-fourth, with less flow in the summer (Reclamation 2013b). Corresponding Azotea Tunnel flows are projected to decline by a similar amount.

Allocation of San Juan-Chama water to contractors is projected to decline, from a nearly full supply on average currently to an average allocation of 81 percent of contracted amounts. Years in which all contracts receive a full allocation is projected to decline from 99 percent of years to 61 percent of years.

While the change in water needs and demands could increase, the actual regional water demand could decrease, due to lowered water supply availability (Reclamation 2013b). For example, the increased temperatures and reduced summer precipitation would lead to higher evapotranspiration rates. However, the predicted lower supply from native runoff and reduced San Juan-Chama supplies would reduce irrigation uses. Reduced recharge to groundwater and increased reliance on pumping to supplement the lower surface water supply could lead to affected aquifers and reduced phreatophyte and riparian vegetation losses. While the predicted evaporation rates from reservoirs would increase from 10 to 12 percent, lower runoff and reservoir storages could mean reduced total evaporation losses. Predicted agricultural water needs could increase in net by 5 percent. Municipal water needs in the summer could increase by 10 percent. Evaporation losses from reservoirs are, in net, projected to decline, due to lower overall storage.

4.25.8 Vegetation

4.25.8.1 No Action Alternatives

Potential short- and long-term impacts from past, present, and reasonably foreseeable future projects could result from constructing or installing facilities or infrastructure in or near vegetation. Impacts would include vegetation disturbance and removal and the spread of invasive species. If projects in the region were not successfully re-seeded, native vegetation communities could be lost, or native vegetation communities could be permanently converted to communities dominated by invasive, nonnative species, leading to an incremental reduction in land health.

Under the No Action Alternative of the RWS, groundwater would continue to be depleted by residents and from other projects in the Pojoaque Basin, causing potential cumulative impacts on vegetation as the water table in the general project area is lowered due to continued groundwater pumping. These potential cumulative impacts do not apply to the No Action Alternatives of the Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and Pueblo de San Ildefonso future projects. No cumulative impacts on vegetation would occur related to these projects under the no action alternatives.

4.25.8.2 Impacts Common to All Action Alternatives

The same cumulative impacts from the other projects listed above could occur under the action alternatives of the RWS, Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and Pueblo de San Ildefonso future projects, including vegetation disturbance and removal, and the spread of invasive species.

Impacts on vegetation resulting from these projects would be both short- and long-term disturbance and loss of vegetation, which could also result in the spread of noxious weeds. However, these projects would include efforts to mitigate for overall loss of vegetation and to reduce the spread of noxious weeds. Therefore, cumulative impacts from the proposed RWS, Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and Pueblo de San Ildefonso future projects would likely result in only a negligible contribution to cumulative impacts on vegetation in the area of analysis.

4.25.9 Wetlands, Non-wetland Waters, and Floodplains

4.25.9.1 No Action Alternatives

For wetlands, non-wetland waters, and floodplains, the past, present, and reasonably foreseeable future projects listed in **Table 4-57**, along with future trends of this area, indicate that the demand for water will likely increase in the Pojoaque Basin. Potential cumulative impacts from these projects could involve disturbance of wetlands during construction or impacts related to changes in hydrology over the long term.

4.25.9.2 Impacts Common to All Action Alternatives

For wetlands, cumulative impacts could include disturbing potential wetlands during construction. The RWS, Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and Pueblo de San Ildefonso future projects would all include efforts to mitigate for the potential overall loss of wetlands; therefore, the

proposed projects would not likely contribute to cumulative impacts on wetlands. Indirect impacts on wetlands, when added to past, present, and reasonably foreseeable future projects, center on the hydrology of the region and the use of groundwater versus water diverted from rivers and streams. Indirect impacts consist of a reduction in groundwater pumping and resultant higher surface-water flows.

For floodplains, the RWS service water transmission and distribution lines located within delineated FEMA floodplains would be the same in all alternatives. The extent of new electrical distribution lines would vary by alternative, however. Floodplain impacts from the transmission pipes and electrical lines would not require mitigation. Project infrastructure in other alternatives may have some impacts on floodplains. Potential floodplain impacts of a water treatment plant for Alternatives C, D, and E of the RWS should be evaluated during engineering design and mitigated if needed. Other potential RWS infrastructure would not be expected to require mitigation.

The Rio Pojoaque irrigation improvement project Alternative RP-B may either require mitigation for increased floodplain water surface changes, or delineation of the proposed detailed floodplain as a Letter of Map Revision.

The Rio Tesuque channel modification project Alternatives RT-B and RT-C would promote additional flooded areas. Alternative RT-C would be further evaluated during final engineering design, with flood impacts outside of the new channel mitigated if needed. Other alternatives are not anticipated to require mitigation.

More detailed information is required to assess potential impacts of the Pueblo de San Ildefonso future projects.

4.25.10 Wildlife

4.25.10.1No Action Alternatives

The No Action Alternative of the RWS could alter the current wildlife habitat by continuing to reduce groundwater levels over time. A reduced groundwater table could also cause noxious weeds to spread throughout the area of analysis as upland plants and riparian vegetation may change with water availability. These impacts could be additive to the effects of the past, present, and reasonably foreseeable projects listed in **Table 4-57**, which could cause similar impacts. No cumulative impacts on wildlife would occur related to the Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, or Pueblo de San Ildefonso future projects under the No Action Alternatives.

4.25.10.2Impacts Common to All Action Alternatives

The same impacts from the other projects described listed in **Table 4-57** could occur under the action alternatives for the RWS, Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and Pueblo de San Ildefonso future projects. These are the conversion of wildlife habitat to other uses, the disruption of wildlife from construction activities and noise, and the spread of invasive species in habitat areas.

Impacts on wildlife from the RWS, Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and Pueblo de San Ildefonso future projects include both short-term and long-term disturbance on habitat and wildlife species from construction, operation, and maintenance. However, these projects would include efforts

to mitigate for overall loss of vegetation and to reduce the spread of noxious weeds. There also would be noise restrictions to minimize disturbance of wildlife during construction. The action alternatives account for a negligible contribution to the overall cumulative impacts on wildlife in the area of analysis, including increased fragmentation of habitat and the reduction in nesting areas for migratory birds and other smaller wildlife species that may not be as adaptable or mobile.

4.25.11 Aquatic Resources

4.25.11.1No Action Alternatives

Potential short-term and long-term direct impacts from the projects listed in **Table 4-57** could involve construction or installation of facilities or infrastructure in water bodies. With proper construction measures, impacts in the vicinity of the general project area would likely be prevented or mitigated, so the potential for cumulative impacts would be low.

Under the RWS No Action Alternative, there would be no construction or operation of the water diversion or collection structures along the Rio Grande, and no water body crossings associated with the installation of water transmission and distribution pipelines. Therefore, there would be no impacts on aquatic resources from constructing a cofferdam and no modification or loss of aquatic habitat and adjacent riverside vegetation. However, continued pumping of groundwater wells in combination with other groundwater pumping projects would continue to impact aquifer recharge in the Pojoaque Basin. This could, over time, reduce available surface water and reduce habitat for aquatic species. The amount and extent of this potential impact has not been quantified.

Under the No Action Alternatives, there would be no construction activities associated with the Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, or Pueblo de San Ildefonso future projects. No cumulative impacts on aquatic resources would occur related to these projects.

4.25.11.2Impacts Common to All Action Alternatives

The short-term and long-term direct and indirect impacts from the other cumulative projects described above would also apply to all action alternatives. Existing water diversion projects along the Rio Grande, including those operated by the City of Española, the City of Albuquerque, and the BDD are additive to the proposed RWS project. Overall, the RWS diversion and collection sites would receive higher consistent year-round flow, due to the transfer of groundwater rights from Top of the World Farms and the reach of the Rio Grande near Questa, New Mexico. Reallocating San Juan-Chama diversion water from storage at Heron Reservoir to the RWS diversion sites would also increase flow between Heron Reservoir and the RWS collection sites. These increased flows would not measurably improve or degrade aquatic habitat upstream of the RWS collection sites (Reclamation 2015a).

Resource management agencies do not have trend, aquatic populations, or habitat data in which to quantify or assess the potential cumulative impacts from municipality diversions of San Juan-Chama waters. However, because impacts from the proposed RWS, Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and Pueblo de San Ildefonso future projects on aquatic species are not expected to be measurable, no discernible contributions to cumulative impacts are forecast.

4.25.12 Federally Listed Threatened and Endangered Species

4.25.12.1No Action Alternatives

Birds, Mammals, and Other Terrestrial Species

Long-term impacts could include conversion of existing potential habitat for federally listed species into habitat that listed species no longer use, especially if noxious weeds spread into these areas following construction. Direct impacts on threatened and endangered species resulting from the projects listed in **Table 4-57** are unlikely due to the federal regulations related to these species. If direct impacts occur, they would be largely restricted to specific project locations and would fall under the regulatory oversight of the Service. Short-term, indirect impacts associated with other past, present, and reasonably foreseeable future projects include species temporarily departing or avoiding habitat from areas adjacent to construction activities associated with the some projects.

The RWS No Action Alternative could alter the current wildlife habitat by continuing to reduce groundwater levels over time. The Rio Grande cottonwood requires a high water table (Daniel 2002), and diminishing groundwater levels could reduce the number of cottonwoods or associated galleries as water is depleted from these areas. The loss of these trees used as wildlife habitat and foraging sites for federally listed wildlife species could affect the species that currently live in or travel through the biological resources area of analysis (**Figure 3-8**, Biological Resources Area of Analysis), and may decrease the presence of federally listed species within the general project area through habitat loss, such as the loss of willows for SWFLs. A reduced groundwater table could also cause noxious weeds to spread throughout the area of analysis as upland plants and riparian vegetation change with water availability.

No cumulative impacts on threatened or endangered species would occur related to the Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, or Pueblo de San Ildefonso future projects under the No Action Alternatives.

Aquatic Species (Rio Grande Silvery Minnow)

Existing water diversion projects along the Rio Grande, including those operated by the City of Española, City of Albuquerque, and the BDD, contribute to cumulative impacts on the Rio Grande silvery minnow through reduction in native Rio Grande flows downstream of the RWS Study Area to Cochiti reservoir, and further downstream into habitats occupied by the silvery minnow.

No cumulative impacts on the Rio Grande silvery minnow would occur related to the RWS, Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, or Pueblo de San Ildefonso future projects under the No Action Alternatives.

4.25.12.2Impacts Common to All Action Alternatives

Birds, Mammals, and Other Terrestrial Species

The short-term and long-term direct and indirect impacts from the other cumulative projects described above would also apply to all action alternatives. In addition, the action alternatives of the RWS would increase groundwater resources within the general

project area. These action alternatives would reduce pumping from existing infrastructure and would allow groundwater levels to recover over time. The reduction in water being pumped from the area would support habitat for wildlife in the future. Any cottonwoods destroyed during construction activities if mulched and left on site would provide important nutrients to the soil, and provide additional hunting, perching, and foraging sites for many wildlife species.

Under the action alternatives for the Rio Pojoaque irrigation improvement project and Rio Tesuque channel modification project, impacts on threatened and endangered species would be minimal. Short-term impacts may include the temporary disturbance of wildlife species during construction activities; no long-term impacts are anticipated.

More detailed information is required to assess potential cumulative impacts of the Pueblo de San Ildefonso future projects.

Aquatic Species (Rio Grande Silvery Minnow)

The short-term and long-term direct and indirect impacts from the other cumulative projects described above would also apply to all action alternatives. The cumulative effects of the RWS Project have been analyzed, taking into account projects that are likely to affect the silvery minnow within the planning horizon for this project (2018–2026). Cumulative impact analysis considers whether these other projects may reduce native Rio Grande flows downstream of the RWS general project area to Cochiti reservoir, and further downstream into habitats occupied by the silvery minnow.

Under all RWS action alternatives, consumptive groundwater rights for Top of the World Farms would be abandoned and transferred to surface water rights for the RWS. The groundwater currently allocated through those irrigation groundwater rights would infiltrate into the Rio Grande and be used as a primary source of water for the RWS. This means that there would be slightly more water upstream of the RWS because the groundwater associated with the "Top of the World Farms" irrigation use would no longer be lost, via baseflow, from the river (INTERA 2016a, 2016b; see **Section 4.3**, Surface Water). Until the RWS is operational, Top of the World Farms water would not be depleted from the Rio Grande. Because of this, there would be no new net depletions of native Rio Grande water for many years. When the RWS becomes operational and begins to draw the "Top of the World Farms" water in the diversion or collection systems, imported water (San Juan-Chama Project water) would make up these depletions (see **Section 2.3.1.1**, Operational Planning and Scheduling of San Juan-Chama Project Water Supplies).

Although the RWS would use 1,079 afy of water of San Juan-Chama water, the cumulative effects from the RWS Project on Rio Grande silvery minnow would be the result of the diversion of native Rio Grande waters and not the diversion of San Juan-Chama water. San Juan-Chama water is not native to the Rio Grande and was not originally intended to ensure the survival of the silvery minnow. However, it has been purchased in the past to provide water during low-flow conditions in the Rio Grande. Thus, there would be no net annual depletions of native Rio Grande waters below the Otowi Bridge, and the RWS project would not contribute to the degradation of aquatic habitat for silvery minnow downstream of Cochiti Dam (INTERA 2016a).

Further, the increased flow provided by primary source waters upstream of the RWS aquatic action area would be diverted by the RWS. Reclamation would manage contracted water from the Heron Reservoir in a manner that would not affect flows downstream of the RWS diversion locations (see **Section 2.3.1.1**, Operational Planning and Scheduling of San Juan-Chama Project Water Supplies). Thus, there would be no net annual depletion of flows downstream of Otowi Bridge.

No cumulative impacts on the Rio Grande silvery minnow would occur related to the action alternatives for the Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, or Pueblo de San Ildefonso future projects.

4.25.13 Cultural Resources

4.25.13.1No Action Alternatives

Based on the cumulative projects listed in **Table 4-57** and future trends, there would be continued growth, residential and commercial development, and demand for water supply and delivery infrastructure in the area of analysis. Future construction could result in direct and indirect impacts as a result of ground-disturbing activities, vibratory construction practices, or changes to the visual setting of historic properties.

Under the No Action Alternatives for the RWS project, and for the Rio Pojoaque irrigation improvement project, the Rio Tesuque channel modification project, and the Pueblo de San Ildefonso future projects, no construction would occur and there would be no direct and indirect impacts on cultural resources. Therefore, this alternative for each of these projects would not contribute to cumulative impacts on cultural resources.

4.25.13.2Impacts Common to All Action Alternatives

The same direct and indirect impacts from the other cumulative projects described under the no action alternatives could occur under the action alternatives, including ground-disturbing activities, vibratory construction practices, or changes to the visual setting of historic properties.

The action alternatives for the RWS, Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and Pueblo de San Ildefonso future projects, could also result in direct and indirect adverse impacts on cultural resources as a result of ground-disturbing activities, vibratory construction practices, or changes to the visual setting of historic properties. If the RWS service area is expanded in the future by adding additional distribution lines or short-term storage tanks, the same types of direct and indirect impacts on cultural resources could occur. For example, two housing projects are planned on the Pueblo de San Ildefonso and on the Pueblo of Tesuque, both of which would be integrated with their respective water systems (see **Table 4-57**).

While the action alternatives would likely contribute to the cumulative impacts on cultural resources, such impacts could be resolved through mitigation strategies such as future survey, documentation, and data recovery.

4.25.14 Indian Trust Assets

4.25.14.1No Action Alternatives

Based on the cumulative projects listed in **Table 4-57** and future trends, there would be continued growth, residential and commercial development, and demand for water supply and delivery infrastructure in the Pojoaque Basin and on the Settlement Pueblos. Under the No Action Alternatives, RWS facilities—along with the Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and Pueblo de San Ildefonso future projects—would not be constructed on Pueblo land, and infrastructure to address anticipated growth, development, and water demand would not be built.

Groundwater pumping would continue to be relied on as the primary source of water in the Pojoaque Basin, and no Settlement Pueblo water would be accessed through the RWS. Priority Pueblo water rights would not change, but litigation regarding water rights would likely resume. The lack of a reliable water supply system and agreement on regional water rights may impede Pueblo use of water rights and Pueblo lands and could limit economic development on the Settlement Pueblos.

4.25.14.2Impacts Common to All Action Alternatives

Under the action alternatives, the RWS would provide a more reliable water supply to support anticipated growth, residential and commercial development, and demand for water supply and delivery in the Pojoaque Basin and on the Settlement Pueblos. Pueblo lands would be used for RWS facilities, along with those of the Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and Pueblo de San Ildefonso future projects, but these facilities would allow the Settlement Pueblos to continue to exercise their water rights and support Pueblo growth and economic development.

4.25.15 Land Use

4.25.15.1No Action Alternatives

Impacts on land use, access, and recreation would occur mostly during construction of projects listed in **Table 4-57**. Construction would temporarily reduce access to private and Pueblo lands and physically displace certain types of recreation activities. In the long term, there would be a conversion of existing land use to other uses related to these projects. For example, the IHS Tesuque HUD housing subdivision and the San Ildefonso phased housing projects would convert current land uses to housing. Overall, the projects in **Table 4-57** would result in minimal changes in land use.

Under the No Action Alternatives, the RWS, Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and Pueblo de San Ildefonso future projects would not be constructed, and there would be no changes to or conflicts with land uses, zoning, access or recreation from the construction or operation of these projects. Therefore, the no action alternatives would not contribute to cumulative impacts on land use.

4.25.15.2Impacts Common to All Action Alternatives

The same impacts related to subdivision or conversion of properties in the area of analysis under the no action alternatives would also occur under the action alternatives.

Under the action alternatives, the RWS would provide a sustainable water supply to support agricultural uses, such as those associated with the current acequia system, and would provide a firm and reliable water supply for future residential and commercial development. New electrical lines would provide opportunities for collocating future electrical infrastructure to support new urban and suburban development in the general project area and throughout northern Santa Fe County. Overall, the action alternatives would account for a negligible incremental contribution to cumulative impacts on land use. This would come about by temporarily reducing access to properties, displacing some recreation activities during construction, and converting existing land uses into new types of uses.

Under the action alternatives for the Rio Pojoaque irrigation improvement project and Rio Tesuque channel modification project, no long-term changes to land use would occur. However, the ability of residents to irrigate would be improved as a result of the Rio Pojoaque irrigation improvement project. Short-term impacts may include the reduction in access to certain areas surrounding construction, and the temporary displacement of some recreation activities.

More detailed information is required to assess potential impacts of the Pueblo de San Ildefonso future projects, although they would likely be similar to the RWS but on a smaller scale.

4.25.16 Visual Resources

4.25.16.1No Action Alternatives

Direct short-term impacts would result from surface disturbance caused by construction associated with the cumulative projects listed in **Table 4-57**. This would produce direct, short-term, localized changes to the visual landscape by removing or disturbing the top layers of soil or vegetation to reveal colors that contrast with the surrounding landscape. Direct long-term impacts would result from permanent aboveground features with new HUD housing subdivision (23 units), San Ildefonso Phased Housing (12 units), IHS Pojoaque White Sands Project (26 homes and wastewater facilities), and the Verde Transmission Line (30 miles of transmission line). Depending on design, these developments' form, line, color, and texture would contrast with the surroundings.

Habitat restoration projects for the BDD could directly change the visual landscape by changing vegetation and color in the short term. However, once desired vegetation becomes established, it could indirectly create a landscape with vegetation and color that does not contrast with the local visual landscape in the long term.

Depending on its extent, reduction in water flows caused by Rio Nambé Debris Flow Barriers and Sediment Removal project could directly change the visual landscape in the long term. Reducing flows could reveal new colors and would create new lines of river flow.

Under the no action alternatives no new facilities would be constructed, and any potential impacts on visual resources from the construction and operation of facilities would not occur. Therefore, there would be no cumulative impacts on visual resources related to the RWS, Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, or Pueblo de San Ildefonso future projects under the No Action Alternatives.

4.25.16.2Impacts Common to All Action Alternatives

The short-term and long-term impacts on visual resources from the other cumulative projects described above would also apply to all action alternatives. These changes in the visual landscape, in combination with the changes described under the various project action alternatives, would cumulatively change the form, line, color, and texture of the existing landscape; these changes would be in the short term for construction impacts and in the long term for the impacts from new permanent aboveground developments associated with the RWS and Pueblo de San Ildefonso future projects, including access roads and overhead electrical distribution lines.

The intensity of cumulative visual impacts would depend on such factors as the timing and location of construction (i.e., whether construction of different projects would happen concurrently or in the same location) and the location of aboveground structures and access roads (i.e., whether such features would be near or far from each other). If construction occurs at the same time or in the same location as other projects, this could result in more intense, localized, short-term impacts in that location. If construction were to occur during a different time or at a different location, short-term impacts could be less intense at specific locations but more widespread regionally. Similarly, if aboveground features were near each other, this could result in more intense, localized, long-term impacts in that location. If features were far from one another, long-term impacts could be less intense at specific locations but more widespread regionally. These issues apply more specifically to the RWS and Pueblo de San Ildefonso future projects; for the Rio Pojoaque irrigation improvement project and the Rio Tesuque channel modification project, these impacts would be minimal and largely short-term.

4.25.17 Traffic

4.25.17.1No Action Alternatives

Future actions in **Table 4-57** that introduce additional vehicles on roads would result in short- and long-term impediments to access and increased congestion. This would lead to changes in traffic volumes and patterns on roads in the area of analysis. Other actions, such as road improvement projects, may result in similar short-term impacts, but they would help alleviate access and congestion issues over the long term.

Under the no action alternatives, facilities would not be constructed and there would be no direct or indirect impacts on traffic. Therefore, there would be no cumulative impacts on traffic related to the RWS, Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, or Pueblo de San Ildefonso future projects under the No Action Alternatives.

4.25.17.2Impacts Common to all Action Alternatives

The same direct and indirect impacts from the cumulative projects under the no action alternatives would occur under the action alternatives.

Under all action alternatives, there would be impacts on traffic by introducing congestion on roadways during construction and by limiting access to roadways and locations during construction. Most of these cumulative impacts would be similar under all action alternatives for all projects; the exception is that short-term impacts may be more noticeable during construction of additional short-term storage tanks under Alternative D

of the RWS. As described under the no action alternatives, some reasonably foreseeable future actions would degrade access and increase congestion over the short term, while improving the condition of both indicators over the long term. The relative contribution of the action alternatives to long-term cumulative impacts is negligible, because so few vehicles would be used for operation and maintenance of any of the proposed projects.

4.25.18 Noise

4.25.18.1No Action Alternatives

Direct short-term construction noise impacts would result from the cumulative projects listed in **Table 4-57**. Any area with construction would have direct short-term noise impacts. Direct long-term impacts would result from added ambient noise from the new HUD housing subdivision (23 units), San Ildefonso Phased Housing development (12 units), and IHS Pojoaque White Sands Project (26 homes and wastewater facilities). All of these developments would be permanent; therefore, impacts would be long term. Ambient noises associated with residential areas include human and animal noises.

Short- and long-term increases in ambient noise levels would occur indirectly from increased traffic noise associated with new access roads to these new developments. In the short term, heavy truck traffic and personal vehicle traffic associated with construction would increase along roadways to bring personnel and supplies to construction sites. In the long term, maintenance and operation personnel and residents using these roads would result in a direct increase in noises from vehicles along new access roads.

Under the no action alternatives, no new facilities would be constructed and any potential impacts related to noise from the construction and operation of facilities would not occur. Therefore, this alternative would not contribute to cumulative noise impacts. This applies to the No Action Alternatives under the RWS, Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and Pueblo de San Ildefonso future projects.

4.25.18.2Impacts Common to All Action Alternatives

The short-term and long-term increases in noise and the associated direct and indirect impacts from the other cumulative projects described under the no action alternatives would also apply to all action alternatives. These noises, in combination with the noises described under the RWS, Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and Pueblo de San Ildefonso future projects action alternatives, would further increase the cumulative ambient noise in the area of analysis in the short term and long term. The Rio Pojoaque irrigation improvement project and the Rio Tesuque channel modification project could contribute to short-term ambient noise through construction activities; no long-term operational impacts are anticipated.

The extent of ambient noise increase would depend on such factors as the timing and location of construction (i.e., whether construction of different projects would happen concurrently in the same location) and the location of access roads (i.e., whether new roads associated with different projects would be located near or far from each other). If construction occurs at the same time or in the same location as other projects, this could result in more intense, localized, short-term ambient noise increases in that location. If construction were to occur during a different time or at a different location, short-term

ambient noise increases could be less intense at those locations but more widespread regionally. Similarly, if access roads were near each other, this could result in more intense localized long-term ambient noise increases in that location. If access roads were far from one another, long-term ambient noise increases could be less intense at specific locations but more widespread across the area of analysis.

4.25.19 Solid and Hazardous Materials

4.25.19.1No Action Alternatives

Potential short-term and long-term direct impacts from the projects listed in **Table 4-57** could involve spills or minor releases of hazardous, nonhazardous, or potentially hazardous materials that may be used as part of the construction or operations, such as gasoline and diesel. Another possible temporary direct impact is the discovery of potentially hazardous materials that could be found during construction. With proper pollution prevention measures and hazardous waste disposal practices, impacts in the vicinity of the general project area would likely be prevented or mitigated, so the potential for cumulative impacts from these projects would be low. Also, conducting Phase I, and possibly Phase II, preconstruction investigations of hazardous sites along areas designated for short- and long-term impacts would reduce these impacts. The No Action Alternative for the RWS, would not contribute to these types of cumulative impacts because the RWS would not be constructed. This also applies to the No Action Alternatives under the Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and Pueblo de San Ildefonso future projects.

Several projects listed in **Table 4-57** would provide long-term drinking water and sanitary sewer improvements in the Pojoaque Basin, improving public health and safety by providing clean, reliable sources of water. The RWS No Action Alternative would not contribute to the ability to provide clean drinking water, because the RWS would not be constructed. Similarly, the No Action Alternatives under the Rio Pojoaque irrigation improvement project and the Rio Tesuque channel modification project would not contribute to the increased availability of water for irrigation and other purposes on the Settlement Pueblos. Under the No Action Alternative for the Pueblo de San Ildefonso future projects, a proposed wastewater treatment plant would not be constructed, forcing continued reliance on septic systems for many Pueblo de San Ildefonso residents.

4.25.19.2Impacts Common to All Action Alternatives

The short- and long-term impacts on health and safety from the other cumulative projects described above would also apply to all action alternatives. Under the action alternatives, there would be potential short-term direct impacts on the health and safety at construction sites from fuel and chemical spills and hazardous materials used during construction. These impacts, in combination with the impacts from the other cumulative projects, would further increase risks on health and safety from fuel and chemical spills and hazardous materials in the short term. Landfill disposal of solids over the long term may contribute to reduced capacities and the need to develop new facilities or to use other facilities to accept these wastes.

Similar to the no action alternatives, it is highly unlikely that the proposed projects in **Table 4-57** would impact any existing hazardous material sites. Conducting Phase I, and possibly Phase II, preconstruction investigations of hazardous sites along areas

designated for short- and long-term impacts would reduce the likelihood of cumulative impacts from hazardous materials under the action alternatives. Preconstruction activities would likely result in no cumulative impacts related to hazardous material sites.

Under the action alternatives, river water would be treated to meet all applicable drinking water standards before being distributed as potable water to the RWS service area. This would contribute to long-term direct cumulative improvements in water quality (e.g., chemicals and total dissolved solids) in the analysis area. Other cumulative improvements would be realized under the Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project through increased availability of water for irrigation and other purposes on the Settlement Pueblos. Construction of a wastewater treatment plant as part of the Pueblo de San Ildefonso future projects would allow Pueblo residents to stop relying on septic systems, reducing the hazards associated with such systems in the area of analysis.

4.25.20 Socioeconomic Resources

4.25.20.1No Action Alternatives

Ongoing or proposed construction in the area of analysis related to the projects listed in **Table 4-57** would result in short-term impacts for area residents. Impacts would include increased traffic, dust, and noise. The degree of impacts would vary, depending on the site-specific location, size, and nature of the activity. These impacts would change the quality of life for residents in the area of analysis. In addition, proposed and ongoing construction would result in short-term economic impacts, including direct and indirect jobs. The degree of impacts would vary, depending on the total employment requirements at a given time, the overlap of project employment needs, and the skill level of workers and number of employees hired from the local area.

Under the no action alternatives, no direct or indirect impacts would occur on the area economy, population, property values, or residents' quality of life. This is because there would be no construction of the RWS, Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, or Pueblo de San Ildefonso future projects; therefore, this alternative would not contribute to these types of cumulative impacts.

In the long term, the no action alternatives would not support cumulative improvement in water quality or quantity in and around the area of analysis. Proposed development may further strain the groundwater resources in the area, affecting water availability for local communities. These projects are the San Ildefonso Phased Housing, the IHS Tesuque new HUD housing subdivision, the IHS Pojoaque White Sands Project, and projected community growth.

4.25.20.2Impacts Common to All Action Alternatives

The short- and long-term impacts on social and economic conditions from the other cumulative projects described above would also apply to all action alternatives.

Under all action alternatives for the proposed projects, construction would contribute to short-term impacts in the area of analysis. These impacts may include an increase in traffic, noise, and dust, and changed visual setting from construction of the RWS, Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and

Pueblo de San Ildefonso future projects. These changes could impact residents' quality of life.

As noted in **Section 4.22**, Socioeconomic Resources, up to 416 direct and 629 total-person-years would be supported by proposed RWS project activities from 2018 through 2024. This would result in a cumulative addition to the total of construction employees in the region. Construction employees would also be added for the Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and Pueblo de San Ildefonso future projects. The degree to which these cumulative employment needs would impact area populations and demands on public services would depend on specific timing of construction. Another factor would be the overlap of the construction period for proposed and ongoing projects with that of the RWS, Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and Pueblo de San Ildefonso future projects. Projects identified in the area of analysis most likely to overlap the construction period of the projects analyzed in this EIS are the IHS Pojoaque White Sands Project, San Ildefonso Phased Housing, and IHS Tesuque Pueblo Sewer Main Rehabilitation/Replacement.

Additionally, there are potential impacts from transferring water to be used in the RWS. Impacts are most likely to occur from the transfer of water rights from the Top of the World in Taos County currently available for agriculture. No quantitative estimates of impacts are available, but this transfer would represent a potential decrease in economic contributions to agriculture in the Taos region.

4.25.21 Environmental Justice

4.25.21.1No Action Alternatives

Proposed construction in the area of analysis related to the cumulative projects in **Table 4-57** could result in temporary impacts, such as dust, noise, and traffic. These may cause disproportionate adverse impacts on the minority or low-income population in the area of analysis. The level of impacts would vary depending on the location, size, and nature of the construction activity. The No Action Alternatives would not contribute to these types of cumulative impacts, because the RWS, Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and Pueblo de San Ildefonso future projects would not be constructed.

In the long term, the no action alternatives would not support cumulative improvement in water quality or quantity in and around the area of analysis for any populations, including those that are low income or minority.

4.25.21.2Impacts Common to All Action Alternatives

The short-term and long-term impacts on environmental justice from the other cumulative projects described above would also apply to all action alternatives.

Under all action alternatives, construction of the RWS, Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and Pueblo de San Ildefonso future projects would contribute to the cumulative short-term impacts in the area of analysis. These include an increase in traffic, noise, and dust, and change in visual setting for all area residents, including low-income and minority populations. In addition, employment needs for construction of the RWS and other projects is a potential change in

population and impacts on local residents, including minority and low-income populations. Total population changes from the proposed projects are anticipated to be minimal, although impacts on a specific population cannot be determined.

The level of cumulative impacts would depend on the timing of construction and the overlap of the construction period for proposed and ongoing projects with that of the projects analyzed in this EIS. Projects identified in the area of analysis most likely to overlap the construction period of the projects analyzed in this EIS are the IHS Pojoaque White Sands Project, San Ildefonso Phased Housing, and IHS Tesuque Pueblo Sewer Main Rehabilitation/Replacement.

In the long term, operation of the RWS, Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and Pueblo de San Ildefonso future projects would contribute to cumulative improvements in water quality and water availability for minority and low-income populations in the area.

4.25.22 Energy and Utilities

4.25.22.1No Action Alternatives

Based on the cumulative projects listed in **Table 4-57** and future trends, there would be continued growth, residential and commercial development, and consequent increased demand for energy from the utilities system and delivery infrastructure in the Pojoaque Basin and on the Settlement Pueblos. Under the No Action Alternatives, RWS facilities along with those of the Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and Pueblo de San Ildefonso future projects would not be constructed on Pueblo land, with no resultant increase in peak power loads on the utility system. Other ongoing commercial and residential development would, however, still increase loads on the electrical grid.

4.25.22.2Impacts Common to All Action Alternatives

Under the action alternatives, facilities operations associated with the RWS and Pueblo de San Ildefonso future projects alternatives would have potential long-term impacts on the utility network and energy usage from any potential system upgrades that may be necessary to accommodate the increase in peak power load on the relevant PNM or JMEC circuits. Additionally, long-term impacts from any facilities operations in the action alternatives with proposed solar generation (or the potential for solar generation) would potentially come from the upgrades potentially required in the system as distributed energy resources (solar generation) facilities could introduce issues with reverse-flow loading and voltage control in the electrical grid. The Rio Pojoaque irrigation improvement project and Rio Tesuque channel modification project would not impact cumulative peak power loads as they do not include energy-intensive infrastructure associated with operations.

4.26 Short-Term Uses and Long-Term Productivity

NEPA requires consideration of "the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity" (40 CFR, Subpart 1502.16). This involves using all practicable means and measures, including financial and technical assistance, in a manner calculated to: foster and promote the

general welfare; to create and maintain conditions under which man and nature can exist in productive harmony; and fulfill the social, economic, and other requirements of present and future generations of Americans.

All action alternatives analyzed in this EIS would involve new construction, such as installing short-term storage tanks, distribution pipelines, electrical distribution lines, and access roads. All of the action alternatives would result in indirect and induced employment, which may support hiring in businesses that would provide materials to the construction effort and in service-related industries that would provide food, beverages, and other goods to construction workers. Sales and profits for businesses that support the construction industry in the general project area would increase over the construction period, which is estimated to be from 2018 to 2024.

Potential habitat and land use losses caused by constructing project facilities would irreversibly affect habitats and land uses in these areas. Construction activities would include short-term uses of capital, labor, fuels, and construction materials; and habitats. General commitments of construction materials are largely irreversible because most construction materials are unsalvageable.

Potential benefits of the action alternatives include decreased use of groundwater in the RWS service area and may contribute to groundwater recharge. The RWS would provide a firm, safe supply of treated drinking water for distribution in the Pojoaque Basin, which would have a direct benefit both in the near term and to future generations. There would also be benefits to area farmers and irrigators with implementation of the Rio Pojoaque irrigation improvement project and Rio Tesuque channel modification project. The Pueblo de San Ildefonso future projects would also benefit members of the Pueblo de San Ildefonso—offering expanded water and wastewater services.

Environmental uses and habitat for a variety of aquatic and terrestrial species along the waterways within the general project area would be maintained and potentially enhanced with the proposed mitigation associated with the projects.

4.27 Unavoidable Adverse Impacts

Unavoidable adverse impacts are those on natural and human resources that would remain after mitigation measures have been applied. They are environmental consequences of an action that could not be avoided, either by changing the nature of the action or through mitigation. After consideration of actions, operations, and features to avoid, mitigate, and/or compensate for adverse effects, the action alternatives would likely result in the following unavoidable direct and indirect impacts.

Surface Water—The commitment of water right portfolio and San Juan-Chama contracts to the RWS would unavoidably prevent using this water for other uses. Some of these past uses have included allocating waters to other San Juan-Chama contractors in water-short years and using it for environmental purposes.

Paleontological Resources—The proposed RWS facilities would be sited on geologic units with high potential for paleontological resources; the Pueblo de San Ildefonso future projects is not well developed and more information would be required to assess potential impacts on paleontological resources. The Rio Pojoaque irrigation improvement project and Rio Tesuque channel modification project are in lower probability areas, although unanticipated discoveries are always possible. As with cultural resources, Reclamation

always prefers to avoid significant paleontological resources, but engineering constraints and other critical design features may make total avoidance of paleontological resources impossible if they are found to be present. However, because much of the anticipated disturbance is for linear pipelines, only a small percentage of the potential paleontological resources in these geologic units may be adversely affected. These unavoidable adverse impacts are common to all of the action alternatives.

Vegetation and Wildlife Habitat—Direct loss of vegetation and wildlife habitat would occur from constructing permanent structures, such as buildings, roads, and short-term storage tanks.

Wetlands—Direct adverse impacts on some wetlands would occur if Phase II RWS pipeline alignments cannot be rerouted in some areas. The unavoidable indirect adverse impact of all the RWS alternatives is the possible reduction in the size of riverine wetlands caused by decreased in-stream flow.

Wildlife and Federally Listed Threatened and Endangered Species—Potential short-term disruption of wildlife and federally listed threatened and endangered species would occur due to construction noise and activity in areas next to their habitat.

Aquatic Resources—Construction of the surface water diversion intake under Alternative B of the RWS would unavoidably replace a small amount of in-stream habitat with intake-related infrastructure. Operating the intake without fish screens would unavoidably entrain aquatic species.

Cultural Resources—Engineering constraints and other critical design features may make total avoidance of historic properties impossible if they are found to be present for the RWS, Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, or Pueblo de San Ildefonso future projects. However, because much of the anticipated disturbance is for linear pipelines, only a small percentage of NRHP-eligible or listed cultural resources may be adversely affected.

Indian Trust Assets—The construction of RWS and other project facilities would temporarily disturb access to, and other uses of, trust lands in the vicinity of the projects.

Land Use—The proposed RWS, Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and Pueblo de San Ildefonso future projects would temporarily change the physical character of some areas, impede some access, and displace some recreation opportunities.

Visual Resources—Temporary impacts may occur from heavy equipment and staging areas, material depots, construction trailers, push-piles, and vegetation removal. Long-term impacts may occur from changes to the landscape's form, line, color, and texture.

Traffic—Temporary reduction in access and increased traffic congestion would occur during construction of the projects analyzed in this EIS.

Noise—Short-term impacts would include construction-related noise from vehicles, generators, tools, and project implementation. Long-term impacts may come from an increase in ambient noise levels near pumping plants, the water treatment plant, or other project-related infrastructure.

4.28 Irreversible and Irretrievable Commitments of Resources

Irreversible and irretrievable resource commitments involve the use of nonrenewable resources and the effects of use on future generations. Irreversible effects primarily result from the use or destruction of specific resources that cannot be replaced within a reasonable time frame, such as energy and minerals. Irretrievable resource commitments involve the loss in value of an affected resource that cannot be restored as a result of the action, such as extinction of a threatened or endangered species or the disturbance of a cultural resource. The action alternatives would result in the irreversible and irretrievable commitment of the following resources during project construction and operation:

- Construction materials, including resources such as soil and rocks
- Labor
- Land area committed to new/expanded project facilities
- Energy expended in the form of electricity, gasoline, diesel fuel, and oil for equipment and transportation vehicles that would be needed for project construction and operations

Nonrenewable resources are expected to account for a minimal portion of the region's resources; the project's use of nonrenewable resources would not affect the availability of these resources for other needs within the region. Construction activities would not result in inefficient use of energy or natural resources. The selected construction contractors would use best available engineering techniques, construction and design practices, and equipment operating procedures.

Irreversible commitments can also be those that are only lost for a period of time but are unlikely to revert to their former use. For example, if the RWS facilities are no longer needed in the future, the land could be converted to another use. However, it is unlikely that this would occur; therefore, the resource commitments of habitat, wetlands, and land use would likely also be irreversible since they would not be expected to ever revert to former uses. The loss of any potential cultural and paleontological resources would be considered irreversible, and the expenditure of funds for project improvements would be irreversible.

The irreversible and irretrievable commitment of these resources is offset by the benefits associated with the proposed RWS, Rio Pojoaque irrigation improvement project, Rio Tesuque channel modification project, and Pueblo de San Ildefonso future projects. These benefits include a firm, reliable supply of treated drinking water for distribution in the Pojoaque Basin, irrigation and surface water availability improvements to benefit Pueblo residents, and potential wastewater improvements on the Pueblo de San Ildefonso. These projects would have direct benefits both in the near term and to future generations.

This page intentionally left blank.

CHAPTER 5 PUBLIC INVOLVEMENT, CONSULTATION, AND COORDINATION

5.1 Introduction

This chapter details the consultation and coordination among Reclamation and other federal, state, and local agencies, American Indian Tribes, and the public in preparing this EIS. The Notice of Intent to prepare this EIS was published in February 2012. Since then, Reclamation has solicited input from a broad range of public constituencies as part of the ongoing public involvement process.

The agency sought comments and involvement in the planning for and preparation of this EIS through the following actions, each of which invited input from the general public:

- Communication and consultation with a variety of federal, state, and local agencies, American Indian Tribes, and interest groups, including cooperating agencies
- The formal EIS scoping process
- Project newsletters and website

5.2 Public Outreach and Involvement

Public involvement is a vital part of the EIS process. It provides an opportunity for those affected by the federal action to take part in the decision-making process and facilitates full environmental disclosure. Guidance for implementing public involvement under NEPA is codified in 40 CFR, Subpart 1506.6, and 43 CFR, Part 46, ensuring that federal agencies make a diligent effort to involve the public in the NEPA process.

Public involvement is being conducted throughout the course of the EIS process; however, the public has specific opportunities to comment during three phases:

- Public scoping before NEPA analysis begins, to determine the scope of issues and alternatives to be addressed in the EIS; this phase occurred from February 24, 2012, to May 31, 2013, and is summarized in a scoping report published in August 2013 (Reclamation 2013a)
- Public review of and comment on the Draft EIS
- Public review of the Final EIS

Scoping is the phase in the NEPA process whereby the initial issues to be analyzed are determined. This phase occurs early in the process. Its intent is to obtain the views of the public, other agencies, Indian Tribes, and other interested parties regarding the scope of the analysis.

Public outreach during the public scoping period included the following:

- Publishing a notice of intent to prepare the EIS in the *Federal Register* (February 24, 2012)

- Placing newspaper advertisements in the *Rio Grande Sun*, *Santa Fe New Mexican*, *Journal North*, and *Taos News*
- Distributing a project newsletter to over 4,200 individuals and businesses on the project mailing list (February 2013)
- Announcing the public scoping meetings via a press release and on Reclamation's project website, www.PojoaqueBasinEIS.com

Reclamation held seven public scoping meetings at the following locations in April 2013; all were in New Mexico:

- Tesuque Valley Elementary School in Tesuque
- Pojoaque Valley High School District Campus in Pojoaque
- Santa Fe Community College in Santa Fe County
- Northern New Mexico College in Española
- Taos Convention Center in Taos
- Tewa Center on the Pueblo de San Ildefonso
- El Rancho Community Center in El Rancho

The purpose of these meetings was to provide the public with opportunities to become involved, to learn about the project and the planning process, to meet the RWS EIS team members, and to offer comments. The public input received during the scoping period is summarized in a report (Reclamation 2013a) available at https://sites.google.com/site/pbwatereis/documents/project-reports. Reclamation took these comments into consideration when developing the EIS and incorporated this feedback as appropriate during alternatives development, surveys, modeling, and impact analysis.

Reclamation also held two open houses in August 2013 to provide updated information on the project and upcoming surveys. These meetings were held at the Tesuque Valley Elementary School in Tesuque and Pojoaque Valley High School in Santa Fe County.

In 2014, Reclamation also held four public meetings on surveying activities, as follows:

- January 30, at the San Ildefonso Pueblo-San Ildefonso Community Center in El Rancho
- January 21, at the Pojoaque Pueblo-Buffalo Thunder Resort Conference Room
- January 22, at the Nambé Pueblo-Santa Fe County Community Center in Nambé
- November 13, at the Tesuque Pueblo-Tesuque Elementary School

Additionally, Santa Fe County conducted outreach to obtain input on possible tank locations on the non-Pueblo lands; this included hosting meetings at the following locations and dates:

- October 21, 2014, site visit to proposed Griego Hill tank location
- June 15, 2015, meeting at Bishop's Lodge

- July 7, 2015, open house at Tesuque Elementary
- July 15, 2015, open house at Tesuque Elementary
- August 15, 2015, site visit to proposed Tesuque tank locations
- September 10, 2016, meeting at Pojoaque Satellite Office
- September 14, 2016, meeting at Tesuque Elementary

On June 18, 2012, Reclamation presented information on the proposed RWS and the Settlement Agreement at an acequia workshop with the Rio Pojoaque Acequia & Water Well Association and the New Mexico Acequia Association. The Pueblo de San Ildefonso coordinated with the Acequia de Los Indios and the Pojoaque Valley Irrigation District in developing the Rio Pojoaque irrigation improvement project alternatives.

Reclamation continues to reach out to the Acequia de Los Indios and other affected stakeholders in the vicinity of the proposed canal extension under Alternative RP-B. Reclamation also provided an informational booth at a Santa Fe County-hosted, private well water quality testing fair on July 7 and 8, 2017.

Additional outreach during EIS preparation was via publication and distribution of four additional newsletters to individuals and businesses on the project mailing, as follows:

- September 3013, announcing the availability of the public scoping report
- November 2014, announcing the beginning of alternatives development
- December 2015, announcing the development of working alternatives
- January 2017, announcing the availability of the Draft EIS

Reclamation participated in other public outreach undertaken by Santa Fe County and the New Mexico State Engineer's Office to provide information and answer questions on the RWS and the Settlement Agreement.

At the time of the Draft EIS availability, the mailing list included approximately 3,600 contacts. All those on the mailing list received the January 2017 newsletter, announcing the Draft EIS availability by U.S. Postal Service mail, email, or both. The newsletter also notified the public of upcoming Draft EIS meetings and announced a 45-day Draft EIS public review period.

During the comment period, four public meetings were held (**Table 5-1**, below). At the meetings, the public had the opportunity to learn more about the project, visit with Reclamation, Tribal, state, and county staff, view maps, ask questions, and submit comments.

The Draft EIS was made available to the public on the project website. The website included an interactive map for the public to review proposed facility locations. Paper copies of the Draft EIS were also made available for public review at libraries in the Pojoaque Basin. A press release announcing the Draft EIS availability was provided to local newspapers, and Reclamation posted newspaper advertisements in the *Rio Grande Sun*, *Santa Fe New Mexican*, and *Journal North* newspapers.

Table 5-1. List of Draft EIS Public Meeting Locations and Dates

New Mexico City	Date	Location
Pojoaque	February 15, 2017	Pojoaque Valley High School, Gymnasium 1574 NM-502
Tesuque	February 16, 2017	Tesuque Elementary School, Gymnasium 1555 Bishop's Lodge Road
Nambé	February 21, 2017	Nambé Community Center 180 A SR 503
Santa Fe	February 22, 2017	Santa Fe Community College, Jemez Room 6401 Richards Avenue

During the Draft EIS comment period, Reclamation received 301 submissions, 41 of which were from a single form letter, leaving 260 unique submissions. These submissions yielded 455 unique comments. Sixty-nine percent of the comments were on changes to the existing alternatives. Another 8 percent related to the best available information and baseline data, and 5 percent were on the impact analysis. Volume III of this EIS contains comments received during the 45-day Draft EIS public review period, as well as comment summaries and responses.

5.3 Cooperating Agency Involvement

The following 11 agencies signed a memorandum of understanding with Reclamation to become cooperating agencies for this EIS:

- U.S. Army Corps of Engineers – Regulatory Branch
- U.S. Bureau of Indian Affairs – Southwest Regional Office
- U.S. Fish and Wildlife Service – New Mexico Ecological Services Field Office
- U.S. Indian Health Service – Albuquerque Area Office
- Pueblo de San Ildefonso
- Pueblo of Nambé
- Pueblo of Pojoaque
- Pueblo of Tesuque
- New Mexico Department of Transportation
- Santa Fe County
- City of Santa Fe

The following agencies were invited to participate as cooperating agencies but declined the invitation: New Mexico Interstate Stream Commission, New Mexico Department of Game and Fish, and the New Mexico Office of the State Engineer.

Cooperating agencies provide information, expertise, and review of working documents. Reclamation hosted periodic cooperating agency meetings throughout the preparation of this EIS to ensure that all the agencies were informed of and involved in the issues and analyses. As part of cooperating agency coordination, Reclamation held four alternatives development workshops with cooperating agencies, plus an additional meeting with the Service and USACE, for initial assessment of the environmental impacts of the alternatives.

Through these workshops, Reclamation and cooperating agencies developed a suite of alternative project elements and screening criteria. It compared each element against the screening criteria to determine which elements would be carried forward for combination into complete alternatives and detailed analysis.

5.4 Pueblo and Tribal Consultation and Coordination

5.4.1 Pueblo and Tribal Coordination

In accordance with Executive Order 13175, Consultation and Coordination with Indian Tribal Governments, Reclamation sent letters in January 2012 to Pueblos and Tribes that could have an interest in the project. It invited them to participate in formal government-to-government consultation. In addition to the Settlement Pueblos, the Hopi Tribe expressed an interest in consulting on any proposal that could adversely affect cultural resources in New Mexico. On October 23, 2012, a kickoff meeting was held with the settlement parties at BIA. Since the kickoff meeting, over 55 meetings have been conducted with the Pueblo of Nambé, the Pueblo of Pojoaque, the Pueblo de San Ildefonso, and the Pueblo of Tesuque. The purposes of these meetings were to provide project updates, answer questions about the EIS, and receive input and direction on the EIS. Reclamation also consulted Pueblos before conducting any field surveys. A list of meetings is available upon request.

5.4.2 National Historic Preservation Act

In order to meet its obligations under Section 106 of the NHPA, Reclamation, as the lead federal agency for the proposed undertaking, has undertaken a Class III (100 percent) cultural resources inventory of the project area. Its purpose was to identify cultural resources, historic properties, and properties of religious, cultural, or community significance that may be affected by the RWS project.

Reclamation prepared technical reports that detail the findings of the Class III survey. These reports include NRHP eligibility recommendations for all identified resources and were submitted to New Mexico SHPO and THPOs (as appropriate) for concurrence on NRHP eligibility recommendations and determinations.

Furthermore, Reclamation prepared a Programmatic Agreement that broadly outlines procedures for mitigating adverse impacts on cultural and historic resources that may be affected by the proposed undertaking.

The following entities have agreed to be signatories to the Programmatic Agreement:

- Bureau of Reclamation
- Pueblo of Nambé

- Pueblo of Pojoaque
- Pueblo de San Ildefonso
- Pueblo of Tesuque
- New Mexico State Historic Preservation Officer
- Advisory Council on Historic Preservation

Concurring parties to the Programmatic Agreement are as follows:

- Bureau of Indian Affairs Southwest Regional Office
- U.S. Army Corps of Engineers
- New Mexico Department of Transportation

In addition to these parties, Reclamation has invited the following federally recognized Indian Tribes to consult on the undertaking; this is because these Tribes may attach religious or cultural significance to historic properties that could be affected by the RWS project:

- Comanche Nation
- Jicarilla Apache Nation
- Kiowa Tribe of Oklahoma
- Navajo Nation
- Ohkay Owingeh
- Pueblo of Cochiti
- Pueblo of Isleta
- Pueblo of San Felipe
- Pueblo of Sandia
- Pueblo of Santa Ana
- Pueblo of Santa Clara
- Pueblo of Santo Domingo

5.5 Other Consultations and Coordination

5.5.1 U.S. Fish and Wildlife Service, Endangered Species Act, Section 7 Consultation

To comply with ESA Section 7(a)(2) and 50 CFR, Part 402, Reclamation prepared a biological assessment to address the potential impacts of the proposed projects (see **Appendix J**).

In the biological assessment, Reclamation analyzed impacts on the following species:

- Western yellow-billed cuckoo (*Coccyzus americanus occidentalis*)
- Mexican spotted owl (*Strix occidentalis lucida*)
- New Mexico meadow jumping mouse (*Zapus hudsonius luteus*)
- Rio Grande silvery minnow (*Hybognathus amarus*)
- Southwestern willow flycatcher (*Empidonax traillii extimus*)

Based on this analysis, Reclamation concluded that the proposed project "may affect, [but] not likely to adversely affect" the southwestern willow flycatcher for actions specifically associated with the RWS, the Rio Pojoaque Irrigation Improvement project, and the Rio Tesuque Channel Modification project; however, the actions associated with the Pueblo de San Ildefonso future projects alternatives would have "no effect" on the flycatcher.

In addition, Reclamation determined that the proposed projects would have "no effect" on the western yellow-billed cuckoo, Mexican spotted owl, New Mexico meadow jumping mouse, Rio Grande silvery minnow, or the designated or proposed critical habitat for these species, including the flycatcher. The Service wrote a letter of concurrence to Reclamation on June 5, 2017 (see **Appendix J**).

5.5.2 U.S. Army Corps of Engineers, Clean Water Act, Section 404 Coordination

Reclamation has held meetings with the USACE Albuquerque District Permitting Program to assess potential permitting requirements for the project. In accordance with Section 404 of the CWA, following completion of the wetland delineations in 2016, the USACE will be responsible for determining final jurisdiction and permitting requirements.

5.6 Final EIS Distribution

Reclamation distributed hard copies or CD-ROM copies of the Final EIS to the following recipients:

- U.S. Army Corps of Engineers – Regulatory Branch
- U.S. Bureau of Indian Affairs – Southwest Regional Office
- U.S. Fish and Wildlife Service – New Mexico Ecological Services Field Office
- U.S. Indian Health Service – Albuquerque Area Office
- Pueblo de San Ildefonso
- Pueblo of Nambé
- Pueblo of Pojoaque
- Pueblo of Tesuque
- City of Santa Fe

- New Mexico Department of Transportation
- Santa Fe County

The Final EIS is available on the project website, www.pojoaquebasineis.com.

CHAPTER 6 LIST OF PREPARERS

This Final EIS was prepared by the Bureau of Reclamation, Albuquerque Area Office with assistance from Environmental Management and Planning Solutions, Inc. (EMPSi) in partnership with HDR, Inc., Parametrix, and Aeraser, LLC. The names of persons who prepared various sections, provided extensive background information, or participated to a significant degree in reviewing the present document are listed below in **Table 6-1**. Harvey Economics provided technical review of the socioeconomic analysis.

Table 6-1. Preparers of Draft Environmental Impact Statement

Name	Education and Professional Experience	EIS Responsibility
U.S. Department of the Interior Bureau of Reclamation		
Keenan Arnold	BS, Civil Engineering Years of Experience: 8	Engineering
Jennifer Bachus	MS, Biology Years of Experience: 17	Endangered Species Act consultation and coordination with the Service
Sarah Branum	BS, Environmental Studies Years of Experience: 15	Environmental project manager
Nancy Coulam	PhD, Anthropology Years of Experience: 28	Regional review coordinator, NEPA and Endangered Species Act compliance
Kathy Dickinson	MS, Physics Years of Experience: 23	Project manager
Carolyn Donnelly	MS, Engineering Years of Experience: 15	Hydrologic modeling
Matt Dorsey	Years of Experience: 15	GIS
Michele A. Gallagher	BS, Biology Years of Experience: 10	Real estate acquisition planning
Hector Garcia	MS, Biology and Anthropology Years of Experience: 25	Endangered Species Act consultation and coordination with the Service, NEPA compliance, biological data
Chris Grosso	BS, Wildlife Management Years of Experience: 20	Endangered Species Act, special status species, wetlands, critical habitat, biological data

Table 6-1. Preparers of Draft Environmental Impact Statement (cont.)

Name	Education and Professional Experience	EIS Responsibility
Rick Hall	BS, Engineering Years of Experience: 35	Lead project engineer, engineering, design, alternatives development
Lam Ho	BS, Engineering Years of Experience: 10	Engineering, alternatives development
Mark Hungerford	MA, Anthropology Years of Experience: 25	Cultural and historic resources
Edward Kandl	MS, Hydrology Years of Experience: 26	Hydrologic modeling
William J. Liebhauser	BA, Political Science Years of Experience: 40	Real estate acquisition planning
Dagmar Llewellyn	MS, Civil/Environmental Engineering Years of Experience: 4	Hydrologic modeling, water resources, climate change modeling
Larry Moore	MA, Anthropology Years of Experience: 10	EIS project lead, cultural and historic resources
Tim Murphy	MS, Soil Science Years of Experience: 20	Soils science, NEPA
Jerry Nieto	MS, Civil Engineering Years of Experience: 32	Project manager
Jeff Rice	Years of Experience: 20	Land surveys
Christine Sapien	Years of Experience: 24	GIS
Molly Thrash	MA, Anthropology Years of Experience: 10	EIS project lead
Arthur Valverde	BS, Engineering Years of Experience: 30	EIS responsibility
Lori Walton	BS, Biology Years of Experience: 15	Endangered Species Act consultation and coordination with the Service, wetlands, USACE 404/401 permit consultation
	EMPSi	
David Batts	MS, Natural Resource Planning, 1993 Years of Experience: 23	Project manager
Jacob Accola	Bachelor of Environmental Design, 2015 Years of Experience: 2	Visual simulations, GIS analysis
Jordan Adams	BS, Environmental Sciences, 2012 Years of Experience: 4	Geology and soils

Table 6-1. Preparers of Draft Environmental Impact Statement (cont.)

Name	Education and Professional Experience	EIS Responsibility
Blake Busse	JD, 2015 Years of Experience: 2	Geology and soils
Amy Cordle	BS, Civil Engineering, 1992 Years of Experience: 20	Air quality and climate
Sarah V. Crump	BA, Environmental Studies, Political Science, 2011 Years of Experience: 3	Solid and hazardous materials
Annie Daly	BA, Environmental Studies, 2011 Years of Experience: 4.5	Solid and hazardous materials
Kevin Doyle	BA, Sociology, 1976 Years of Experience: 31	ITAs, paleontological resources, cultural and historic resources
Melissa Estep	BS, Industrial & Systems Engineering, 2011 Years of Experience: 5	Surface water and floodplains, groundwater, water quality, geomorphology
Zoe Ghali	MS, Environmental Physiology, Masters Certificate in Environmental Policy, 2006 Years of Experience: 9	Socioeconomics, environmental justice
Peter Gower, AICP	MS, Land Use Planning, 2007 Years of Experience: 12	Land use
Derek Holmgren	MS, Environmental Science, 1999 Years of Experience: 16	Visual resources, noise, geology and soils
Jenna Jonker	BA, Geography, 2009 Years of Experience: 6	GIS analysis
John King, CIH	MPH, Environmental Health, 1982 MS, Environmental Engineering, 1978 Years of Experience: 25	Principal in charge, quality assurance/quality control
Molly McCarter	BA, Environmental Studies, Geography, 2011 Years of Experience: 6	Solid and hazardous materials, noise, visual resources, document production, quality assurance/quality control specialist

Table 6-1. Preparers of Draft Environmental Impact Statement (cont.)

Name	Education and Professional Experience	EIS Responsibility
Katie Patterson	JD, Environmental Law, 2001 Years of Experience: 7	Deputy project manager, Chapters 1 and 2
Nick Parker	MA, Archaeology, 1999 Years of Experience: 16	ITAs, paleontological resources, solid and hazardous materials, energy and utilities, NEPA quality assurance/quality control specialist
Kevin Rice	BS, Environmental Science, 2009 Years of Experience: 6	Vegetation, wildlife, aquatic resources, threatened and endangered species, wetlands
Marcia Rickey	MS, Conservation Biology, 2002 Years of Experience: 14	GIS analysis
Chad Ricklefs, AICP	Master of Urban and Regional Planning, Environmental Planning, 2003 Years of Experience: 15	Traffic, NEPA quality assurance/quality control specialist
Cindy Schad	BFA, Creative Writing, 1988 Years of Experience: 23	Formatting, 508 compliance
Drew Vankat	MS, Environmental Policy and Planning, 2006 Years of Experience: 11	Traffic, land use, and recreation
Randolph Varney	MFA, Writing, 2005 BA, Technical and Professional Writing, 1995 Years of Experience: 25	Technical editing
HDR, Inc.		
Becky Holloway	MS, Biology, 1996 Years of Experience: 19	Aquatic resources, threatened and endangered species
Michael Kasch	Master of Engineering, Civil Engineering, 1996 Years of Experience: 19	Water quality
Creighton Omer	MS, Civil Engineering, 2002 Years of Experience: 13	Surface water and floodplains
Lauren Perreault	MS, Environmental Science, 2011 Years of Experience: 9	Geomorphology

Table 6-1. Preparers of Draft Environmental Impact Statement (cont.)

Name	Education and Professional Experience	EIS Responsibility
Christopher Rodriguez	MS, Environmental Engineering, 1994 Years of Experience: 21	Water resources
Theodore Shannon	MS, Civil Engineering, 2001 Years of Experience: 15	Water resources
Kristine Shaw	MS, Civil Engineering, University of Texas Austin, 2001 Years of Experience: 19	Groundwater
Shawn Tracy	BS, Fisheries and Wildlife, 2001 Years of Experience: 13	Geomorphology
Parametrix		
Berenika Byszewski	MA, American Studies, 2011 Years of Experience: 19	Cultural and historic resources
Christine Hannum	M.Ed., Educational Psychology, 1987 Years of Experience: 12	Vegetation, wildlife, threatened and endangered species, wetlands
Teresa Hurt	MA, Anthropology, 1996 Years of Experience: 19	Cultural and historic resources, vegetation, wildlife, threatened and endangered species, wetlands
Ethan Kalosky	MA, Anthropology, 2009 Years of Experience: 12	Cultural and historic resources
Shawn Kelley	MA, Anthropology Years of Experience:16	Cultural and historic resources
Jenny Lisignoli	MS, Renewable Natural Resources – Wildlife and Fisheries Sciences, 1991 Years of Experience: 24	Vegetation, wildlife, threatened and endangered species, wetlands
Jennifer von Rohr	BA, Environmental Science, 1985 Years of Experience: 27	Vegetation, wildlife, threatened and endangered species, wetlands
Aeraser, LLC		
Brinda Ramanathan	PhD, Chemistry, 1980 Years of Experience: 35	Air quality

This page intentionally left blank.

CHAPTER 7 REFERENCES

AIWRMG (Aamodt Indian Water Rights Mediation Group). 2001. Water Production/Transmission/Distribution System Pre-Feasibility Study. Prepared for Aamodt Indian Water Rights Mediation Group. Pojoaque River Basin, New Mexico. July 9, 2001. Santa Fe, New Mexico.

Albuquerque Journal. 2006. Land Grant Heirs Under Pressure to Sell. Internet website: http://abqjournal.com/news/state/apheirs07-03-06.htm.

Albuquerque Journal. 2011a. Ash from Las Conchas Fire Contaminates Runoff Water. July 19, 2011. Albuquerque, New Mexico.

Albuquerque Journal. 2011b. Ash in the Rio Grande slows Albuquerque Drinking Water Intake. August 22, 2011. Albuquerque, New Mexico.

AMEC Foster Wheeler. 2016. Pojoaque Basin Regional Water System Hydrogeologic Support Services Draft Comprehensive Study Plan. Prepared for U.S. Department of the Interior, Bureau of Reclamation. February 2016. Santa Fe, New Mexico.

American Speech-Language-Hearing Association. 2017. Loud Noise Dangers. Internet website: https://www.asha.org/public/hearing/Noise/.

Anderholm, Scott K. 1994. Groundwater Recharge Near Santa Fe, North Central New Mexico USGS Water Resources Investigations Report 94-4078. Albuquerque, New Mexico.

Andersen, D. C. 2016. "Flow regime effects on mature *Populus fremontii* (Fremont cottonwood) productivity on two contrasting dryland river floodplains." *The Southwestern Naturalist* 61(1): 8–17.

Anderson, B. W., and R. D. Ohmart. 1984. Final Report Vegetation Management Study for the Enhancement of Wildlife Along the Lower Colorado River. U.S. Department of the Interior, Bureau of Reclamation. Contract No. 7-07-30-V0009. Boulder City, Nevada.

Balleau. 2003. Hydrologic Impacts of Future Reduced Groundwater Use and Increased Surface Water Use by the Santa Fe Area. Part of Aamodt Feasibility Study Report, U.S. Department of the Interior, Bureau of Reclamation. August 2003. Denver, Colorado.

Balleau Groundwater, Inc. 1995. Buckman Alluvial Aquifer Yield Analysis. Albuquerque, New Mexico.

Balleau Groundwater, Inc. 2003. Breakdown of Hydrologic Impacts in Pojoaque River Basin Due to Out-of-Basin and In-Basin Water Use. Part of Aamodt Feasibility Study Report, U.S. Bureau of Reclamation. September 2003. Denver, Colorado.

Benoit, V. 2014. Hydrologic Assessment of Rio Tesuque, Bureau of Reclamation, Albuquerque Area Office, Technical Services Division, Albuquerque, New Mexico.

Bent, Devin. 2013. The Public Health Disaster called Aamodt: Part 1. Failed Septic or A Stream without Minnows. Unpublished document submitted to Reclamation by local resident, Dr. Bent.

Bestgen, K., and S. P. Platania. 1991. "Status and conservation of the Rio Grande silvery minnow, *Hybognathus amarus*." Southwestern Naturalist: 26(2): 225–232.

BIA (U.S. Department of the Interior, Bureau of Indian Affairs). 2000. Environmental Assessment for the Rio Grande Infiltration Collector Well Demonstration Project at San Ildefonso Pueblo. Prepared by The Louis Berger Group, Inc. Report to BIA. October 2000. Albuquerque, New Mexico.

BIA. 2013. Environmental Assessment for Top of the World Water Rights. August 20, 2013.

BISON-M (Biota Information System of New Mexico). 2013. BISON-M black tern home page. Internet website: http://www.bison-m.org/booklet.aspx?id=042050.

BISON-M. 2014. BISON-M spotted bat home page. Internet website: http://www.bison-m.org/booklet.aspx?id=050095.

BISON-M. 2015a. BISON-M bald eagle home page. Internet website: http://www.bison-m.org/booklet.aspx?id=040370.

BISON-M. 2015b. BISON-M golden eagle home page. Internet website: http://www.bison-m.org/booklet.aspx?id=040372.

BISON-M. 2015c. BISON-M Southwestern willow flycatcher home page. Internet website: http://www.bison-m.org/booklet.aspx?id=040521.

BISON-M. 2015d. BISON-M Mexican spotted owl home page. Internet website: http://www.bison-m.org/booklet.aspx?id=041375.

BISON-M. 2016a. BISON-M Find a Species Booklet home page. Internet website: http://www.bison-m.org/speciesbooklet.aspx.

BISON-M. 2016b. BISON-M Baird's sparrow page. Internet website: http://www.bison-m.org/booklet.aspx?id=041785.

BISON-M. 2016c. BISON-M least tern home page. Internet website: http://www.bison-m.org/booklet.aspx?id=042070.

BISON-M. 2016d. BISON-M gray vireo home page. Internet website: http://www.bison-m.org/booklet.aspx?id=042200.

BLM (U.S. Department of the Interior, Bureau of Land Management). 1984. Manual 8400 – Visual Resource Management. Department of the Interior, Bureau of Land Management. April 5, 1984. Washington, DC.

BLM. 2007. Instructional Memorandum (IM) IM 2008-009 Potential Fossil Yield Classification (PFYC) System, Attachment 1. BLM Washington Office. Internet website: http://www.blm.gov/style/medialib/blm/wo/Information_Resources_Management/policy/im_attachments/2008.Par.69083.File.dat/IM2008-009_att1.pdf.

BLM GIS 2014. Bureau of Land Management GIS data used to describe the surface administration, last updated May 1, 2014, and to describe Potential Fossil Yield Classification. Received via e-mail from BLM Dario Lunari December 2014.

Bohannan-Huston, Inc. 2002. Bare Earth and Breakline lidar data, prepared for Santa Fe County, New Mexico. Albuquerque, New Mexico.

Brinkman, James, and Francis West. 2005. Evaluation of Water Supply and Demand in the Pojoaque River Basin. Report to the Pojoaque Basin Water Alliance. Internet website: http://nnmprotect.org/docs/Aamodt/BrinkmanReport.pdf.

Buntjer, M., and J. Remshardt. 2005. Final Report Fish Surveys and Habitat Assessment in the Rio Chama and Rio Grande Upstream of Cochiti Lake. U.S. Fish and Wildlife Service New Mexico Ecological Services Field Office and Fishery Resources Office. Albuquerque, New Mexico.

Cartron, Jean-Luc E. (editor). 2010. *Raptors of New Mexico*. University of New Mexico Press, Albuquerque.

Castell, R., S. Denny, E. Frey, K. Gardiner, and R. Hansen. 2012. Statewide Fisheries Monitoring. F-84-R Final Report. New Mexico Department of Game and Fish, Santa Fe.

CEQ (Council on Environmental Quality). 1981. Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations. CEQ, Washington, DC. 46 *Federal Register* 18026.

CEQ. 1997. Environmental Justice Guidance under the National Environmental Policy Act. December 10, 1997. Washington, DC.

Chem Risk LLC. 2010. Buckman Direct Diversion Project Independent Peer Review: Preliminary Draft Report. October 15, 2010. Internet website: http://bddproject.org/archive/Final-Draft-BDD-IPR.pdf.

City of Española. 2012. Water Quality Report. Internet website: http://www.cityofespanola.org/Forms/CCRReport2012.pdf

City of Santa Fe. 2012. Minutes of the City of Santa Fe and Santa Fe County Buckman Direct Diversion Board Meeting. September 13, 2012. Santa Fe, New Mexico.

Crowell, Hugh. 2014. Ecological Impacts of Inadvertent Returns from Horizontal Directional Drilling (HDDR). Presentation at the HullRAC Science Summit. February 4, 2014. Internet website: http://www.hullinc.com/lib/sitefiles/Ghost%20Pages/HullRAC%20Summit/Presentations/9%20-%20HCrowell_Inadvertent%20Returns.pdf.

Curtis, K. E. and R. W. Lichvar. 2010. Updated Datasheet for the Identification of the Ordinary High Water Mark (OHWM) in the Arid West Region of the Western United States. U.S. Army Engineer Research and Development Center, Hanover, New Hampshire. Internet website: http://www.spl.usace.army.mil/Portals/17/docs/regulatory/JD/UpdatedDatasheetforIDOHWM_ERDC_2010.pdf.

Cuyamungue Institute. 2014. The Land's History. Internet website: http://www.cuyamungueinstitute.com/the-land/history/.

Daly, Christopher, Michael Halbleib, Joseph I. Smith, Wayne P. Gibson, Matthew K. Doggett, George H. Taylor, Jan Curtis, and Phillip P. Pasteris. 2008. "Physiographically sensitive mapping of climatological temperature and precipitation across the conterminous United States." *International Journal of Climatology* 28(15). December 2008. Internet website: http://www.prism.oregonstate.edu/documents/Daly2008_PhysiographicMapping_IntJnlClim.pdf.

Daniel, N. 2002. Rio Grande Cottonwood (*Populus fremontii*). Newsletter, Volume 9, Issue 3. Internet website: http://www.friendsofthebosque.org/articles/Rio_Grande_Cottonwood.pdf.

DBS&A (Daniel B Stephens & Associates). 2015. Results of Water Quality Analyses and Soil Column Testing: Pojoaque Basin Regional Water System. December 4, 2015. Albuquerque, New Mexico.

Department of Energy. 2005. Final Environmental Assessment for Chromium Plume Control Interim Measure and Plume-Center Characterization, Los Alamos National Laboratory, Los Alamos, New Mexico. December 2005. Department of Energy, Environmental Management, Los Alamos Field Office. Los Alamos, New Mexico.

Des Rosiers, F., A. Bolduc, and M. Thériault. 1999. "Environment and value: Does drinking water quality affect house prices?" *Journal of Property Investment & Finance* 17(5): 444–463.

Dick-Peddie, William A. 1993. *New Mexico Vegetation, Past, Present, and Future*. University of New Mexico Press, Albuquerque.

Dudley, R. K., S. P. Platania, and G. C. White. 2014. Rio Grande Silvery Minnow Population Monitoring Program Results from May to December 2013. A Middle Rio Grande Endangered Species Collaborative Program Funded Research Project. American Southwest Ichthyological Researchers, Albuquerque, New Mexico.

Easton, D., and J. Rubinstein. 2015. "Preface to the focus section on injection-induced seismicity." *Seismological Research Letters* 86(4).

eBird. 2016. Internet website: http://www.ebird.org/content/ebird.

EIA (U.S. Energy Information Administration). 2011. Emissions of Greenhouse Gases in the United States in 2009. March 2011. Washington, DC.

EIA. 2016a. U.S. Energy Information Administration Glossary. Internet website: http://www.eia.gov/tools/glossary/index.cfm?id=P.

EIA. 2016b. U.S. retail fuel costs (January 2016). Internet website: http://www.eia.gov.

EMPSi (Environmental Management and Planning Solutions, Inc.). 2013. Methods of Analysis Study Plan: Pojoaque Basin Regional Water System Environmental Impact Statement. Boulder, Colorado.

EPA (Environmental Protection Agency). 2002. Filter Backwash Recycling Rule: Technical Guidance Manual. Internet website: http://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=200025V5.txt.

EPA. 2012a. Total Maximum Daily Load (TMDL) for Upper Rio Grande Watershed. Internet website: http://www.nmenv.state.nm.us/swqb/documents/swqbdocs/MASTMDLs/.URG2012/UpperRioGrandeTMDL2012.pdf.

EPA. 2012b. NPL Site Narrative for North Railroad Avenue Plume. Internet website: http://www.epa.gov/superfund/sites/npl/nar1518.htm.

EPA. 2012c. Uranium. Internet website: http://www.epa.gov/radiation/radionuclides/uranium.html.

EPA. 2013a. Basic Information about Arsenic in Drinking Water. Internet website: http://water.epa.gov/drink/contaminants/basicinformation/arsenic.cfm.

EPA. 2013b. Basic Information about Barium in Drinking Water. Internet website: http://water.epa.gov/drink/contaminants/basicinformation/barium.cfm.

EPA. 2013c. Basic Information about Fluoride in Drinking Water. Internet website: http://water.epa.gov/drink/contaminants/basicinformation/fluoride.cfm.

EPA. 2014a. STORET Data Warehouse. Internet website: http://www.epa.gov/storet/.

EPA. 2014b. Consultation on a Rulemaking to Provide More Opportunities for Tribes to Engage in the Clean Water Act Impaired Water Listing and Total Maximum Daily Load Program. Open letter to tribal leaders. March 28, 2014. Internet website: https://www.epa.gov/sites/production/files/201510/documents/final_mar28_2014_303_tasconsultation_letter.pdf.

EPA. 2014c. National Priorities List Search. Internet website: http://www.epa.gov/superfund/sites/query/queryhtm/nplmapsg.htm. .

EPA. 2014d. Basic Information about Nitrate in Drinking Water. Internet website: http://water.epa.gov/drink/contaminants/basicinformation/nitrate.cfm.

EPA. 2014e. Basic Information about Selenium in Drinking Water. Internet website: http://water.epa.gov/drink/contaminants/basicinformation/selenium.cfm.

EPA. 2015. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2013. Internet website: https://www3.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2015-Main-Text.pdf.

EPA. 2016a. National Ambient Air Quality Standards (NAAQS). Internet website: https://www.epa.gov/criteria-air-pollutants/naaqs-table.

EPA. 2016b. The Green Book Nonattainment Areas of Criteria Pollutants. Internet website: https://www3.epa.gov/airquality/greenbook/anayo_nm.html /.

EPA. 2016c. Air Data. Internet website: http://www.epa.gov/airdata/.

EPA. 2016d. Summary of the Clean Air Act, Internet website: https://www.epa.gov/laws-regulations/summary-clean-air-act.

Epp, D. J., and K. S. Al-Ani. 1979. "The impact of water quality on rural non-farm residential property values." *American Journal of Agricultural Economics*. August 1979.

Fawver, S., and F. Britten. 2012. Comparison of a Type 2 Sound Level Meter vs. Sound Level Meter Applications on an iPhone. Fort Hays State University, Hays, Kansas.

FEMA (Federal Emergency Management Agency). 2012. Flood Insurance Rate Maps, Santa Fe County, New Mexico and Incorporated Areas. December 4, 2012. Internet website: https://catalog.data.gov/dataset/basemap-framework-submission-for-santa-fe-county-nm-and-incorporated-areas.

FEMA. 2013. Community Status Book. Internet website: http://www.fema.gov/cis/New Mexico.pdf.

FEMA. 2014. Federal Emergency Management Agency, Flood Zones. Internet website: http://www.fema.gov/floodplain-management/flood-zones.

FEMA. 2015. FEMA Funds Sediment Removal from Nambé Reservoir in Santa Fe County, New Mexico. January 30, 2015. Internet website: http://www.fema.gov/news-release/2015/01/30/fema-funds-sediment-removal-nambe-reservoir-santa-fe-county-new-mexico.

Ferguson, John F., W. Scott Baldridge, Laurence W. Braile, Shawn Biehler, Bernard Gilpin, and George R. Jiracek. 1995. Structure of the Española Basin, Rio Grande Rift, New Mexico, from SAGE Seismic and Gravity Data. Los Alamos National Laboratory, New Mexico. New Mexico Geological Society Guidebook. Los Alamos, New Mexico.

Fisheries Hydroacoustic Working Group. 2008. Agreement in Principle for Interim Criteria for Injury to Fish from Pile Driving. Internet website: http://www.wsdot.wa.gov/NR/rdonlyres/4019ED62-B403-489C-AF05-5F4713D663C9/0/BA_InterimCriteriaAgree.pdf.

Forest Service (U.S. Department of Agriculture, Forest Service). 2014. Santa Fe National Forest, Recreation. Internet website: http://www.fs.usda.gov/recmain/santafe/recreation.

Forest Service. 2016. Santa Fe National Forest. Internet website: http://www.fs.usda.gov/santafe/.

Forest Service and BLM (U.S. Department of Agriculture, Forest Service and U.S. Department of the Interior, Bureau of Land Management). 2006. Final Environmental Impact Statement for the Buckman Water Diversion Project. Santa Fe National Forest and BLM, Taos Field Office, Santa Fe County, New Mexico.

Galusha, Ted, and John C. Blick. 1971. "Stratigraphy of the Santa Fe Group, New Mexico." *Bulletin: American Museum of Natural History*, Volume 144 Article 1. New York.

GAO (U.S. General Accounting Office). 2001. Treaty of Guadalupe Hidalgo, Definition and List of Community Land Grants in New Mexico. GAO-01-951. Internet website: http://www.gao.gov/new.items/d01951.pdf.

GAO. 2004. Treaty of Guadalupe Hidalgo. Findings and Possible Options Regarding Longstanding Community Land Grant Claims in New Mexico. GAO-04-59. Pp. 156–160. Internet website: http://www.gao.gov/assets/160/157550.pdf.

Gesch, D.B. 2007. The National Elevation Dataset (D. Maune, editor), Digital Elevation Model Technologies and Applications: The DEM Users Manual, 2nd Edition: Bethesda, Maryland, American Society for Photogrammetry and Remote Sensing. Pp. 99–118. Internet website: http://ned.usgs.gov/.

Glaser, Leah. Undated. San Juan-Chama Project (History of). U.S. Bureau of Reclamation. Internet website: http://www.usbr.gov/projects/ImageServer ?imgName=Doc_1305641466592.pdf.

Global Carbon Project. 2014. Carbon Budget 2014: An annual update of the global carbon budget and trends. Internet website: http://www.globalcarbonproject.org/ index.htm.

Grantz, K., B. Rajagopalan, M. Clark, and E. Zagona. 2007. "Seasonal shifts in the North American monsoon." *Journal of Climate*, 20(9): 1923–1935.

Grauch, V. J. S., J. D. Phillips, D. J. Koning, P. S. Johnson, and V. Bankey. 2009. Geophysical Interpretations of the Southern Española Basin, New Mexico, that Contribute to Understanding Its Hydrogeologic Framework. U.S. Department of the Interior, U.S. Geological Survey, Professional Paper 1761.

Halterman, M. D., M. J. Johnson, J. A. Holmes, and S. A. Laymon. 2015. Draft—A Natural History Summary and Survey Protocol for the Western Distinct Population Segment of the Yellow-billed Cuckoo. U.S. Fish and Wildlife Techniques and Methods. 45 pp. Internet website: http://www.southernsierrare search.org/Workshop/YellowBilledCuckooWorkshop/Materials/Halterman%20et %20al%202015.pdf.

Harpold, Adrian, Joel Biederman, Katherine Condon, Manuel Merino, Yoganand Korgaonkar, Tongchao Nan, Lindsey Sloat, et al. 2013. "Changes in snow accumulation and ablation following the Las Conchas Forest Fire, New Mexico, USA." *EcoHydrology*. 7(2): 440–452.

Hawley, John. 1998. "Overview of the hydrogeology and geohydrology of the northern Rio Grande Basin - Colorado, New Mexico, and Texas." Presented at the WRRI Conference Proceedings, 1999. Las Cruces, New Mexico.

HDR (Henningson, Durham, and Richardson, Inc.). 2014a. Pojoaque Basin Regional Water System Project–Aquatic Habitat Survey Summary. February 2014. Albuquerque, New Mexico.

HDR. 2014b. Groundwater Technical Memo prepared for the Pojoaque Basin Regional Water System. U.S. Department of the Interior, Bureau of Reclamation. Albuquerque, New Mexico.

HDR-CDM Joint Venture. 2016. Pojoaque Basin Regional Water System Water Treatment Plant Pilot Study: Pilot Study Results Report. May 2016. Albuquerque, New Mexico.

HDR and EMPSi (Henningson, Durham, and Richardson, Inc. and Environmental Management and Planning Solutions, Inc.). 2014. Pojoaque Basin Regional Water System Environmental Impact Statement: Water Resources Technical Memorandum: Groundwater. Boulder, Colorado.

Hearne, Glenn A. 1985. "Mathematical model of the Tesuque aquifer system near Pojoaque, New Mexico." U.S. Geological Survey Water-Supply Paper 2205. Alexandria, Virginia.

Hedge, Allen. 2011. Acoustic Environment. DEA3500. January 2011. Cornell University, Ithaca, New York.

HKM (HKM Engineering, Inc.). 2008. Pojoaque Regional Water System Engineering Report. September 2008. Internet website: https://sites.google.com/site/pbwatereis/documents/project-reports.

HUD (U.S. Department of Housing and Urban Development). 2014. Santa Fe Comprehensive Housing Market Analysis. July 1, 2014. Internet website: https://www.huduser.gov/portal/ushmc/chma_archive.html.

Hunt Power. 2015. Verde Transmission Project Frequently Asked Questions. November 2015. Internet website: http://www.huntpower.com/docs/VerdeFAQ201 51119.pdf.

IMPLAN. 2014. MIG, Inc., IMPLAN System (data and software 2014), 502 2nd Street, Suite 301, Hudson, Wisconsin 54016.

INTERA (INTERA Incorporated). 2016a. Hydrologic Modeling and Analyses Associated with a Proposed Regional Water System in the Pojoaque River Basin. July 31, 2016.

INTERA. 2016b. Report for Analyses Associated with Top of the World Farms Water Rights Transfer. Albuquerque, New Mexico. May 6, 2016.

Jemez y Sangre Water Planning Council. 2003. Jemez y Sangre Regional Water Plan. Prepared by Daniel B. Stephens & Associates and Amy C. Lewis. March 2003. Albuquerque, New Mexico.

Jemez y Sangre Water Planning Council. 2008. Jemez y Sangre Regional Water Plan: 2007 Update Report, Phase 1. July 17, 2008. Albuquerque, New Mexico.

Jemez y Sangre Water Planning Council and Daniel B. Stephens & Associates. 2002. White Paper, Alternative: Utilize San Juan-Chama Project Water. White Paper Jemez y Sangre Water Plan Alternatives Assessment Charrette. February 2002. Albuquerque, New Mexico.

JGMS (JG Management Systems, Inc.). 2014. Final Environmental Investigation Report. Produced for the Bureau of Reclamation, Albuquerque Area Office – Pojoaque Basin Regional Water System. September 29, 2014. Albuquerque, New Mexico.

JMEC (Jemez Mountains Electric Cooperative). 2014. Table of Contents – Rates and Service Area & District Map. Internet website: http://www.jemezcoop.org/index.cfm.

Kaven, J. O., S. Hickman, and A. McGarr. 2015. "Surface monitoring of microseismicity at the Decatur, IL, CO_2 sequestration demonstration site." *Seismological Research Letters* 86(4).

Keating, Elizabeth. 2002. Overview of the Hydrogeology of the Española Basin, New Mexico, Los Alamos Laboratories.

Kelley, Vincent C. 1978. Geology of the Española Basin, New Mexico: Socorro, New Mexico Bureau of Mines and Mineral Resources Geologic Map 48, scale 1:125,000.

LANL (Los Alamos National Laboratory). 2008. Interim Measure Work Plan to Mitigate Contaminated Sediment Transport in Los Alamos and Pueblo Canyons. Los Alamos National Laboratory document LA-UR-08-1071, Los Alamos, New Mexico. 101714. February 2008.

LANL. 2011. 2010 Geomorphic Changes at Sediment Transport Mitigation Sites in the Los Alamos and Pueblo Canyon Watersheds. Los Alamos National Laboratory document LA-UR-11-2970 (203661). Los Alamos, New Mexico. May 2011.

LANL. 2015. 2014 Annual Site Environmental Report. Report LA-UR-15-27513. Environmental Impact Statement. Santa Fe, New Mexico.

Lavine, Alexis, Gregory Kuyumjian, Steven Reneau, Danny Katzman, and Daniel Malmon. 2005. "A five-year record of sedimentation in the Los Alamos Reservoir, New Mexico, following the Cerro Grande Fire." Proceedings of the Eighth Federal Interagency Sedimentation Conference (8thFISC), April 2-6, 2006, Reno, Nevada, USA. U.S. Geological Survey. Internet website: http://pubs.usgs.gov/misc/FISC_1947-2006/pdf/1st-7thFISCs-CD/8thFISC/Poster_Lavine.pdf.

Lazarus, Jay, and Paul Drakos. 2014. "Geohydrologic characteristics and hydrocarbon contamination of the shallow alluvial/Tesuque Formation aquifer, Santa Fe, New Mexico." *New Mexico Geological Society, 46th Field Conference, Geology of the Santa Fe Region*. Pp. 307–311.

Lewis, A. C., K. MacClune, and K. Tyler. 2013. Climate Change and the Santa Fe Basin: A Preliminary Assessment of Vulnerabilities and Adaptation Alternatives. Albuquerque, New Mexico. Prepared by Amy C. Lewis, Hydrology and Water Planning, and Karin MacClune and Kari Tyler, Institute for Social and Environmental Transition. Prepared for the Bureau of Reclamation, City of Santa Fe, and Santa Fe County. February 2013.

Lewis, Amy, and Francis West. 1995. Conceptual Hydrologic Systems for Santa Fe County. New Mexico Geological Society, 46th Field Conference, Geology of the Santa Fe Region. Internet website: https://nmgs.nmt.edu/publications/guidebooks/downloads/46/46_p0299_p0306.pdf.

Lichvar, R. W. and S. M. McColley. 2008. A Field Guide to the Identification of the Ordinary High Water Mark (OHWM) in the Arid West Region of the Western United States. Cold Regions Research and Engineering Laboratory. U.S. Army Engineer Research and Development Center, Hanover, New Hampshire.

Linhoff B., P. Longmire, M. Rearick, D. McQuillan, G. Perkins. 2016. "Water quality and hydrogeochemistry of a basin and range watershed in a semi-arid region of Northern New Mexico." *Environmental Earth Science* 75:640. April 11, 2016.

Lyman, J., S. L. Reneau, D. Katzman, A. Levine, and D. V. Malmon (Los Alamos National Laboratory). 2005. Characterization of Erosion and Deposition of Sediment in Pueblo Canyon, Los Alamos, New Mexico, Following the Cerro Grande Fire. Los Alamos National Laboratory report LA-14231, Los Alamos, New Mexico. June 2005.

Malone, P., and R. Barrows. 1990. "Groundwater pollution's impacts on residential property values, Portage County, Wisconsin." *Journal of Soil and Water Conservation* 45(2).

Maurer, E. P., L. Brekke, T. Pruitt, and P. B. Duffy. 2007. Fine-resolution climate projections enhance regional climate change impact studies. *Eos Trans. AGU* 88(47). Internet website: http://gdo-dcp.ucllnl.org/downscaled_cmip_ projections/dcpInterface.html.

McAda, Douglas P., and Maryann Wasiolek. 1988. Simulation of the regional geohydrology of the Tesuque aquifer system near Santa Fe, New Mexico. U.S. Geological Survey Water Resources Investigations Report 87-4056. Internet website: https://pubs.er.usgs.gov/publication/wri874056.

McLin, Stephen, Everett Springer, and Leonard Lane. 2001. Predicting floodplain boundary changes following the Cero Grande wildfire. Los Alamos National Laboratory report LA-UR-01-1819. Los Alamos, New Mexico.

McQuillan, Dennis, Benjamin Linhoff, Patrick Longmire, Michael Rearick, Robert Gallegos, Karen Torres, Stephen Wiman, et al. 2009. Private Domestic Well Testing in the Santa Fe Region. New Mexico Environment Department, Los Alamos National Laboratory, the City of Santa Fe, Santa Fe County, and the Good Water Company. Internet website: https://www.env.nm.gov/fod/ liquidwaste/documents/SF.Co.09.water.test.results2.pdf.

Melillo, J. M., T. Richmond, and G. Yohe. 2014. Climate Change Impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program. Washington, DC.

New Mexico Bureau of Mines and Mineral Resources. 1990. A Compilation of Trace Metal Values in Water and Sediments Collected Along the Rio Grande and its Tributaries in New Mexico. Data from Selected Published and Unpublished Sources, Open File Report 359. April 1990. Socorro, New Mexico.

New Mexico Office of the State Engineer. 2006. The Impact of Climate Change on New Mexico's Water Supply and Ability to Manage Water Resources. Santa Fe, New Mexico.

New Mexico Office of the State Engineer. 2011. W.A.T.E.R.S. geodatabase. Internet website: http://www.ose.state.nm.us/WRAB/index.php.

New Mexico Office of the State Engineer. 2013. New Mexico Water Use by Categories 2010, by John W. Longworth, PE, Julie M. Valdez, Molly L. Magnuson, PE, and Kenneth Richard, New Mexico Office of the State Engineer, Technical Report 54. October 2013. Santa Fe, New Mexico.

New Mexico Office of the State Engineer. 2016. Well Records Database. Santa Fe, New Mexico.

New Mexico Tourism. 2014a. El Camino Real National Scenic Byway. Internet website: http://www.newmexico.org/el-camino-trail/.

New Mexico Tourism. 2014b. High Road to Taos Scenic Byway. Internet website: http://www.newmexico.org/high-road-to-taos-trail/.

NHD (National Hydrography Dataset). 2013. GIS data describing perennial, intermittent, and ephemeral streams. National Hydrography Dataset. Internet website: ftp://rockyftp.cr.usgs.gov/vdelivery/Datasets/Staged/Hydro/FileGDB101/.

NMDA (New Mexico Department of Agriculture). 2009. New Mexico Noxious Weed List Update. Memorandum, dated April 1, 2009. New Mexico State University, Las Cruces.

NMDA. 2016. New Mexico Noxious Weed List Update. Memorandum, dated October 19, 2016. New Mexico State University, Las Cruces. Internet website: http://www.nmda.nmsu.edu/wp-content/uploads/2016/11/Weed-List-memo-and-weed-list-2016.pdf.

NMDFA (New Mexico Department of Finance and Administration). 2011. 2011 Facts Display Tables. Internet website: http://nmdfa.state.nm.us/Property_Tax_ Facts.aspx.

NMDFA. 2012. Local Government Division. Property Tax Facts for Tax Year 2012. Internet website: http://nmdfa.state.nm.us/uploads/FileLinks/ff1373ca37bb 4c4f800f868687821827/Property_Tax_Facts_for_2012_for_Web.pdf.

NMDGF (New Mexico Department of Game and Fish). 2014. 2014-2015 New Mexico Hunting Rules and Information. Published by the New Mexico Department of Game and Fish, Information and Education Division. Santa Fe, New Mexico.

NMDGF and Natural Heritage New Mexico. 2013. Biota Information System of New Mexico (BISON-M) Data: Rio Grande Sucker, information from Colorado database. References not available. Coordinator in Colorado is Donald Schrupp, 6060 North Broadway, Denver 80216. Phone (303) 291-7277.

NMDOT (New Mexico Department of Transportation). 2013. Environmental Assessment for NM 30 Improvement Project. NMDOT Environmental Section. February 21, 2013. Santa Fe, New Mexico.

NMDOT. 2014. District 5 Projects. Internet website: http://dot.state.nm.us/en/ProjectsD5 .html.

NMDOT. 2015a. TIMS Road Segments by Posted Route/Point with AADT Info, U.S. Routes. Run date May 27, 2015. Santa Fe, New Mexico.

NMDOT. 2015b. TIMS Road Segments by Posted Route/Point with AADT Info, NM Routes. Run date May 27, 2015. Santa Fe, New Mexico.

NMDOT (New Mexico Department of Transportation), City of Albuquerque, Albuquerque Metropolitan Arroyo Flood Control Authority, The University of New Mexico Environmental Health, Southern Sandoval County Arroyo Flood Control Authority, City of Rio Rancho, Bernalillo County Public Works, and New Mexico Environment Department. 2012. National Pollutant Discharge Elimination System Manual: Storm Water Management Guidelines for Construction and Industrial Activities Revision 2. August 2012. Santa Fe, New Mexico.

NMDTR (New Mexico Department of Tourism) 2014. Annual Report 2014. Internet website: http://nmtourism.org/wp-content/uploads/2014/01/2014-NMTD-Annual-Report-9-30-14.pdf.

NMED (New Mexico Environment Department). 2007. Distribution of Radionuclides in Northern Rio Grande Fluvial Deposits near Los Alamos National Laboratory. NMED, Department of Energy Oversight Bureau, Santa Fe, New Mexico. April 2007.

NMED. 2008. Los Alamos National Laboratory Legacy Contaminant Study at the Buckman Direct Diversion. NMED, Department of Energy Oversight Bureau. August 2008. Santa Fe, New Mexico.

NMED. 2010. Inventory of New Mexico Greenhouse Gas Emissions: 2000-2007. Santa Fe: New Mexico Environment Department.

NMED. 2011. Las Conchas Fire Impacts to Water Quality in the Rio Grande. Department of Energy Oversight Bureau. Internet website: https://www.env.nm.gov/swqb/Wildfire/6.LasConchas-ImpactsToRioGrande2011.pdf.

NMED. 2012. 2012-2014 State of New Mexico Clean Water Act 303(d)/305(b) Integrated Report, effective May 8, 2012. Santa Fe, New Mexico.

NMED. 2013. Surface Water Quality Standards. U.S. EPA Approval Effective on June 5, 2013. Internet website: http://www.nmenv.state.nm.us/swqb/Standards/.

NMED. 2014a. 2014-2016 State of New Mexico Clean Water Act 303(d)/305(b) Integrated Report. September 9, 2014. Santa Fe, New Mexico.

NMED. 2014b. NPDES Permits in New Mexico. Internet website: http://www.nmenv.state.nm.us/swqb/Permits/.

NMED. 2014c. Ground Water Quality Bureau, Remediation Oversight Bureau. Active State Cleanup Sites. Internet website: http://www.nmenv.state.nm.us/gwb/RemediationOversight/.

NMED. 2016. Infrastructure Development Report. NMED, Santa Fe, New Mexico. January 2016. Internet website: https://www.env.nm.gov/cpb/documents/LatestInfrastructureDevelopmentReportCPB.pdf.

NMEMNRD (New Mexico Energy, Minerals, and Natural Resources, Forestry Division). 2015. New Mexico State Endangered Plant Species. Internet website: http://www.emnrd.state.nm.us/SFD/ForestMgt/documents/19212NMACEndangeredPlants.pdf.

NMGCB (New Mexico Gaming Control Board). 2014. Revenue Sharing (2008–2013). Internet website: http://www.nmgcb.org/tribal/revsharing.html.

NMHPD (New Mexico Historic Preservation Division). 2013. User's Guide to the New Mexico Cultural Resource Information System: Guidelines for Submitting Cultural Resource Records. State of New Mexico Department of Cultural Affairs, Historic Preservation Division, Santa Fe.

NMOS (New Mexico Ornithological Society). 2016. Searchable Database for the NMOS Field Notes. Internet website: http://www.nhnm.unm.edu/partners/NMOS.

NMRPTC (New Mexico Rare Plant Technical Council). 1999. New Mexico Rare Plants, Albuquerque, New Mexico Rare Plants Home Page (latest update 20 April 2015). Internet website: http://nmrareplants.unm.edu/index.html

Northern Río Grande National Heritage Area, Inc. 2013. Internet web site: http://riograndenha.com/.

NPS (National Park Service). 1990. Guidelines for Evaluating and Documenting Traditional Cultural Properties. National Register Bulletin 38. USDI National Park Service. Government Printing Office, Washington, DC.

NRCS (Natural Resources Conservation Service). 2008. Soil Survey of Santa Fe County Area, New Mexico. Natural Resources Conservation Service, U.S. Department of Agriculture. Internet website: http://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/new_mexico/NM687/0/SantaFe.pdf.

NRCS. 2013. Soil Survey Staff, United States Department of Agriculture. Web Soil Survey. Internet website: http://websoilsurvey.nrcs.usda.gov.

NRCS. 2016. National Soil Survey Handbook. Natural Resources Conservation Service, U.S. Department of Agriculture. March 2016.

NRCS GIS. 2014. GIS data for New Mexico soil survey 687 attribute, using the Soil Data Viewer: Map unit name, corrosive soils, rutting, and hydric soils. Natural Resources Conservation Service. Internet website: http://datagateway.nrcs.usda.gov/.

Okun, Adam, Ethan Kalosky, Shawn Kelley, and Teresa Hurt. 2014. Cultural Resources Literature Review for the Pojoaque Basin Regional Water System Study Area. Report No. PMX-2013-7, Parametrix, Albuquerque, New Mexico.

Page, W., and H. Rabinowitz. 1993. "Groundwater contamination: Its impacts on property values and cities." *JAPA* 59(4).

Parametrix. 2014a. Technical Memorandum: Pojoaque Basin Regional Water System, Results of Preliminary Wildlife Habitat and Wetlands Evaluation. January 2014. Albuquerque, New Mexico.

Parametrix. 2014b. Technical Memorandum: Pojoaque Basin Regional Water System, Results of Sensitive Wildlife Habitat Reconnaissance Field Trip. August 2014. Albuquerque, New Mexico.

Parametrix. 2017. Pojoaque Basin Regional Water System Wetland and Non-wetland Waters Delineation Report. October 2017. Albuquerque, New Mexico.

Parametrix and Southern Sierra Research Station. 2016. Yellow-billed Cuckoo Surveys and Population Monitoring on the Lower Colorado River and Tributaries, 2015 Annual Report. Prepared by D. Tracy and S. E. McNeil, Southern Sierra Research Station, Weldon, California, and Parametrix, Inc., Albuquerque, New Mexico. Submitted to the Bureau of Reclamation, Boulder City, Nevada. February 2016.

Pitts, Al. 2006. Demographic and economic profile of the greater Pojoaque Valley 1990-2010. Santa Fe County Land Use Planning Division. Santa Fe, New Mexico

Platania, S. P. 1993. The fishes of the Rio Grande between Velarde and Elephant Butte Reservoir and their habitat associations. University of New Mexico Museum of Southwestern Biology, Albuquerque.

Platania, S. P. 1995. Reproductive Biology and Early Life-History of Rio Grande Silvery Minnow, Rio Grande Silvery Minnow, *Hybognathus amarus*. U.S. Army Corps of Engineers, Albuquerque, New Mexico.

Platania, S. P., and C. S. Altenbach. 1998. "Reproductive strategies and egg types of seven Rio Grande Basin cyprinids." *Copeia* 1998: 559–569.

PNM (Public Service Company of New Mexico). 2014. Electric Service Guide 2013, Service Area Detail, and 19th Revised Rate No. 1A. Internet website: https://www.pnm.com/.

Pueblo de San Ildefonso. 2014. Water Quality: Monthly Physiochemical Parameters and Tribal Designated Uses. Internet website: http://www.sanipueblo.org/water-quality.aspx

Pueblo of Nambé. 2006. Nambé O-Ween-Ge Water Quality Code. Internet website: http://water.epa.gov/scitech/swguidance/standards/wqslibrary/tribes.cfm#r6.

Pueblo of Pojoaque. 1999. Pueblo of Pojoaque Revised Water Quality Standards. Internet website: https://www.epa.gov/wqs-tech/water-quality-standards-regulations-pueblo-pojoaque.

Pueblo of Tesuque. 2005. Pueblo of Tesuque Water Quality Standards. Internet website: http://water.epa.gov/scitech/swguidance/standards/wqslibrary/tribes.cfm#r6.

Purtymun, William, and Steven Johanson. 1974. General geohydrology of the Pajarito Plateau. New Mexico Geological Society, 25th Field Conference. Los Alamos, New Mexico.

Reclamation (U.S. Department of the Interior, Bureau of Reclamation). 2005. Pueblo de San Ildefonso River Maintenance Priority Site: Geomorphic Trends Assessment. September 2005. Albuquerque, New Mexico.

Reclamation. 2007a. Cochiti Lake: Operations Fact Sheet. Internet website: http://www.usbr.gov/uc/albuq/water/SanJuanChama/Reservoirs/fs/sjc_cochiti.html.

Reclamation. 2007b. Middle Rio Grande River Maintenance Plan Summary. May 2007. Albuquerque, New Mexico.

Reclamation. 2011. Final Environmental Assessment and Finding of No Significant Impact: San Juan-Chama Project Repayment Contracts Taos Pueblo Indian Water Rights Settlement Act. November 2011. Albuquerque, New Mexico.

Reclamation. 2012. Middle Rio Grande River Maintenance Program Comprehensive Plan and Guide. Albuquerque, New Mexico. April 2012.

Reclamation. 2013a. Pojoaque Basin Regional Water System Environmental Impact Statement Scoping Report. August 2013. Albuquerque Area Office, New Mexico.

Reclamation. 2013b. West-Wide Climate Risk Assessment: Upper Rio Grande Impact Assessment. Reclamation Upper Colorado Region, Albuquerque Area Office. Albuquerque, New Mexico.

Reclamation. 2013c. Nambé Falls Reservoir 2013 Bathymetric Survey. July 2013.

Reclamation. 2013d. Literature Research Report: Biological Resources. Prepared for the Pojoaque Basin Regional Water System Environmental Impact Statement. Prepared by EMPSi, Parametrix, and HDR. April 2013.

Reclamation. 2014a. Pojoaque Barrier Dam Extension Alternatives. Reclamation Technical Service Center. Denver, Colorado.

Reclamation. 2014b. Technical Guidance for Incorporating Climate Change Information into Water Resources Planning Studies. Washington, DC. September 2014.

Reclamation. 2015a. Final Environmental Assessment and Finding of No Significant Impact: San Juan-Chama Project Repayment Contract. Aamodt Litigation Settlement Act. October 2015. Reclamation, Albuquerque Area Office, Albuquerque, New Mexico.

Reclamation. 2015b. Pojoaque Basin Regional Water System Feasibility Design Report. Albuquerque Area Office, Upper Colorado Region. October 2015. Albuquerque, New Mexico.

Reclamation. 2015c. Memorandum: Daily-Timestep Flow Projections at the Otowi Stream Gage to support the Pojoaque Basin Regional Water System Environmental Impact Statement. June 22, 2015.

Reclamation. 2016a. Technical Report No. SRH-2016-14 Rio Tesuque Channel Modification Alternatives. Reclamation Technical Service Center. Denver, Colorado.

Reclamation. 2016b. Pojoaque Basin Regional Water System: Water Treatment Plant Pilot System—Pilot Study Results Report. May 2016. Denver, Colorado.

Reclamation GIS. 2017. GIS data used to describe the Pojoaque Basin Regional Water System alternatives, study areas, and infrastructure, including primary source water collection, water treatment, long-term storage/secondary water supply, short-term storage, transmission and distribution system, access roads, and electrical power. Draft EIS data developed June 2014–January 2016; Final EIS data developed June–July 2017. Bureau of Reclamation, Upper Colorado Region, Albuquerque Area Office, New Mexico.

Reclamation and City of Albuquerque. 2004. Final Environmental Impact Statement City of Albuquerque Drinking Water Project. Prepared by the U.S. Department of the Interior, Bureau of Reclamation and City of Albuquerque Public Works Department in cooperation with the U.S. Army Corps of Engineers. June 2, 2004. Albuquerque, New Mexico.

Rees, D. E., R. J. Carr, and W. J. Miller. 2005. Rio Grande Chub (*Gila pandora*): A technical conservation assessment. USDA Forest Service, Rocky Mountain Region. May 11, 2005. Internet website: http://www.fs.fed.us/r2/projects/scp/assessments/riograndechub.pdf.

Rood, S. B. and Polzin, M. L. 2003. "Big old cottonwoods." *Canadian Journal of Botany* 81(7): 764–776.

Rosgen, David. 2006. *Watershed Assessment of River Stability and Sediment Supply (WARSSS).* Wildland Hydrology Books. Fort Collins, Colorado.

Santa Fe County. 2000a. Rio Tesuque Community Land Use Plan. Internet website: http://www.santafecountynm.gov/userfiles/RioTesuquePlan.pdf.

Santa Fe County. 2000b. Ordinance No. 2000-13. Tesuque Zoning. Internet website: http://www.santafecountynm.gov/documents/ordinances/2000-13TESUQUEZONING.pdf

Santa Fe County. 2002. Ordinance No. 2002-3. March 2002. Internet website: http://www.santafecountynm.gov/userfiles/Community_Planning_Ordinanc.pdf.

Santa Fe County. 2007. Pojoaque Valley Community Strategic Plan. Prepared by the Pojoaque Valley Planning Committee and the Santa Fe County Planning Division. August 2007. Internet website: http://www.santafecountynm.gov/userfiles/CPFINAL%20PLAN%20-AUG2007.pdf.

Santa Fe County. 2010. Santa Fe County Sustainable Growth Management Plan. November 2010. Internet website: http://www.santafecountynm.gov/userfiles/SGMP.pdf.

Santa Fe County. 2013. Tesuque Community Plan 2013. Santa Fe County and Tesuque Valley Planning Committee. December 2013. Internet website: http://www.santafecountynm.gov/userfiles/Planning_Update_2014/TesuqueCommunityPlan2013.pdf.

Santa Fe County. 2014a. Population Estimates and Forecasts for: Growth Management Areas, Sustainable Development Areas, and the Water/Wastewater Service Area. County of Santa Fe. October 2014. Santa Fe, New Mexico.

Santa Fe County. 2014b. Comparative Costs of Water at Various Utilities around the Aamodt Settlement Area. Internet website: http://www.santafecountynm.gov/userfiles/Aamodt_2013/WaterRatesAamodtComparison.pdf.

Santa Fe County. 2014c. Economic Development Plan 2014. Prepared By David Breecker Associates. June 2014. Santa Fe, New Mexico.

Santa Fe County. 2016. Santa Fe County Capital Improvement Planning Project Overview. Internet website: http://www.santafecountynm.gov/userfiles/SF-County-Capital-Projects-Descriptions-03-13.pdf.

Santa Fe County Volunteer Fire District. 2016. Insurance Services Organization (ISO) Ratings. Internet website: https://www.santafecountynm.gov/media/files/iso info2016.pdf. Updated April 2016.

Santa Fe Economic Development. 2016. Lodgers tax report. Fiscal year 2016. Santa Fe, New Mexico.

Schultz, S. 2007. The Impact of Rural Water Supply Systems on Property Values USGS/NIWR 104G Project: # 2005NE83G. August, 31, 2007. Omaha, Nebraska.

Sechrist, J., V. Johanson, and D. Ahlers. 2009. Western Yellow-billed Cuckoo Radio Telemetry Study Results—Middle Rio Grande New Mexico—2007–2008. U.S. Bureau of Reclamation, Technical Service Center, Denver, Colorado.

Sechrist J., D. D. Ahlers, K. P. Zehfuss, R. H. Doster, E. H. Paxton, and V. M. Ryan. 2013. "Home range and the use of habitat of western yellow-billed cuckoos on the Middle Rio Grande, New Mexico." *Southwestern Naturalist* 58(4): 411–419.

SEINet (Southwest Environmental Information Network). 2014. Species checklists. Internet website http://swbiodiversity.org/seinet/checklists/index.php.

Service (U.S. Department of the Interior, Fish and Wildlife Service). 1999. Rio Grande Silver Minnow Recovery Plan (*Hybognathus amarus*). First Revision. Southwest Region, Albuquerque, New Mexico.

Service. 2004. Biological Opinion on the Effects of Actions Associated with the Programmatic Biological Assessment (BA) for the City of Albuquerque Drinking Water Project. New Mexico Ecological Services Field Office. February 13, 2004. Albuquerque, New Mexico.

Service. 2005. Final Report Fish Surveys and Habitat Assessment in the Rio Chama and Rio Grande Upstream of Cochiti Lake. Prepared by Mike Buntjer, New Mexico Ecological Services Field Office, and Jason Remshardt, U.S. Fish and Wildlife Service, New Mexico Fishery Resources Office. Albuquerque, New Mexico. Internet website: http://www.fws.gov/southwest/es/Documents/R2ES/Rio _Grande_Silvery_Minnow_Recovery_Plan_First_Revision.pdf.

Service. 2011. Migratory Bird program Focal Species Strategy. Internet website: www.fws.gov/migratorybirds/dmbmdbhc.html.

Service. 2012. Endangered and threatened wildlife and plants; review of native species that are candidates for listing as endangered or threatened. Annual Notice of Findings on Resubmitted Petitions; Annual Description of Progress on Listing Actions. Proposed rules, 77(25 [Wednesday]):69994-70060. November 21, 2012.

Service. 2014. Species Status Assessment Report New Mexico meadow jumping mouse (*Zapus hudsonius luteus*). Albuquerque, New Mexico.

Service. 2015. NWI. Wetlands Mapper. Internet website: http://www.fws.gov/wetlands/ Data/Mapper.html.

Service. 2016a. IPaC. Internet website: http://www.ecos.fws.gov/ipac.

Service. 2016b. Critical Habitat Portal. Internet website: http://www.criticalhabitat .fws.gov/crithab/.

Service. 2016c. Migratory Bird Treaty Act Trust Resources List. Internet website: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Management/BCC.html.

Service. 2017. National Wetland Inventory Mapper. 2015 through 2017. Internet website: https://www.fws.gov/wetlands/index.html.

Service and NMFS (U.S. Fish and Wildlife Service and National Marine Fisheries Service). 2004. Endangered Species Act – Section 7 Consultation, Informal Concurrence and Formal Biological Opinion and Conference and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation Oregon Department of Transportation's OTIA III Statewide Bridge Delivery Program, Oregon. NOAA Fisheries NWR 2004/00209; USFWS file #8330.02233 (04).

Sherwood, D. 2014. Valuation of Easements. Right of Way magazine. November/December 2014. Pp. 36-39. Internet website: https://www.irwaonline .org/eweb/upload/web_novdec_14_Valuation.pdf.

Sminchak, J., N. Gupta, C. Byrer, and P. Bergman. Undated. Issues Related to Seismic Activity Induced by the Injection of CO_2 in Deep Saline Aquifers. U.S. Department of Energy, National Energy Technology Laboratory. Columbus, Ohio.

Smith, M. D., R. S. Krannich, and L. M. Hunter. 2001. "Growth, decline, stability, and disruption: A longitudinal analysis of social well-being in four western rural communities." *Rural Sociology* 66 (3): 425–450.

Souder, Miller and Associates. 2016. Preliminary 50 year Water Demand Forecast. Prepared for the Pueblo of Tesuque. August 26, 2016. Albuquerque, New Mexico.

Souder, Miller and Associates GIS. 2017. Preliminary GIS data on Pueblo de San Ildefonso Wastewater Improvements. Received from Royce Beaudry, July 2017. Santa Fe, New MExico.

Spiegel, Zane, and Brewster Baldwin. 1963. Geology and Water Resources of the Santa Fe Area, New Mexico. U.S. Geological Survey Water Supply Paper 1525. Washington, DC.

Sublette, J. E., M. D. Hatch, and M. Sublette. 1990. *The Fishes of New Mexico*. University of New Mexico Press, Albuquerque.

SWReGAP (Southwest Regional Gap Analysis Project). 2014. Internet website: http:// earth.gis.usu.edu/swgap/.

Thomsen, F., K. Lüdemann, R. Kafemann, and W. Piper. 2006. Effects of offshore wind farm noise on marine mammals and fish. Internet website: http://www.thecrown estate.co.uk/media/5935/km-ex-pc-noise-062006-effects-of-offshore-windfarm-noise-on-marine-mammals-and-fish.pdf.

Tibbs, John E. 1998. Flathead Chub (*Platygobio gracilis*): Rangewide Status Assessment. Report Prepared for the U.S. Fish and Wildlife Service, Region 3. June 1998. Columbia, Missouri.

Tourism Economics. 2012. The Economic Impact of Tourism in New Mexico. 2011 analysis.

TripAdvisor.com. 2016. Santa Fe County hotel information. Internet website: http://www.tripadvisor.com/Tourism-g60958-Santa_Fe_New_Mexico-Vacations.html.

Tsui, P. T. P., and P. J. McCart. 1981. "Impacts of stream crossing by a pipeline on the benthic macroinvertebrate communities of a small mountain stream." *Hydrobiologia* 79: 271–276.

U.S. Census Bureau. 1980. 1980 Census of Population: General Population Characteristics, United States Summary and New Mexico. Internet website: http://www.census.gov/prod/www/decennial.html.

U.S. Census Bureau. 1990. 1990 Census of Population: General Population Characteristics, United States Summary. Internet website: http://www.census.gov/prod/www/decennial.html.

U.S. Census Bureau. 2000. Census 2000, Summary File 1, Table DP-1 and Summary File 3, Table DP-3; generated by Lauren Zielinski, using American FactFinder. Internet website: http://factfinder2.census.gov.

U.S. Census Bureau. 2014a. American Community Survey, 2014 American Community Survey 5-Year Estimates, Tables DP-02, DP-03, DP-04, DP-05; generated by Mary Patterson, using American FactFinder. Internet website: http://factfinder 2.census.gov.

U.S. Census Bureau. 2014b. Poverty threshold by size of family. Internet website: http://www.census.gov/hhes/www/poverty/data/threshld/index.html.

U.S. District Court, New Mexico District. 2016. Partial Final Judgment and Decree of the Water Rights of the Pueblos of Nambé, Pojoaque, San Ildefonso, and Tesuque. March 23, 2016.

USACE (United States Army Corps of Engineers). 1998. Installation of Pipelines Beneath Levees Using Horizontal Directional Drilling. April 1998. Vicksburg, Mississippi.

USACE. 2008. Environmental Laboratory. Regional Supplement to the Corps of Engineers (Wetland Delineation Manual: Arid West Region [Version 2.0]). September 2008. Vicksburg, Mississippi. USACE. 2012a. Public Notice Application Number SPA-2012-00442-ABQ. Albuquerque, New Mexico.

USACE. 2012b. ETEBA Presentation. August 9, 2012. Internet website: https://www .eteba.org/images/stories/presentations/presentation9aug12.pdf.

USACE. 2015. Española Valley, Rio Grande and Tributaries, New Mexico: Draft Final Integrated Feasibility Report and Environmental Assessment. USACE, Albuquerque District, South Pacific Division, Albuquerque, New Mexico. August 2015. Internet website: http://www.spa.usace.army.mil/Portals/16/docs/environmental/fonsi/Espa%C3%B1ola%20Valley,%20Rio%20Grande%20and%20Tributaries,%20New%20Mexico%20Draft%20Integrated%20Report%20and%20Environmental%20Assessment.pdf.

USACE. 2016. Española Valley, Rio Grande and Tributaries. Internet website: http://www.spa.usace.army.mil/Media/FactSheets/FactSheetArticleView/tabid/2135/Article/479098/espaola-valley-rio-grande-and-tributaries.aspx.

USDA NRCS, USGS, and EPA (U.S. Department of Agriculture Natural Resources Conservation Service, the U.S. Geological Survey, and the U.S. Environmental Protection Agency). 2014. The Watershed Boundary Dataset (WBD). Watershed Boundary Dataset for New Mexico HUC 2 and 10. Internet website: http://datagateway.nrcs.usda.gov.

USGS (U.S. Geological Survey). 2008. Analysis of the Magnitude and Frequency of Peak Discharge and Maximum Observed Peak Discharge in New Mexico and Surrounding Areas. Scientific Investigations Report 2008-5119. Reston, Virginia.

USGS. 2011. Three-Dimensional Geologic Model of the Southeastern Española Basin, Santa Fe County, New Mexico. USGS. Internet website: http://pubs.usgs.gov/sir/2011/5025/downloads/Report/sir2011-5025.pdf.

USGS. 2017. NHD (National Hydrography Dataset), online interactive mapper. 2015 through 2017. Internet website: http://nhd.usgs.gov/.

USGS. Various years. Water Resources Data for New Mexico. Internet website: http://nm.water.usgs.gov/.

USGS and Scripps Institution of Oceanography. 2007. Trends in Snowfall versus Rainfall for the Western United States, 1949 to 2001. La Jolla, California.

Vesselinov, Vemir, and Elizabeth Keating. 2002. Analysis of Capture Zones of the Buckman Well Field and a Proposed Horizontal Collector Well North of the Otowi Bridge. Los Alamos National Laboratory. May 2002. Los Alamos, New Mexico.

Vinikour, W. S., and J. P. Schubert. 1987. Impacts of Gas-pipeline Construction on the Aquatic Ecosystem of Canada Creek, Presque Isle County, Michigan. Report to Gas Research Institute, Chicago, Illinois.

Wasiolek, M. 1995. Subsurface Recharge to the Tesuque Aquifer System from Selected Drainage Basins along the Western Side of the Sangre de Cristo Mountains near Santa Fe, New Mexico. U.S. Geological Survey Water Resources Investigations Report 94-4072. Albuquerque, New Mexico.

Waters, T. F. 1995. "Sediment in streams; sources, biological impacts, and control." *American Fisheries Society* Monograph 7.

Wendorf, Fred, and Erik Reed. 1955. "An alternative reconstruction of Northern Rio Grande Prehistory." *El Palacio* 62: 131–173.

Work Safe. 2015. Noise levels created by common construction tools. Work Safe New Zealand. March 2015. Internet website: http://construction.worksafe.govt.nz/assets/resources/WSNZ-1311-Construction-Machinery-Fact-Sheet-v5.pdf.

WSDOT (Washington State Department of Transportation). 2015. Biological Assessment Preparation, Advanced Training Manual, Version 02-2015. Chapter 7.0, Construction Noise Impact Assessment. Olympia, Washington.

Young, R. J., and G. L. Mackie. 1991. "Effect of oil pipeline construction on the benthic invertebrate community structure of Hodgson Creek, Northwest Territories." *Canadian Journal of Zoology* 69: 2154–2160.

This page intentionally left blank.

CHAPTER 8 GLOSSARY

7Q10. The average peak annual flow for seven consecutive days that has a recurrence interval of ten years; the lowest stream flow for seven consecutive days that would be expected to occur once in ten years.

100-year flood. A flood that statistically has a 1 percent chance of occurring in any given year.

Aamodt Litigation Settlement Act (Settlement Act). The Settlement Act (Title VI of the Claims Resolution Act of 2010 [Public Law 111–291, Title VI; 124 Stat. 3065]) authorizes and ratifies the Settlement Agreement, dated January 19, 2006. It also confirms that the Settlement Agreement is consistent with the Settlement Act. The settlement parties include the United States, the State of New Mexico, Santa Fe County, the City of Santa Fe, the Pueblo de San Ildefonso, the Pueblo of Nambé, the Pueblo of Pojoaque, and the Pueblo of Tesuque, and other individual defendants.

Acequia. A community operated watercourse used for irrigation.

Acre-foot (af). The amount of water that would cover 1 acre with 1 foot of water. One acre foot is equal to 0.326 million gallons.

Active channel. The portion of the channel that is frequently flooded by the low-flow channel.

Air pollution. Degradation of air quality resulting from unwanted chemicals or other materials occurring in the air.

Alluvial aquifer. A permeable formation that forms naturally underground by deposition of weathered material, such as sand and silt particles, and stores or conducts groundwater to wells and springs. Water flow in these types of aquifers is very slow.

Ambient air quality. The state of the atmosphere at ground level as defined by the range of measured and/or predicted ambient concentrations of all significant pollutants for all averaging periods of interest.

Annual average daily traffic (AADT). The total volume of vehicle traffic of a highway or road for a year divided by 365 days.

Archaeological site. A location that contains material remains of past human activities, generally defined as over 50 years old.

Aquifer storage and recovery (ASR). A process that conveys water underground to replenish groundwater stored in aquifers, which is later recovered for reuse.

Artifact. A human-modified object, often appearing on an archaeological site, that typically dates to over 45 years in age.

Attainment area. A geographic area in which levels of a criteria air pollutant meet the health-based National Ambient Air Quality Standard for that specific pollutant.

Bankfull width. The horizontal distance from bank to bank at an elevation equal to the bankfull elevation at any cross section.

Base flow. Sustained low flows in a stream, often composed largely of groundwater effluent.

Borrow pit. In construction and civil engineering, a borrow pit, also known as a sand box, is an area where material (usually soil, gravel, or sand) has been dug for use at another location. Borrow pits can be found close to many major construction projects.

Bosque. A gallery forest found along the riparian floodplains of streams and riverbanks in the southwestern United States.

Buildout. The area of land projected to be developed as part of a municipality or district in the future. Generally, the prediction is for maximum capacity for the residential, commercial, industrial, and municipal development of that community.

Cation. An ion with a positive charge (as opposed to an anion, which has a negative charge).

Carbon Dioxide (CO_2). A naturally occurring gas, and also a by-product of burning fossil fuels and biomass, as well as land-use changes and other industrial processes. It is the principal human caused greenhouse gas that affects the Earth's radiative balance. It is the reference gas against which other greenhouse gases are measured.

Carbon dioxide equivalents (CO_2e). Carbon dioxide equivalents. A measure that accounts for the global warming potential of the different greenhouse gases.

Climate. Climate is the generally prevailing weather conditions of a particular region throughout the year, averaged over a series of years.

Climate change. Any significant change in measures of climate (such as temperature, precipitation, or wind) lasting for an extended period (decades or longer). Climate change may result from:

- natural factors, such as changes in the sun's intensity or slow changes in the Earth's orbit around the sun
- natural processes within the climate system (e.g., changes in ocean circulation)
- human activities that change the atmosphere's composition (e.g., driving automobiles) and the land surface (e.g., deforestation, reforestation, urbanization, and desertification)

Criteria pollutant. The EPA uses six "criteria pollutants" as indicators of air quality, and has established for each of them a maximum concentration above which adverse effects on human health may occur. These threshold concentrations are called National Ambient Air Quality Standards. The criteria pollutants are ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter and lead.

Cienega. Small marsh.

Clear well. A container, sometimes referred to as a contact tank, where chemical disinfecting agents are added to disinfect water during the treatment process.

Consumptive use. The amount of water used up by applying that water to beneficial use. Examples are water for drinking and water taken up by growing crops.

Cooperating agency. A federal, state, Tribal or local agency having special expertise with respect to an environmental issue or jurisdiction by law. During the NEPA process, a cooperating agency assists the lead agency by participating at the earliest possible time; by participating in the scoping process; by participating in developing information and preparing environmental analyses, including portions of the environmental impact statement where it has special expertise; and participating in making available staff support at the lead agency's request to enhance the agency's interdisciplinary capabilities.

Corrosive soil. A sensitive soil type with the potential to corrode concrete or steel. The common indicators of a soil's tendency to corrode materials its porosity, electrical conductivity or resistivity, dissolved salt content, moisture content, and pH.

Critical habitat. Specific geographic areas, whether occupied by listed species or not, that are determined to be essential for the conservation and management of listed species and that have been formally described in the *Federal Register*.

Cultural resource. The present expressions of human culture and the physical remains of past activities, such as historic buildings, structures, objects, districts, landscapes, and archaeological sites. These resources can be significant in the context of national, regional, or local history, architecture, archaeology, engineering, or culture. They may also include sacred sites and natural features of landscapes that are significant to living communities.

Cut slope. The excavated portion of a roadway upslope of the road surface.

Emergent wetland. Wetland type that contains emergent plants (erect, rooted, herbaceous, and water loving) as the tallest life form with at least 30 percent coverage.

El Niño-Southern Oscillation conditions. An index of ocean temperatures in the equatorial Pacific Ocean that cycles between warmer and cooler currents. The ENSO index is linked to regional precipitation and temperature influences in New Mexico.

Environmental Protection Agency/New Mexico Water Quality Control Commission (EPA/WQCC) Standards. Drinking water quality standards of New Mexico.

Ephemeral. A drainage basin or stream that flows during storms or other wet times. Typically not supplied by groundwater.

Erosive soil. A soil that meets National Soil Survey Handbook definitions for susceptibility to erosion by wind or water. The U.S. Department of Agriculture defines soils susceptible to erosion by water using a K factor, which ranges from 0.02 to 0.69. Soils with K values less than 0.15 are considered resistant to water erosion; those with K values greater than or equal to 0.40 are assumed to have a high potential for water erodibility.

In order to estimate susceptibility to wind erosion, the U.S. Department of Agriculture uses a wind erodibility index, which assigns soils to eight groups. Those in Group 1 are the most susceptible to wind erosion, and those in Group 8 are the least susceptible. Group classification is based on the composition of the surface, including texture, size, and durability of surface clods, rock fragments, organic matter, and carbonate presence. For this EIS, Groups 1 through 4 were considered to have a high potential of wind erosion, averaging a minimum of 85 tons of soil per acre per year lost to wind.

Exchange. A process by which water, under certain conditions, may be diverted out of priority at one point by replacing a like amount of water at a downstream location.

Expansive clay. A type of sensitive soil that has a high shrink-swell potential. This is the relative change in volume to be expected with changes in moisture content; that is, the extent to which the soil shrinks as it dries out or swells when it gets wet. Soils with a high shrink-swell potential have a 6 percent or greater linear extensibility, a liquid limit greater than 40 percent, and a plasticity index greater than 25 percent.

Federal action. An action by a federal agency. This may include supplying funding for a project, authorizing or permitting a project, or undertaking or sponsoring a project.

Firm, reliable water supply. A water supply that is able to provide up to 4,000 afy of drinking water for the RWS while having the capacity to satisfy estimated peak demands and providing some level of fire protection, based on available budget.

Firm yield. Also called firm annual yield or dry-year firm yields. The annual yield that is available during a defined drought period.

Flood Insurance Rate Map (FIRM). An official map published by FEMA that shows locations of flood risks in a community.

Floodplain. Flat areas next to rivers and streams that are subject to inundation from precipitation. Any area that can be inundated with water. In this EIS, a floodplain can refer to either an area having unique vegetative or channel characteristics caused by flooding or a regulatory area, generally the 1 percent annual change (100-year) flood.

Fluvial. Found in rivers or streams.

Fugitive dust. Significant atmospheric dust arises from the mechanical disturbance of granular material exposed to the air. Dust generated from these open sources is termed "fugitive" because it is not discharged to the atmosphere in a confined flow stream. Common sources of fugitive dust include unpaved roads, agricultural tilling operations, aggregate storage piles, and heavy construction operations.

Gabion. A partitioned, wire fabric container, filled with stone at the site of use, to form flexible, permeable structures for earth retention.

General project area. Approximate quarter-mile buffer surrounding all proposed project features, including the RWS infrastructure, the Pojoaque River Barrier Dam modification project, the Rio Tesuque channel modifications project, and the Pueblo de San Ildefonso future water-related infrastructure projects.

General circulation model. A type of computer model used to predict or forecast global climate. These models are coupled with projections of future greenhouse gas emissions and other assumptions to predict future climate scenarios.

Global warming potential (GWP). A measure of the total energy that a gas absorbs over a particular period of time (usually 100 years), compared to carbon dioxide.

Greenhouse gas (GHG). Any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include carbon dioxide, methane, nitrous oxide, ozone, chlorofluorocarbons, hydrochlorofluorocarbons, hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride.

Groundwater. Water found under ground in porous rock strata and soils.

Hazardous waste. EPA defines as waste that is dangerous or potentially harmful to health or the environment. Hazardous wastes can be liquids, solids, gases, or sludges. They can be discarded commercial products, like cleaning fluids or pesticides, or the byproducts of manufacturing processes.

Historic built environment. Buildings, structures, objects, districts, and linear features such as roads, trails, and acequias (irrigation ditches) that are at least 50 years old.

Historic property. Cultural resources—such as historic buildings, structures, objects, districts, or archaeological sites—that are listed on, or eligible for inclusion on, the National Register of Historic Places.

Hydric soil. Soils in which anaerobic conditions have developed.

Hydrograph. A graph of flow past a point in a river over time.

Hyporheic zone. An area beneath a river or streambed that is water saturated and supports invertebrate fauna.

Impaired water. A water body that repeatedly exceeds regulatory water quality limits in one or more types of contamination or conditions.

Indian trust assets (ITAs). Legal interests in property held in trust by the United States for the beneficial interest of federally recognized Indian Tribes or individual Indians**.**

Indirect economic impact. The change in sales, income, or employment in the local region in industries that supply goods and services directly to affected businesses.

Induced impact. The change in sales in the local impact region that result from changes in local household spending of income, for example, on housing, utilities, and groceries. Induced impact is from income earned in the tourism, construction, and other supporting industries.

Intermittent. A stream or drainage that flows periodically during the year. It may flow during certain seasons or storm, but it does not flow year-round. Intermittent streams may or may not be supplied by groundwater.

Isolated occurrence. Cultural manifestations that are at least 50 years old that do not meet the definition of an archaeological site; typically locations with fewer than 10 artifacts or with an isolated feature that lacks integrity.

Key observation point (KOP). One of a series of critical viewpoints on a travel route or at a use area where the proposed project would be most revealing. This is usually along commonly traveled routes or at other likely observation points, such as culturally or locally significant sites.

Kiva. A Native American ceremonial structure common in the Southwest.

Long-term impacts. Impacts that would occur beyond construction and from operation of the proposed facilities.

Loss. Loss of water that results from such factors as system loss and evaporation.

Macroalgae. Large aquatic plants.

Maximum contaminant level (MCL). The legal threshold limit on the level of a hazardous substance that is allowed in drinking water under the Safe Drinking Water Act.

The limit is usually expressed as a concentration in milligrams or micrograms per liter of water.

Mesic. Of, characterized by, or adapted to a moderately moist habitat.

Methane (CH_4). A hydrocarbon that is a greenhouse gas with a global warming potential most recently estimated at 25 times that of carbon dioxide. Methane is produced through anaerobic (without oxygen) decomposition of waste in landfills, animal digestion, decomposition of animal wastes, production and distribution of natural gas and petroleum, coal production, and incomplete fossil fuel combustion.

Metric ton. Common measurement for the quantity of greenhouse gas emissions. A metric ton is equal to 2,205 pounds or 1.1 short tons.

Midden. An area of accumulated domestic refuse.

Mitigation measure. A measure taken to offset the adverse impacts of an action or activity.

National Ambient Air Quality Standard (NAAQS). The specified average concentration of an air pollutant in ambient air during a specified time period, at or above which level the public health may be at risk. National ambient air quality standards have been set for the following criteria pollutants: carbon monoxide, nitrogen dioxide, ozone, sulfur dioxide, lead, and two categories of particulate matter (particulate matter with an aerodynamic diameter of 10 microns or less [PM_{10}] and particulate matter with an aerodynamic diameter of 2.5 microns or less [$PM_{2.5}$]).

National Register of Historic Places (NRHP). A listing of resources that are considered significant at the national, state, or local level and that have been found to meet specific criteria of historic significance, integrity, and age.

National Flood Insurance Program. A federal program enacted by Congress in 1968 intended to promote beneficial floodplain management and reduce national costs of floods.

National Pollution Discharge Elimination System (NPDES). A program created by the Clean Water Act of 1972 that regulates discharge of pollutants into public waters.

Near bank stress and bank erosion hazard indices (NBS/BEHI). The NBS/BEHI, defined by Rosgen, illustrate the potential resiliency of a particular bank to channel forming flows. It considers bank angles, grain size composition, vegetative cover, root density and armoring, as well as the relationship between the deepest near-shore depths to bank heights.

Nitrous oxide (N_2O). A greenhouse gas with a global warming potential of 298 times that of carbon dioxide (CO_2). Major sources of nitrous oxide include soil cultivation practices, especially the use of commercial and organic fertilizers, fossil fuel combustion, nitric acid production, and biomass burning.

Nitrogen dioxide (NO_2). Nitrogen dioxide. A molecule of one nitrogen and two oxygen atoms. Results usually from further oxidation of nitric oxide (NO) in the atmosphere. Ozone accelerates the conversion.

Paleontological resource. Any fossilized remains or traces of organisms that are preserved in, or on, the earth's crust, that are of scientific interest and that provide information about the history of life.

Particulate matter. One of the six "criteria" pollutants for which the EPA established National Ambient Air Quality Standards. Particulate matter is defined as two categories, fine particulates, with an aerodynamic diameter of 10 micrometers (PM_{10}) or less, and fine particulates with an aerodynamic diameter of 2.5 micrometers or less ($PM_{2.5}$).

Parts per billion (ppb). A measure of the amount of one substance found in a second, which is the carrier.

Parts per million (ppm). Parts per million, a measure of the amount of one substance found in a second, which is the carrier.

Perennial stream. A stream that flows continuously throughout the year.

Phreatophyte. Any plant species that obtains a significant portion of the water that it needs to survive from the zone of saturation or the capillary fringe above the zone of saturation. These species are found in riparian ecosystems and other areas characterized by shallow groundwater, such as bottomlands.

Pipe bursting. A trenchless method of replacing buried pipelines by breaking existing pipelines and pushing them from their original location. The replacement pipe, attached behind the bursting head, is then fed into place, filling the cavity left behind by the bursting head.

Pithouse. A prehistoric dwelling, typically circular, built partially underground.

Pojoaque Basin. Section 602(13) of the Aamodt Litigation Settlement Act defines the basin as the geographic area limited by a surface water divide in which rainfall and runoff flow into arroyos, drainages, and named tributaries. These eventually drain into the Rio Pojoaque, the two unnamed arroyos immediately south of Rio Pojoaque, or the two arroyos (including Arroyo Alamo) that are immediately north of the confluence of the Rio Pojoaque and the Rio Grande. The Pojoaque Basin includes the San Ildefonso Eastern Reservation.

Pool. Aquatic habitat in a stream with low gradient that is normally deeper and wider than aquatic habitats immediately above and below it.

Project component. Components include things such as firm, reliable water supply, water treatment, short-term storage, and electrical power service.

Project element. A specific structure such as a water treatment plant or short-term storage tank.

Protocol survey. A wildlife survey of threatened and endangered species that is designed to provide clear guidelines to surveyors in order to standardize methods and produce uniform reporting of results.

Qualitative. A form of assessment that analyzes the impacts in a descriptive manner (e.g., low, moderate, or high).

Quantitative. A form of impact assessment that analyzes the impacts using numerical metrics (e.g., acres or cubic feet per second).

Return flow. Water that returns to streams and rivers after it has been applied to beneficial use. Return flows may return as surface flow or as an inflow of tributary groundwater.

Riffle. A rocky or shallow part of a stream or river with rough water.

Riparian. Areas along creeks or streams and between the aquatic and terrestrial environment; river-influenced.

Rio Grande Compact. An interstate compact enacted in 1939 that allocates the native waters of the Rio Grande between Colorado, New Mexico, and Texas.

Riverine. Wetland contained within a channel.

RWS service area. The general geographic area that would have access to treated water via the RWS, including the Pueblo of Pojoaque, Pueblo of Nambé, Pueblo of Tesuque, Pueblo de San Ildefonso, and portions of Santa Fe County.

San Juan-Chama Project. A system of diversion structures and tunnels for trans-mountain movement of water from the San Juan River Basin to the Rio Grande Basin. It was authorized as a participating project of the Colorado River Storage Project to supply water to the middle Rio Grande Valley for municipal, domestic, and industrial uses.

Section 404 permit. An authorization granted by the U.S. Army Corps of Engineers under Section 404 of the Clean Water Act to place dredge or fill material in a Water of the United States.

Sedimentation. The transport of sediment into a water body.

Sensitive soils. A collection of soil types whose properties give them special cause of consideration and analysis. These soil types are erosive soil, corrosive soil, or expansive clay.

Short-term impacts. Those that would generally occur during construction.

Short-term storage tank. A permanent tank that would provide up to a 2-day domestic supply of water, plus fire protection flow storage.

Sinuosity. Sinuosity provides an index of the degree of channel meander, or the number of bends in a river over a given distance. A ratio of 1.0, where the channel length is the same as the down valley distance, indicates a perfectly straight channel. The degree of sinuosity is generally characterized as low for ratios less than 1.2, moderate for ratios of 1.2 to 1.5, and high for ratios greater than 1.5.

Slip lining. A method of restoring stability to an existing pipeline by installing a smaller "carrier pipe" into a larger "host pipe," grouting the space between the two pipes, and sealing the ends.

Special status species. State or federal threatened or endangered species, as well as proposed or candidate species for threatened or endangered status.

Spoil pile. A pile built of the waste material (spoil) removed during construction.

Stationary source. Refers to a stationary source of emissions. Prevention of Significant Deterioration permits are required for major new stationary sources of emissions that emit 100 tons or more per year of carbon monoxide, sulfur dioxide, nitrogen dioxide, ozone, or particulate matter.

Storage right. A water right that is measured in terms of volume. Storage rights allow a water user to store water for later beneficial use.

Stormwater best management practice. A set of treatment or prevention activities or constructed facilities intended to reduce pollutants entering public waters.

Stormwater pollution prevention plan (SWPPP). A requirement of the NPDES intended to limit erosion and sediment transport during construction projects using BMPs.

Superfund site. A U.S. EPA-identified abandoned hazardous waste site.

Surface water. Water that flows on the surface, either in streams or as surface runoff across the ground.

Take (as defined by the Endangered Species Act). To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct; may include significant habitat modification or degradation if it kills or injures wildlife by significantly impairing essential behavioral patterns including breeding, feeding, or sheltering.

Top of the World water rights. Water rights appurtenant to the Top of the World Farms near Taos, New Mexico. Santa Fe County has acquired these water rights and has transferred them to the United States, in accordance with the Aamodt Litigation Settlement Agreement.

Total dissolved solids. Combined content of all inorganic and organic substances contained in a liquid, which are present in a molecular, ionized, or micro-granular form. Primary sources of TDS are agricultural runoff, leaching of soil contamination, and point-source water pollution discharge from industrial or sewage treatment plants.

Total net win. The amount wagered on slot machines, minus payouts and regulatory fees.

Transfer. The sale or purchase of a water right.

Trash racks. Structures that prevent floating and particulate debris from clogging outlet control structures.

Trust land. Land held in trust by the United States for federally recognized Indian Tribes or individual Indians.

Turbidity. The cloudiness of water due to the presence of suspended particles.

Upland. Hills, plains, mesas, or other areas not in riparian or wetland areas, where the vegetation is not supplied by hydrology from a stream or drainage.

Upper Rio Grande Water Operations Model. A computer model of the upper Rio Grande that simulates water flow, reservoir storage, consumptive and environmental water uses, and water rights.

Water delivery. The amount of water delivered to a water user.

Water demand. The amount of water that municipalities or regions require for everyday functioning.

Water right. A right to use, in accordance with its priority, a portion of the waters of the state by reason of the appropriation of the same.

Waters of the United States. As defined in the Clean Water Act, all waters that are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters that are subject to the ebb and flow of the tide. All interstate waters including interstate wetlands. All other waters, such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, whose use, degradation, or destruction could affect interstate or foreign commerce.

Wetland. Area near the margin between water and land (such as swamps and marshes) that is wet enough to support plant growth typically found in saturated soil conditions.

Yield. The amount of water that a water right supplies under a defined scenario.

Zone A floodplains. Those for which base flood elevations have not been established.

CHAPTER 9 INDEX

100-year flood, ES-18, 2-5, 2-10, 2-35, 3-52, 3-53, 4-92, 4-114, 4-115, 4-116, 4-117, 4-118, 4-119, 4-120, 4-121, 4-122
7Q10, 3-40, 3-41
Aamodt Litigation Settlement Act (Settlement Act), ES-1, ES-2, ES-4, ES-5, ES-6, ES-7, ES-17, ES-20, 1-1, 1-2, 1-3, 1-4, 1-7, 1-8, 1-14, 2-1, 2-2, 2-11, 2-13, 2-14, 2-28, 2-29, 2-67, 2-90, 2-113, 2-117, 3-1, 4-176, 4-177
Aamodt Litigation Settlement Agreement (Settlement Agreement), ES-1, ES-5, 1-1, 1-3, 1-4, 1-7, 2-28, 2-67, 2-112, 2-116, 2-117, 3-89, 3-90, 4-177, 4-269, 5-3
Abiquiu Lake, 2-112
Access road, ES-9, ES-10, 1-12, 2-7, 2-11, 2-14, 2-17, 2-21, 2-24, 2-26, 2-30, 2-32, 2-33, 2-34, 2-35, 2-37, 2-38, 2-39, 2-40, 2-44, 2-47, 2-50, 2-51, 2-52, 2-57, 2-58, 2-59, 2-60, 2-61, 2-65, 2-67, 2-70, 2-71, 2-72, 2-73, 2-78, 2-84, 2-85, 2-92, 4-20, 4-64, 4-65, 4-70, 4-98, 4-141, 4-182, 4-185, 4-187, 4-188, 4-189, 4-195, 4-200, 4-203, 4-206, 4-208, 4-210, 4-213, 4-215, 4-217, 4-218, 4-219, 4-220, 4-227, 4-242, 4-243, 4-244, 4-270, 4-311, 4-312, 4-317
Acequia, ES-14, ES-15, 1-12, 1-13, 2-76, 2-79, 2-102, 2-117, 3-15, 3-82, 3-84, 3-86, 3-87, 3-117, 4-153, 4-168, 4-169, 4-170, 4-171, 4-173, 4-174, 4-175, 4-192, 4-222, 4-310, 5-3
Active channel, 3-15, 3-16, 4-3, 4-5, 4-9
Air pollution, 4-70
Air quality, ES-4, ES-18, 1-14, 2-11, 2-97, 2-108, 3-1, 3-3, 3-35, 4-63, 4-64, 4-66, 4-67, 4-69, 4-70, 4-71, 4-72, 4-73, 4-74, 4-75, 4-76, 4-79, 4-260, 4-264, 4-271, 4-281, 4-301, 6-3, 6-5
Albuquerque, 3-7, 3-9, 3-26, 3-27, 3-45, 3-95, 3-102, 4-305, 4-306, 5-4, 5-7, 6-1
Alluvial aquifer, 2-68, 2-69, 3-19
Ambient air quality, 3-35, 4-65, 4-70, 4-301
Annual average daily traffic (AADT), 3-103, 4-229
Antimony, 3-27
Aquatic resources, ES-19, 2-100, 2-109, 3-4, 3-43, 3-51, 3-61, 4-111, 4-139, 4-140, 4-142, 4-143, 4-146, 4-150, 4-151, 4-152, 4-153, 4-154, 4-155, 4-156, 4-157, 4-158, 4-305, 4-318, 6-4
Aquifer storage and recovery (ASR), ES-7, ES-8, ES-11, 2-2, 2-10, 2-20, 2-22, 2-26, 2-27, 2-29, 2-30, 2-32, 2-33, 2-34, 2-40, 2-41, 2-42, 2-96, 2-113, 3-3, 4-7, 4-20, 4-22, 4-43, 4-46, 4-68, 4-78, 4-80, 4-83, 4-84, 4-177, 4-186, 4-187, 4-262, 4-264, 4-265, 4-266, 4-268, 4-271, 4-273, 4-274, 4-294
Archaeological site, 2-102, 3-79, 3-83, 3-84, 3-85, 3-86, 3-87, 4-168, 4-175
Arroyo, ES-15, ES-18, 1-4, 1-11, 1-12, 2-5, 2-9, 2-10, 2-32, 2-33, 2-42, 2-49, 2-80, 3-1, 3-6, 3-12, 3-13, 3-15, 3-16, 3-28, 3-31, 3-33, 3-55, 3-61, 3-63, 3-65, 3-120, 4-3, 4-5, 4-17, 4-28, 4-32, 4-34, 4-35, 4-38, 4-39, 4-112, 4-113, 4-115, 4-116, 4-117, 4-118, 4-119, 4-141, 4-142, 4-143, 4-146, 4-158, 4-299
Arsenic, 3-27, 3-28, 3-29, 3-109, 4-30, 4-31, 4-280
Artifact, 3-82, 3-84, 3-85, 4-171
Attainment area, 3-35
Bank erosion hazard index (BEHI), 3-16
Bankfull width, 2-86, 3-15
Barium, 3-27, 3-29, 3-109, 4-31
Base flow, ES-17, 4-3, 4-4, 4-5, 4-24, 4-35

Best management practice (BMP), 2-11, 4-32, 4-37, 4-39, 4-40, 4-42, 4-47, 4-50, 4-54, 4-65, 4-66, 4-67, 4-97, 4-99, 4-104, 4-107, 4-110, 4-132, 4-134, 4-136, 4-143, 4-149, 4-161, 4-264, 4-271, 4-273, 4-280, 4-281, 4-282, 4-297
Bicarbonate, 3-27
Birds, migratory, 3-57, 4-131, 4-305
Birds, waterfowl, 3-58
Boron, 3-27
Borrow pit, 1-11, 2-12, 2-24, 2-30, 2-44, 2-55, 2-65
Bosque, ES-12, 2-11, 2-44, 2-46, 2-53, 2-63, 2-67, 2-70, 2-75, 2-111, 3-73, 4-148, 4-149, 4-150, 4-154
Buckman Direct Diversion (BDD), 3-20, 3-24, 3-26, 3-66, 4-245, 4-251, 4-294, 4-297, 4-305, 4-306, 4-310
Buffalo Thunder Resort and Casino, 3-111, 3-130
Buildout, 4-1, 4-5, 4-19, 4-20, 4-23, 4-298
Bureau of Indian Affairs (BIA), ES-1, ES-5, ES-13, 1-1, 1-7, 1-8, 2-13, 2-92, 3-43, 3-66, 3-79, 3-80, 4-3, 4-5, 4-170, 4-176, 4-184, 4-293, 5-4, 5-5, 5-6, 5-7
Bureau of Land Management (BLM), 3-20, 3-32, 3-33, 3-66, 3-69, 3-70, 3-75, 3-90, 4-56, 4-57, 4-58, 4-59, 4-60, 4-61, 4-62, 4-63, 4-147, 4-196, 4-293
Bureau of Reclamation (Reclamation), ES-1, ES-4, ES-5, ES-6, ES-7, ES-10, ES-11, ES-13, ES-14, ES-15, ES-19, 1-1, 1-2, 1-4, 1-7, 1-8, 1-9, 1-12, 1-13, 1-15, 2-1, 2-2, 2-5, 2-6, 2-8, 2-9, 2-11, 2-12, 2-13, 2-14, 2-15, 2-26, 2-27, 2-28, 2-30, 2-33, 2-35, 2-36, 2-37, 2-39, 2-40, 2-41, 2-42, 2-43, 2-44, 2-46, 2-47, 2-48, 2-49, 2-51, 2-52, 2-54, 2-55, 2-57, 2-58, 2-59, 2-61, 2-62, 2-63, 2-64, 2-65, 2-67, 2-68, 2-69, 2-70, 2-71, 2-72, 2-73, 2-74, 2-75, 2-76, 2-78, 2-80, 2-81, 2-85, 2-87, 2-88, 2-89, 2-91, 2-92, 2-111, 2-112, 2-113, 2-114, 2-115, 2-117, 3-1, 3-6, 3-7, 3-8, 3-9, 3-14, 3-15, 3-16, 3-17, 3-30, 3-36, 3-37, 3-38, 3-40, 3-43, 3-49, 3-52, 3-53, 3-62, 3-66, 3-79, 3-80, 3-82, 3-83, 3-88, 3-98, 3-108, 4-1, 4-3, 4-4, 4-6, 4-7, 4-8, 4-9, 4-10, 4-11, 4-21, 4-22, 4-23, 4-29, 4-30, 4-31, 4-32, 4-43, 4-44, 4-45, 4-48, 4-49, 4-51, 4-52, 4-53, 4-54, 4-56, 4-58, 4-60, 4-62, 4-66, 4-78, 4-79, 4-83, 4-85, 4-89, 4-95, 4-100, 4-101, 4-102, 4-105, 4-110, 4-111, 4-112, 4-113, 4-114, 4-115, 4-116, 4-117, 4-118, 4-119, 4-122, 4-123, 4-125, 4-129, 4-130, 4-131, 4-134, 4-135, 4-136, 4-140, 4-141, 4-142, 4-143, 4-144, 4-145, 4-147, 4-148, 4-149, 4-150, 4-151, 4-152, 4-153, 4-154, 4-155, 4-156, 4-157, 4-158, 4-159, 4-160, 4-161, 4-168, 4-170, 4-171, 4-184, 4-186, 4-196, 4-222, 4-230, 4-231, 4-241, 4-251, 4-252, 4-253, 4-254, 4-255, 4-257, 4-259, 4-260, 4-261, 4-262, 4-264, 4-265, 4-270, 4-273, 4-277, 4-278, 4-293, 4-296, 4-299, 4-302, 4-305, 4-308, 4-317, 5-1, 5-2, 5-3, 5-4, 5-5, 5-6, 5-7, 6-1
Calcium, 3-25, 3-27
Camel Rock Casino, 1-11, 1-12, 2-38, 2-43, 2-50, 2-54, 2-60, 2-71, 2-73, 2-74, 2-75, 3-93, 3-130, 4-219, 4-221
Candidate species, 3-69, 4-161
Carbon dioxide (CO_2), 3-40, 4-80
Carbon dioxide equivalents (CO_{2e}), 3-40, 3-43, 4-80
Census-designated place (CDP), 3-123, 3-124, 3-125, 3-128, 4-280, 4-282
Chloride, 2-11, 3-27, 4-251
Chromium, 3-27, 4-30
Cienega, 3-53
Clean Air Act (CAA), 3-35, 4-63, 4-77
Clean Water Act (CWA), ES-5, ES-17, 1-7, 2-1, 2-36, 2-37, 2-49, 2-70, 2-79, 2-82, 2-91, 3-3, 3-21, 3-23, 3-24, 3-51, 3-52, 4-16, 4-27, 4-28, 4-33, 4-35, 4-36, 4-37, 4-38, 4-111, 4-120, 4-124, 4-128, 4-129, 4-253, 4-254, 5-7

Clear well, 2-6, 2-57, 2-58, 2-111, 4-209, 4-212, 4-214, 4-218, 4-219, 4-220
Climate change, ES-18, 2-48, 2-58, 2-69, 2-97, 2-108, 3-3, 3-36, 3-37, 3-38, 3-40, 3-53, 4-3, 4-7, 4-8, 4-21, 4-77, 4-78, 4-79, 4-80, 4-81, 4-82, 4-83, 4-84, 4-85, 4-86, 4-87, 4-88, 4-89, 4-90, 4-91, 4-92, 4-93, 4-94, 4-112, 4-190, 4-302, 6-2
Cobalt, 3-27
Cochiti Lake, ES-19, 3-6, 3-8, 3-9, 3-25, 3-61, 3-62, 3-66, 3-71, 3-78, 4-3, 4-9, 4-12, 4-141, 4-159, 4-293, 4-307
Code of Federal Regulations (CFR), ES-1, ES-13, 1-1, 1-7, 2-111, 3-4, 3-51, 3-71, 4-2, 4-167, 4-170, 4-186, 4-293, 4-316, 5-1, 5-6
Comment period, ES-6, 1-14, 5-3, 5-4
Connected action, ES-1, ES-2, ES-4, ES-13, ES-17, ES-18, ES-19, ES-20, ES-21, 1-1, 1-2, 1-3, 1-7, 1-8, 2-1, 2-76, 2-91, 3-80, 3-83, 3-84, 4-95
Consumptive use, 2-3, 2-4, 3-6, 3-90
Cooperating agency, ES-17, 1-15, 2-1, 5-1, 5-4, 5-5
Copper, 3-25, 3-27, 4-35
Council on Environmental Quality (CEQ), ES-1, ES-7, 1-1, 1-7, 2-2, 2-29, 3-122, 3-126, 4-280, 4-282, 4-293
Criteria pollutant, ES-18, 4-64, 4-66, 4-67, 4-69, 4-71, 4-73, 4-301
Critical habitat, 3-78, 5-7, 6-1
Cultural and historic resources, 3-92, 5-5, 6-2, 6-3, 6-5
Cultural resource, ES-4, 3-1, 3-30, 3-78, 3-79, 3-80, 3-84, 3-85, 3-86, 3-87, 3-92, 3-104, 4-39, 4-50, 4-167, 4-168, 4-170, 4-171, 4-172, 4-173, 4-174, 4-175, 4-180, 4-181, 4-308, 4-317, 4-318, 4-319, 5-5
Cultural resource, isolated occurrence, 3-82
Cultural resource, midden, 3-85
Cultural resource, pithouse, 3-85
Cultural, kiva, 3-85, 3-107
Cumulative impact, ES-17, 1-8, 4-1, 4-2, 4-172, 4-260, 4-293, 4-299, 4-300, 4-301, 4-303, 4-304, 4-305, 4-306, 4-307, 4-308, 4-309, 4-310, 4-311, 4-313, 4-314, 4-315, 4-316
Cut slope, 3-49
Cyanide, 3-27
Eagle, bald, 3-58, 4-130
Easement, ES-5, ES-11, ES-20, ES-21, 1-7, 2-13, 2-26, 2-27, 2-30, 2-44, 2-47, 2-57, 2-65, 2-112, 3-80, 3-89, 4-176, 4-177, 4-178, 4-182, 4-184, 4-185, 4-186, 4-189, 4-261, 4-270, 4-274, 4-287, 4-292
El Niño-Southern Oscillation, 3-37
El Rancho, ES-6, ES-8, ES-12, 1-4, 1-11, 2-12, 2-20, 2-23, 2-38, 2-42, 2-43, 2-44, 2-49, 2-50, 2-54, 2-59, 2-60, 2-64, 2-70, 2-71, 2-75, 2-90, 2-110, 3-86, 3-88, 3-89, 3-94, 3-104, 3-107, 3-120, 3-123, 3-124, 3-128, 3-129, 4-117, 4-187, 4-201, 4-202, 4-204, 4-205, 4-209, 4-212, 4-214, 4-218, 4-219, 4-220, 4-262, 4-295, 5-2
Electrical power service, ES-6, 4-20, 4-32
Endangered species, 3-45, 3-60, 3-71, 4-96, 4-135, 4-164, 4-166, 4-306, 4-318, 4-319
Endangered Species Act (ESA), ES-5, 1-7, 2-1, 3-69, 4-159, 4-161, 5-6, 6-1, 6-2
Energy and utilities, 2-107, 2-110, 3-5, 3-128, 4-287, 4-316, 6-4
Environmental justice, 2-106, 2-110, 3-5, 3-122, 3-123, 3-124, 3-127, 4-279, 4-281, 4-282, 4-315, 6-3
Environmental Protection Agency (EPA), ES-1, 2-5, 2-32, 3-20, 3-21, 3-22, 3-23, 3-25, 3-26, 3-28, 3-29, 3-35, 3-40, 3-108, 3-109, 4-28, 4-30, 4-31, 4-38, 4-64
Environmental Protection Agency/New Mexico Water Quality Control Commission (EPA/WQCC) Standards, 3-28, 3-29, 4-31
Ephemeral, 3-14, 3-22, 3-23, 3-28, 3-61, 3-63, 3-64, 4-152

Española, 2-117, 3-9, 3-10, 3-18, 3-19, 3-20, 3-28, 3-30, 3-31, 3-45, 3-66, 3-86, 3-87, 3-109, 3-120, 3-130, 4-296, 4-305, 4-306, 5-2
Federal action, 3-20, 3-71, 3-89, 3-122, 5-1
Federal Emergency Management Agency (FEMA), 2-35, 3-4, 3-12, 3-14, 3-53, 3-54, 4-17, 4-111, 4-112, 4-113, 4-116, 4-117, 4-118, 4-119, 4-129, 4-293, 4-296, 4-297, 4-304
Firm yield, 3-7
Firm, reliable water supply, ES-6, ES-7, ES-8, ES-12, 1-11, 2-3, 2-4, 2-5, 2-20, 2-22, 2-29, 2-30, 2-44, 2-55, 2-57, 2-64, 4-21, 4-143, 4-148, 4-149, 4-150
Floodplain, ES-5, ES-6, ES-16, ES-18, 1-3, 1-11, 1-13, 2-5, 2-35, 2-81, 2-82, 2-86, 2-99, 2-108, 3-4, 3-32, 3-43, 3-50, 3-51, 3-52, 3-53, 3-54, 3-56, 4-15, 4-17, 4-26, 4-52, 4-90, 4-92, 4-93, 4-107, 4-108, 4-111, 4-112, 4-113, 4-114, 4-115, 4-116, 4-117, 4-118, 4-119, 4-120, 4-121, 4-122, 4-123, 4-124, 4-125, 4-126, 4-127, 4-128, 4-129, 4-136, 4-137, 4-155, 4-156, 4-225, 4-277, 4-296, 4-303, 4-304, 6-3, 6-4
Floodplain, Zone A floodplains, 3-54, 4-117
Fluoride, 3-27, 3-28, 3-29, 3-109, 4-30, 4-31
Fluvial, 3-52, 4-96
Forebay tank, ES-6, 2-9, 2-10, 2-23, 2-39, 2-40, 2-52, 2-61, 2-73, 4-185, 4-186, 4-188, 4-190, 4-198, 4-203, 4-206, 4-210, 4-215, 4-219, 4-221, 4-228
Forest Service, 3-20, 3-62, 3-66, 3-68, 3-69, 3-70, 3-75, 3-90, 3-97, 4-147, 4-293, 4-295, 4-296
Fugitive dust, ES-18, 4-63, 4-64, 4-65, 4-66, 4-67, 4-68, 4-69, 4-70, 4-71, 4-72, 4-73, 4-74, 4-75, 4-76, 4-301
Gabion, 2-78, 2-79, 2-86, 3-13, 4-35, 4-48, 4-222, 4-235, 4-245
General circulation model, 3-36
General project area, ES-2, ES-3, ES-4, 1-4, 1-6, 1-9, 1-13, 2-3, 2-26, 2-30, 2-65, 2-67, 2-82, 2-92, 3-1, 3-2, 3-5, 3-6, 3-12, 3-15, 3-16, 3-17, 3-19, 3-20, 3-21, 3-23, 3-26, 3-27, 3-28, 3-30, 3-31, 3-32, 3-33, 3-35, 3-36, 3-43, 3-45, 3-48, 3-49, 3-50, 3-52, 3-53, 3-54, 3-55, 3-57, 3-61, 3-62, 3-65, 3-66, 3-67, 3-68, 3-69, 3-70, 3-71, 3-74, 3-77, 3-78, 3-79, 3-80, 3-82, 3-83, 3-84, 3-86, 3-87, 3-88, 3-90, 3-92, 3-93, 3-94, 3-95, 3-97, 3-98, 3-102, 3-103, 3-104, 3-108, 3-109, 3-110, 3-128, 4-2, 4-18, 4-19, 4-28, 4-30, 4-39, 4-42, 4-47, 4-50, 4-56, 4-59, 4-61, 4-63, 4-95, 4-96, 4-97, 4-98, 4-99, 4-111, 4-112, 4-113, 4-120, 4-130, 4-140, 4-141, 4-145, 4-146, 4-158, 4-160, 4-162, 4-170, 4-176, 4-185, 4-186, 4-191, 4-199, 4-208, 4-213, 4-217, 4-229, 4-231, 4-232, 4-239, 4-243, 4-244, 4-249, 4-250, 4-253, 4-255, 4-260, 4-287, 4-288, 4-289, 4-293, 4-296, 4-302, 4-303, 4-305, 4-306, 4-307, 4-310, 4-313, 4-317
Geology and soils, 2-96, 2-108, 3-3, 3-30, 4-39, 4-40, 4-299, 6-2, 6-3
Geology and soils, corrosive soil, 2-96, 2-108, 3-30, 4-40, 4-41, 4-47, 4-50, 4-51, 4-52, 4-53
Geology and soils, erosive soil, 3-30, 3-32, 4-40, 4-41, 4-42, 4-43, 4-44, 4-45, 4-46, 4-47, 4-48, 4-49, 4-50, 4-51, 4-52, 4-53, 4-54, 4-299, 4-300
Geology and soils, expansive clay, 3-30, 3-32, 4-40, 4-41, 4-42, 4-43, 4-44, 4-45, 4-46, 4-47, 4-48, 4-50, 4-51, 4-54, 4-55
Geology and soils, hydric soil, 3-51
Geology and soils, sensitive soils, 3-30, 3-32, 4-40, 4-41, 4-42, 4-43, 4-44, 4-45, 4-46, 4-47, 4-48, 4-49, 4-50, 4-51, 4-52, 4-53, 4-54, 4-299, 4-300
Greenhouse gas (GHG), ES-18, 2-97, 2-98, 2-108, 3-3, 3-36, 3-40, 3-43, 4-65, 4-77, 4-78, 4-79, 4-80, 4-81, 4-82, 4-83, 4-84, 4-85, 4-86, 4-87,

4-88, 4-89, 4-90, 4-91, 4-92, 4-93, 4-94, 4-302
Gross, 3-25, 3-26, 3-27, 3-43, 3-121
Gross receipts tax (GRT), 3-121, 3-122
Guaje Canyon, 2-92, 3-20, 3-24, 3-25
Hazardous waste, 3-110, 4-250, 4-252, 4-313
Heron Reservoir, 1-8, 2-5, 3-8, 4-141, 4-305, 4-308
Historic built environment, 3-80, 3-82, 3-86
Historic property, ES-19, 2-102, 2-109, 3-4, 3-78, 3-86, 3-87, 4-167, 4-168, 4-169, 4-171, 4-172, 4-308, 4-318, 5-5, 5-6
HKM Engineering Report, ES-7, 2-2, 2-29, 2-113, 2-115, 2-116
Horizontal radial well collector, ES-8, ES-13, ES-18, 1-11, 1-12, 2-20, 2-22, 2-26, 2-49, 2-52, 2-65, 2-67, 2-68, 2-69, 2-70, 2-73, 2-74, 2-75, 2-111, 3-61, 3-62, 3-67, 4-11, 4-23, 4-34, 4-83, 4-119, 4-120, 4-149, 4-150, 4-151, 4-190, 4-217, 4-218
Hydrograph, 3-13
Indian Health Service (IHS), ES-1, 1-1, 3-108, 3-110, 4-252, 4-253, 4-259, 4-260, 4-293, 4-294, 4-295, 4-309, 4-310, 4-312, 4-314, 4-315, 4-316, 5-4, 5-7
Indian trust asset (ITA), ES-20, 2-102, 2-109, 3-5, 3-88, 3-89, 4-176, 4-178, 4-180, 4-182, 4-309, 4-318, 6-3, 6-4
Induced impact, 4-261, 4-265, 4-266
Infiltration gallery, ES-8, ES-12, ES-14, ES-15, ES-16, 1-13, 2-20, 2-22, 2-26, 2-33, 2-55, 2-57, 2-58, 2-61, 2-62, 2-63, 2-76, 2-78, 2-79, 2-80, 2-84, 2-85, 2-88, 3-13, 4-10, 4-12, 4-13, 4-14, 4-16, 4-23, 4-24, 4-25, 4-26, 4-34, 4-35, 4-44, 4-48, 4-53, 4-72, 4-82, 4-85, 4-88, 4-91, 4-93, 4-104, 4-105, 4-108, 4-118, 4-121, 4-122, 4-123, 4-127, 4-134, 4-135, 4-138, 4-149, 4-150, 4-153, 4-154, 4-157, 4-180, 4-189, 4-213, 4-226, 4-235, 4-236, 4-246, 4-278
Iron, 3-27, 3-29, 3-109, 4-31, 4-251
Key observation point (KOP), 3-5, 3-97, 3-98, 3-101, 4-196, 4-198, 4-200, 4-201, 4-202, 4-203, 4-204, 4-205, 4-206, 4-207, 4-208, 4-209, 4-210, 4-211, 4-212, 4-213, 4-214, 4-215, 4-216, 4-217, 4-218, 4-219, 4-220, 4-221, 4-222, 4-224, 4-226
Land use, ES-20, ES-21, 2-13, 2-103, 2-109, 2-111, 2-112, 2-114, 3-5, 3-12, 3-17, 3-55, 3-90, 3-92, 3-93, 3-94, 3-95, 3-98, 3-117, 4-1, 4-180, 4-182, 4-183, 4-184, 4-185, 4-186, 4-187, 4-188, 4-189, 4-190, 4-191, 4-192, 4-193, 4-194, 4-195, 4-270, 4-309, 4-310, 4-317, 4-318, 4-319, 6-3, 6-4
Los Alamos National Laboratory (LANL), 3-24, 3-25, 3-66, 3-74, 3-77, 3-109, 3-114, 4-29, 4-30
Macroalgae, 3-63, 3-64, 3-65, 3-66
Magnesium, 3-27
Maximum contaminant level (MCL), 3-27, 3-28, 3-109
Mesic, 3-48
Methane (CH_4), 3-40, 4-80
Migratory Bird Treaty Act of 1918 (MBTA), 3-43, 3-57, 3-58, 3-59, 3-60, 3-71, 3-73, 3-74, 4-114, 4-130, 4-133, 4-136, 4-161
Mitigation measure, ES-18, ES-19, ES-21, 1-10, 1-14, 2-12, 2-35, 2-48, 2-58, 2-69, 3-82, 3-87, 4-6, 4-10, 4-13, 4-17, 4-32, 4-35, 4-39, 4-48, 4-49, 4-51, 4-52, 4-53, 4-57, 4-59, 4-61, 4-63, 4-67, 4-71, 4-72, 4-74, 4-75, 4-98, 4-104, 4-107, 4-110, 4-129, 4-131, 4-134, 4-136, 4-148, 4-149, 4-150, 4-151, 4-152, 4-153, 4-154, 4-155, 4-156, 4-157, 4-158, 4-176, 4-185, 4-212, 4-216, 4-221, 4-222, 4-223, 4-224, 4-225, 4-226, 4-235, 4-236, 4-237, 4-242, 4-243, 4-244, 4-245, 4-246, 4-247, 4-248, 4-249, 4-254, 4-256, 4-257, 4-258, 4-260, 4-264, 4-271, 4-280, 4-281, 4-282, 4-301, 4-317
Molybdenum, 3-27

Nambé Falls Reservoir, 2-112, 2-113, 3-8, 3-9, 3-12, 3-13, 3-14, 3-23, 3-118, 4-296, 4-297
National Ambient Air Quality Standards (NAAQS), 3-35
National Environmental Policy Act of 1969 (NEPA), ES-1, ES-5, ES-19, 1-1, 1-7, 1-9, 2-2, 2-46, 2-57, 2-68, 3-79, 3-83, 4-294, 4-316, 5-1, 6-1, 6-2, 6-4
National Flood Insurance Program, 3-54, 4-112
National Historic Preservation Act (NHPA), 3-78, 3-83, 4-170, 5-5
National Hydrography Dataset (NHD), 3-53, 4-142
National Pollutant Discharge Elimination System (NPDES), 3-21, 3-24, 3-27, 3-28, 4-28, 4-33, 4-34, 4-141
National Register of Historic Places (NRHP), 3-79, 3-82, 3-84, 3-86, 4-167, 4-168, 4-170, 4-172, 4-318, 5-5
National Wetlands Inventory (NWI), 3-52, 3-53
Natural Resources Conservation Service (NRCS), 3-6, 3-30, 3-31, 3-32, 3-52, 4-43, 4-44, 4-45, 4-51, 4-52, 4-54
Near bank stress, 3-3
New Mexico Department of Game and Fish (NMDGF), 3-66, 3-67, 3-68, 3-69, 3-70, 3-75, 3-95, 4-153, 5-4
New Mexico Department of Transportation (NMDOT), ES-1, ES-11, 1-1, 2-13, 2-27, 3-79, 3-86, 3-87, 3-98, 3-102, 3-103, 4-32, 4-170, 4-184, 4-186, 4-229, 4-230, 5-4, 5-6, 5-8
New Mexico Environment Department (NMED), 2-5, 3-21, 3-22, 3-23, 3-24, 3-25, 3-26, 3-28, 3-43, 3-108, 3-109, 4-28, 4-29, 4-31, 4-66, 4-80, 4-252, 4-253, 4-259, 4-298
New Mexico State Historic Preservation Office(r) (SHPO), 3-80, 3-82, 4-167, 4-170, 5-5, 5-6
Nickel, 3-27
Nitrate, 3-27, 3-29, 3-109, 4-31
Nitrite, 3-27
Nitrogen dioxide (NO_2), 3-35, 4-64, 4-65, 4-69, 4-70, 4-72, 4-73, 4-76
Nitrous oxide (N_2O), 3-40, 4-80
Noise, ES-6, ES-19, ES-20, ES-21, 1-14, 2-14, 2-104, 2-109, 3-4, 3-5, 3-63, 3-103, 3-104, 3-105, 3-106, 3-107, 3-108, 4-130, 4-137, 4-138, 4-144, 4-145, 4-183, 4-185, 4-187, 4-189, 4-190, 4-192, 4-193, 4-195, 4-238, 4-239, 4-240, 4-241, 4-242, 4-243, 4-244, 4-245, 4-246, 4-247, 4-248, 4-249, 4-264, 4-271, 4-273, 4-275, 4-276, 4-278, 4-280, 4-281, 4-282, 4-284, 4-286, 4-304, 4-305, 4-312, 4-314, 4-315, 4-318, 6-3
Noise inventory site (NIS), 3-103, 3-104, 3-107, 3-108, 4-241, 4-242, 4-243, 4-244, 4-247, 4-249
Nonattainment area, 4-63
Occupational Safety and Health Administration (OSHA), 2-7, 2-11, 4-250, 4-252, 4-256, 4-258
Otowi Bridge, ES-11, ES-12, ES-13, ES-17, 2-5, 2-29, 2-34, 2-37, 2-44, 2-46, 2-48, 2-49, 2-58, 2-65, 2-67, 2-69, 2-111, 2-114, 3-3, 3-6, 3-8, 3-10, 3-11, 3-13, 3-15, 3-22, 3-24, 3-28, 3-40, 3-55, 3-61, 3-62, 3-63, 3-67, 3-69, 3-78, 3-86, 3-101, 3-109, 4-2, 4-3, 4-4, 4-6, 4-12, 4-29, 4-77, 4-79, 4-84, 4-115, 4-141, 4-144, 4-145, 4-147, 4-148, 4-151, 4-169, 4-187, 4-188, 4-189, 4-190, 4-191, 4-293, 4-296, 4-297, 4-307, 4-308
Otowi gage, 2-48, 2-58, 2-69, 3-10, 3-38, 4-3, 4-4, 4-6, 4-21
Ozone (O_3), 3-35, 3-40, 4-251
Paleontological resource, 2-96, 2-108, 3-3, 3-32, 3-33, 4-55, 4-56, 4-57, 4-58, 4-59, 4-60, 4-61, 4-62, 4-63, 4-300, 4-301, 4-317, 4-319, 6-3, 6-4
Parallel river interceptor drain, ES-8, ES-12, 2-20, 2-26, 2-44, 2-46, 2-47, 2-48, 2-52, 2-53, 2-54, 2-57, 2-69, 4-10, 4-11, 4-22, 4-23, 4-33, 4-43, 4-82, 4-117, 4-148, 4-149

Particulate matter, 3-35, 4-65, 4-66, 4-68, 4-69, 4-72, 4-73, 4-76
Particulate matter ($PM_{2.5}$, PM_{10}), ES-18, 3-35, 4-64, 4-65, 4-66, 4-68, 4-69, 4-70, 4-72, 4-73, 4-76
Phosphate, 3-27, 3-65
Pojoaque, ES-1, ES-2, ES-4, ES-5, ES-6, ES-7, ES-14, ES-15, ES-17, 1-1, 1-2, 1-3, 1-4, 1-5, 1-7, 1-10, 1-11, 1-12, 1-13, 1-14, 2-1, 2-2, 2-4, 2-9, 2-10, 2-11, 2-13, 2-27, 2-28, 2-30, 2-32, 2-33, 2-37, 2-38, 2-40, 2-41, 2-43, 2-50, 2-52, 2-53, 2-54, 2-55, 2-60, 2-62, 2-63, 2-64, 2-71, 2-72, 2-73, 2-74, 2-75, 2-76, 2-78, 2-79, 2-93, 2-112, 2-113, 2-117, 3-1, 3-6, 3-7, 3-9, 3-12, 3-13, 3-14, 3-15, 3-16, 3-17, 3-18, 3-20, 3-21, 3-22, 3-23, 3-25, 3-26, 3-28, 3-31, 3-32, 3-33, 3-36, 3-43, 3-45, 3-48, 3-49, 3-52, 3-53, 3-54, 3-55, 3-57, 3-61, 3-63, 3-64, 3-65, 3-68, 3-71, 3-72, 3-73, 3-82, 3-83, 3-85, 3-89, 3-90, 3-92, 3-93, 3-95, 3-97, 3-98, 3-102, 3-103, 3-104, 3-107, 3-108, 3-109, 3-110, 3-111, 3-113, 3-114, 3-117, 3-118, 3-119, 3-120, 3-123, 3-124, 3-128, 3-129, 3-130, 4-2, 4-3, 4-4, 4-12, 4-13, 4-14, 4-18, 4-19, 4-20, 4-24, 4-25, 4-28, 4-29, 4-34, 4-35, 4-43, 4-48, 4-70, 4-78, 4-85, 4-86, 4-95, 4-97, 4-103, 4-104, 4-111, 4-113, 4-115, 4-120, 4-121, 4-122, 4-124, 4-126, 4-127, 4-128, 4-129, 4-130, 4-133, 4-134, 4-140, 4-152, 4-153, 4-154, 4-159, 4-163, 4-164, 4-169, 4-170, 4-171, 4-172, 4-176, 4-177, 4-180, 4-188, 4-191, 4-193, 4-202, 4-205, 4-210, 4-212, 4-215, 4-222, 4-253, 4-271, 4-287, 4-295, 4-296, 4-297, 4-301, 4-303, 4-305, 4-309, 4-310, 4-312, 4-313, 4-314, 4-315, 4-316, 4-317, 4-319, 5-2, 5-3, 5-4
Pojoaque Basin, ES-1, ES-2, ES-4, ES-5, ES-6, ES-7, ES-17, 1-1, 1-2, 1-3, 1-4, 1-5, 1-7, 1-10, 1-13, 1-14, 2-2, 2-11, 2-13, 2-28, 2-53, 2-62, 2-74, 2-117, 3-1, 3-6, 3-12, 3-14, 3-16, 3-17, 3-18, 3-20, 3-21, 3-25, 3-26, 3-31, 3-32, 3-33, 3-36, 3-43, 3-45, 3-48, 3-52, 3-53, 3-55, 3-57, 3-61, 3-71, 3-82, 3-83, 3-89, 3-90, 3-95, 3-97, 3-98, 3-102, 3-103, 3-108, 3-109, 3-110, 3-111, 3-114, 3-117, 3-118, 3-128, 3-129, 3-130, 4-2, 4-3, 4-4, 4-18, 4-19, 4-20, 4-24, 4-28, 4-29, 4-34, 4-35, 4-43, 4-78, 4-95, 4-111, 4-113, 4-115, 4-120, 4-124, 4-126, 4-127, 4-128, 4-129, 4-130, 4-140, 4-159, 4-160, 4-176, 4-177, 4-287, 4-297, 4-303, 4-305, 4-309, 4-313, 4-316, 4-317, 4-319, 5-3
Potassium, 3-27
Potential Fossil Yield Classification (PFYC), 2-96, 2-108, 3-3, 3-32, 3-33, 3-34, 4-55, 4-56, 4-57, 4-58, 4-59, 4-61, 4-63
Primary source water collection, ES-6, ES-8, ES-9, 1-10, 1-11, 2-5, 2-9, 2-10, 2-11, 2-14, 2-15, 2-20, 2-21, 2-22, 2-34, 2-35, 2-46, 2-57, 2-67, 2-69, 2-111, 2-112, 3-78, 4-8, 4-22, 4-23, 4-29, 4-30, 4-32, 4-99, 4-118, 4-144, 4-147, 4-148, 4-149, 4-150, 4-151, 4-228, 4-232, 4-299
Project component, 3-110, 4-261, 4-262, 4-264, 4-265, 4-266, 4-267, 4-273, 4-274, 4-277, 4-278, 4-286
Project element, ES-6, ES-7, ES-18, 2-2, 4-14, 4-20, 4-22, 4-28, 4-34, 4-120, 5-5
Public access, 4-185, 4-228
Pueblo de San Ildefonso, ES-1, ES-2, ES-4, ES-6, ES-11, ES-12, ES-13, ES-14, ES-15, ES-17, ES-18, ES-19, ES-20, 1-1, 1-2, 1-3, 1-4, 1-8, 1-11, 1-12, 1-13, 2-1, 2-4, 2-11, 2-27, 2-29, 2-30, 2-32, 2-34, 2-37, 2-38, 2-42, 2-44, 2-46, 2-49, 2-50, 2-51, 2-57, 2-59, 2-60, 2-61, 2-65, 2-67, 2-70, 2-71, 2-72, 2-76, 2-78, 2-79, 2-80, 2-90, 2-92, 2-93, 2-108, 2-109, 2-111, 2-112, 2-113, 2-114, 2-117, 3-1, 3-9, 3-13, 3-16, 3-17, 3-18, 3-19, 3-20, 3-21, 3-22, 3-23, 3-24, 3-26, 3-49, 3-50, 3-53, 3-54, 3-59, 3-61, 3-63,

3-64, 3-66, 3-71, 3-74, 3-84, 3-86, 3-88, 3-89, 3-90, 3-94, 3-95, 3-97, 3-102, 3-103, 3-104, 3-107, 3-110, 3-111, 3-112, 3-113, 3-114, 3-115, 3-116, 3-118, 3-119, 3-120, 3-122, 3-123, 3-124, 3-125, 3-126, 3-128, 4-6, 4-9, 4-10, 4-11, 4-12, 4-14, 4-17, 4-18, 4-19, 4-20, 4-27, 4-38, 4-47, 4-48, 4-49, 4-54, 4-56, 4-62, 4-76, 4-93, 4-94, 4-95, 4-96, 4-97, 4-105, 4-109, 4-110, 4-113, 4-116, 4-117, 4-118, 4-119, 4-122, 4-123, 4-128, 4-129, 4-130, 4-131, 4-134, 4-135, 4-138, 4-139, 4-153, 4-154, 4-158, 4-159, 4-166, 4-168, 4-169, 4-170, 4-175, 4-182, 4-184, 4-187, 4-188, 4-192, 4-195, 4-222, 4-223, 4-226, 4-227, 4-238, 4-239, 4-249, 4-250, 4-254, 4-255, 4-259, 4-260, 4-279, 4-282, 4-283, 4-286, 4-287, 4-292, 4-293, 4-295, 4-296, 4-297, 4-298, 4-299, 4-300, 4-301, 4-303, 4-304, 4-305, 4-306, 4-307, 4-308, 4-309, 4-310, 4-311, 4-312, 4-313, 4-314, 4-315, 4-316, 4-317, 4-318, 4-319, 5-2, 5-3, 5-4, 5-5, 5-6, 5-7

Pueblo de San Ildefonso future projects, ES-2, ES-4, ES-6, ES-13, ES-17, ES-18, ES-19, ES-20, 1-3, 1-13, 2-27, 2-70, 2-90, 2-92, 2-93, 2-108, 2-109, 3-1, 3-24, 3-71, 3-84, 4-17, 4-27, 4-38, 4-54, 4-56, 4-62, 4-76, 4-93, 4-94, 4-95, 4-96, 4-97, 4-109, 4-128, 4-130, 4-138, 4-139, 4-158, 4-159, 4-166, 4-168, 4-169, 4-175, 4-182, 4-195, 4-226, 4-227, 4-238, 4-249, 4-259, 4-279, 4-286, 4-287, 4-292, 4-293, 4-297, 4-298, 4-299, 4-300, 4-301, 4-303, 4-304, 4-305, 4-306, 4-307, 4-308, 4-309, 4-310, 4-311, 4-312, 4-313, 4-314, 4-315, 4-316, 4-317, 4-318, 4-319, 5-7

Pueblo of Nambé, ES-1, ES-2, 1-1, 1-4, 1-8, 1-12, 2-4, 2-30, 2-32, 2-37, 2-42, 2-44, 2-49, 2-57, 2-59, 2-65, 2-67, 2-71, 2-112, 2-113, 3-12, 3-13, 3-18, 3-20, 3-21, 3-22, 3-23, 3-30, 3-50, 3-53, 3-54, 3-65, 3-66, 3-68, 3-86, 3-88, 3-90, 3-93, 3-94, 3-97, 3-102, 3-103, 3-104, 3-110, 3-111, 3-112, 3-113, 3-114, 3-115, 3-116, 3-118, 3-120, 3-122, 3-123, 3-124, 3-125, 3-126, 3-128, 4-3, 4-6, 4-9, 4-10, 4-11, 4-18, 4-19, 4-20, 4-113, 4-116, 4-117, 4-118, 4-119, 4-131, 4-170, 4-177, 4-184, 4-296, 4-297, 4-298, 5-4, 5-5, 5-7

Pueblo of Pojoaque, ES-1, ES-2, 1-1, 1-4, 1-11, 1-12, 2-4, 2-11, 2-30, 2-32, 2-37, 2-38, 2-42, 2-44, 2-49, 2-50, 2-51, 2-57, 2-59, 2-60, 2-61, 2-65, 2-67, 2-71, 2-72, 2-112, 2-113, 3-13, 3-16, 3-18, 3-20, 3-21, 3-22, 3-23, 3-26, 3-49, 3-53, 3-54, 3-65, 3-68, 3-69, 3-88, 3-89, 3-90, 3-92, 3-93, 3-95, 3-97, 3-98, 3-102, 3-103, 3-104, 3-107, 3-110, 3-111, 3-112, 3-113, 3-114, 3-115, 3-116, 3-118, 3-119, 3-120, 3-122, 3-123, 3-124, 3-125, 3-126, 3-128, 3-130, 4-6, 4-9, 4-10, 4-11, 4-18, 4-19, 4-20, 4-113, 4-116, 4-117, 4-118, 4-119, 4-131, 4-170, 4-184, 4-253, 4-264, 4-298, 5-4, 5-5, 5-6, 5-7

Pueblo of Tesuque, ES-1, ES-2, ES-4, ES-15, ES-16, 1-1, 1-2, 1-3, 1-11, 1-12, 1-13, 2-27, 2-30, 2-37, 2-39, 2-44, 2-49, 2-51, 2-57, 2-59, 2-61, 2-65, 2-67, 2-71, 2-72, 2-81, 2-86, 2-87, 2-88, 2-115, 3-13, 3-17, 3-18, 3-19, 3-21, 3-22, 3-23, 3-50, 3-53, 3-54, 3-55, 3-64, 3-65, 3-68, 3-86, 3-88, 3-89, 3-90, 3-92, 3-93, 3-97, 3-98, 3-102, 3-103, 3-104, 3-110, 3-111, 3-112, 3-113, 3-114, 3-115, 3-116, 3-119, 3-120, 3-122, 3-123, 3-124, 3-125, 3-126, 3-128, 3-129, 4-6, 4-9, 4-10, 4-11, 4-18, 4-19, 4-20, 4-26, 4-50, 4-52, 4-53, 4-108, 4-113, 4-116, 4-117, 4-118, 4-119, 4-127, 4-131, 4-138, 4-170, 4-184, 4-225, 4-226, 4-264, 4-277, 4-278, 4-279, 4-280, 4-286, 4-294, 4-295, 4-298, 4-308, 5-4, 5-5, 5-6, 5-7

Pumping plant, ES-6, ES-9, ES-11, ES-12, ES-13, ES-20, 1-10, 1-11,

1-12, 2-6, 2-9, 2-10, 2-21, 2-26, 2-29, 2-32, 2-33, 2-34, 2-35, 2-39, 2-40, 2-41, 2-43, 2-44, 2-46, 2-51, 2-52, 2-53, 2-54, 2-55, 2-58, 2-61, 2-62, 2-63, 2-65, 2-68, 2-73, 2-74, 2-75, 3-5, 4-5, 4-8, 4-20, 4-68, 4-80, 4-115, 4-116, 4-183, 4-185, 4-186, 4-188, 4-189, 4-190, 4-196, 4-198, 4-200, 4-201, 4-202, 4-203, 4-205, 4-206, 4-208, 4-209, 4-210, 4-213, 4-214, 4-215, 4-218, 4-219, 4-220, 4-221, 4-228, 4-239, 4-250, 4-252, 4-271, 4-273, 4-318
Radium 226, 3-27
Record of Decision, ES-6, 2-2, 4-170
Regional Water Authority, ES-2, ES-5, ES-7, 1-2, 1-7, 2-2, 2-5, 2-13, 2-14, 2-62, 2-67, 2-113, 2-115, 2-116, 4-6, 4-79
Regional water system (RWS), ES-1, ES-2, ES-4, ES-5, ES-6, ES-7, ES-8, ES-9, ES-10, ES-11, ES-12, ES-13, ES-16, ES-17, ES-18, ES-19, ES-20, ES-21, 1-1, 1-2, 1-3, 1-4, 1-7, 1-8, 1-10, 1-11, 1-12, 1-15, 2-1, 2-2, 2-3, 2-4, 2-5, 2-6, 2-7, 2-9, 2-11, 2-12, 2-13, 2-14, 2-20, 2-21, 2-22, 2-23, 2-26, 2-27, 2-28, 2-29, 2-30, 2-31, 2-32, 2-33, 2-35, 2-37, 2-39, 2-41, 2-44, 2-45, 2-46, 2-48, 2-49, 2-51, 2-53, 2-55, 2-56, 2-58, 2-59, 2-61, 2-62, 2-63, 2-64, 2-65, 2-66, 2-67, 2-68, 2-69, 2-70, 2-72, 2-73, 2-74, 2-86, 2-87, 2-88, 2-89, 2-90, 2-92, 2-93, 2-94, 2-95, 2-96, 2-97, 2-98, 2-99, 2-100, 2-101, 2-102, 2-103, 2-104, 2-105, 2-106, 2-107, 2-111, 2-112, 2-113, 2-115, 2-116, 2-117, 3-1, 3-3, 3-5, 3-6, 3-9, 3-20, 3-30, 3-32, 3-33, 3-36, 3-53, 3-61, 3-62, 3-65, 3-66, 3-67, 3-71, 3-80, 3-83, 3-84, 3-86, 3-87, 3-97, 3-108, 3-109, 3-110, 3-111, 3-117, 3-118, 3-119, 4-1, 4-2, 4-3, 4-4, 4-5, 4-6, 4-7, 4-10, 4-11, 4-12, 4-18, 4-19, 4-20, 4-21, 4-24, 4-28, 4-29, 4-30, 4-31, 4-33, 4-34, 4-35, 4-39, 4-40, 4-41, 4-42, 4-43, 4-44, 4-45, 4-46, 4-54, 4-55, 4-56, 4-58, 4-62, 4-63, 4-64, 4-65, 4-67, 4-68, 4-69, 4-70, 4-71, 4-73, 4-76, 4-77, 4-78, 4-79, 4-80, 4-81, 4-82, 4-83, 4-84, 4-85, 4-89, 4-94, 4-95, 4-96, 4-97, 4-98, 4-99, 4-103, 4-109, 4-112, 4-114, 4-115, 4-116, 4-117, 4-118, 4-119, 4-120, 4-121, 4-122, 4-123, 4-129, 4-130, 4-131, 4-132, 4-133, 4-139, 4-140, 4-141, 4-142, 4-143, 4-149, 4-151, 4-157, 4-159, 4-160, 4-167, 4-168, 4-169, 4-170, 4-172, 4-173, 4-174, 4-175, 4-176, 4-177, 4-178, 4-182, 4-183, 4-184, 4-185, 4-186, 4-187, 4-188, 4-191, 4-195, 4-196, 4-198, 4-199, 4-200, 4-208, 4-213, 4-217, 4-221, 4-227, 4-229, 4-239, 4-242, 4-244, 4-245, 4-250, 4-251, 4-252, 4-255, 4-259, 4-261, 4-263, 4-269, 4-270, 4-271, 4-272, 4-273, 4-274, 4-275, 4-276, 4-277, 4-279, 4-280, 4-281, 4-282, 4-284, 4-286, 4-287, 4-288, 4-289, 4-293, 4-297, 4-298, 4-299, 4-300, 4-301, 4-303, 4-304, 4-305, 4-306, 4-307, 4-308, 4-309, 4-310, 4-311, 4-312, 4-313, 4-314, 4-315, 4-316, 4-317, 4-318, 4-319, 5-2, 5-3, 5-5, 5-6, 5-7
Renewable energy, 2-115, 3-129, 4-288
Return flow, 3-13, 3-14, 3-30, 4-29
Riffle, 3-14, 3-62, 3-63, 4-3
Right-of-way (ROW), ES-5, ES-11, ES-20, 1-7, 2-11, 2-13, 2-27, 2-115, 3-5, 3-49, 3-80, 3-86, 3-87, 3-89, 4-131, 4-133, 4-176, 4-177, 4-178, 4-182, 4-183, 4-184, 4-185, 4-186, 4-287, 4-292
Rio Grande, ES-1, ES-7, ES-8, ES-11, ES-12, ES-13, ES-17, ES-19, 1-1, 1-3, 1-4, 1-8, 2-3, 2-4, 2-5, 2-6, 2-9, 2-20, 2-22, 2-28, 2-29, 2-30, 2-32, 2-34, 2-36, 2-37, 2-44, 2-46, 2-48, 2-49, 2-53, 2-55, 2-57, 2-58, 2-63, 2-64, 2-65, 2-67, 2-69, 2-70, 2-75, 2-101, 2-111, 2-112, 2-114, 3-1, 3-3, 3-6, 3-7, 3-8, 3-9, 3-10, 3-11, 3-12, 3-13, 3-14, 3-15, 3-16, 3-17, 3-18, 3-19, 3-20, 3-22, 3-24, 3-25, 3-26, 3-27,

3-28, 3-30, 3-31, 3-36, 3-37, 3-38, 3-40, 3-50, 3-51, 3-53, 3-54, 3-55, 3-57, 3-58, 3-60, 3-61, 3-62, 3-63, 3-66, 3-67, 3-69, 3-70, 3-71, 3-72, 3-73, 3-74, 3-75, 3-77, 3-78, 3-83, 3-84, 3-85, 3-86, 3-89, 3-92, 3-94, 3-97, 3-101, 3-109, 3-118, 4-2, 4-3, 4-4, 4-5, 4-6, 4-7, 4-8, 4-9, 4-10, 4-12, 4-20, 4-21, 4-22, 4-23, 4-24, 4-29, 4-30, 4-31, 4-33, 4-34, 4-42, 4-43, 4-44, 4-45, 4-77, 4-79, 4-81, 4-82, 4-83, 4-84, 4-85, 4-89, 4-111, 4-114, 4-115, 4-119, 4-140, 4-141, 4-142, 4-144, 4-145, 4-146, 4-147, 4-148, 4-149, 4-150, 4-152, 4-153, 4-154, 4-159, 4-160, 4-163, 4-164, 4-169, 4-177, 4-182, 4-187, 4-188, 4-189, 4-190, 4-201, 4-209, 4-214, 4-218, 4-245, 4-253, 4-254, 4-271, 4-293, 4-294, 4-296, 4-297, 4-299, 4-302, 4-305, 4-306, 4-307, 4-308, 5-2, 5-3, 5-7

Rio Grande Compact, 3-8, 4-4, 4-6

Rio Nambé, 1-8, 2-9, 3-12, 3-14, 3-17, 3-18, 3-23, 3-30, 3-38, 3-54, 3-55, 3-61, 3-92, 3-93, 3-98, 4-29, 4-35, 4-142, 4-296, 4-302, 4-310

Rio Pojoaque, ES-2, ES-4, ES-5, ES-6, ES-13, ES-14, ES-15, ES-17, ES-19, 1-2, 1-3, 1-4, 1-7, 1-8, 1-12, 1-13, 2-1, 2-9, 2-13, 2-27, 2-33, 2-76, 2-77, 2-78, 2-79, 2-80, 2-81, 2-93, 2-94, 2-95, 2-96, 2-97, 2-98, 2-99, 2-98, 2-99, 2-100, 2-101, 2-102, 2-103, 2-104, 2-105, 2-106, 2-107, 2-111, 2-117, 3-1, 3-6, 3-9, 3-12, 3-13, 3-14, 3-15, 3-16, 3-17, 3-18, 3-19, 3-20, 3-22, 3-23, 3-25, 3-26, 3-28, 3-50, 3-53, 3-54, 3-55, 3-57, 3-61, 3-62, 3-63, 3-64, 3-65, 3-67, 3-68, 3-70, 3-71, 3-72, 3-73, 3-77, 3-84, 3-85, 3-86, 3-87, 3-94, 3-98, 3-101, 3-107, 4-2, 4-3, 4-5, 4-12, 4-13, 4-14, 4-24, 4-25, 4-35, 4-36, 4-39, 4-46, 4-47, 4-48, 4-49, 4-58, 4-59, 4-60, 4-70, 4-72, 4-84, 4-85, 4-86, 4-87, 4-88, 4-94, 4-95, 4-96, 4-97, 4-103, 4-104, 4-105, 4-106, 4-113, 4-117, 4-120, 4-121, 4-122, 4-123, 4-130, 4-133, 4-134, 4-135, 4-140, 4-142, 4-151, 4-152, 4-153, 4-154, 4-155, 4-159, 4-163, 4-164, 4-168, 4-169, 4-173, 4-174, 4-178, 4-179, 4-180, 4-191, 4-192, 4-193, 4-196, 4-222, 4-234, 4-239, 4-241, 4-244, 4-255, 4-256, 4-274, 4-282, 4-287, 4-289, 4-290, 4-293, 4-297, 4-298, 4-299, 4-300, 4-301, 4-303, 4-304, 4-305, 4-306, 4-307, 4-308, 4-309, 4-310, 4-311, 4-312, 4-313, 4-314, 4-315, 4-316, 4-317, 4-318, 4-319, 5-3, 5-7

Rio Tesuque, ES-2, ES-4, ES-5, ES-13, ES-15, ES-16, ES-17, ES-19, 1-2, 1-3, 1-4, 1-7, 1-8, 1-13, 2-1, 2-9, 2-13, 2-27, 2-81, 2-82, 2-83, 2-84, 2-85, 2-86, 2-87, 2-88, 2-89, 2-93, 2-94, 2-95, 2-96, 2-97, 2-98, 2-97, 2-98, 2-99, 2-98, 2-99, 2-100, 2-101, 2-100, 2-101, 2-102, 2-103, 2-104, 2-105, 2-106, 2-107, 3-1, 3-6, 3-12, 3-13, 3-14, 3-15, 3-16, 3-18, 3-19, 3-20, 3-22, 3-23, 3-26, 3-28, 3-50, 3-53, 3-54, 3-55, 3-57, 3-61, 3-62, 3-63, 3-64, 3-65, 3-68, 3-71, 3-84, 3-87, 3-92, 3-93, 3-95, 3-98, 4-5, 4-15, 4-16, 4-25, 4-26, 4-27, 4-36, 4-37, 4-39, 4-49, 4-50, 4-51, 4-52, 4-53, 4-60, 4-61, 4-62, 4-73, 4-75, 4-89, 4-90, 4-91, 4-92, 4-93, 4-95, 4-96, 4-97, 4-106, 4-107, 4-108, 4-109, 4-113, 4-123, 4-124, 4-125, 4-126, 4-127, 4-128, 4-130, 4-135, 4-136, 4-137, 4-138, 4-140, 4-142, 4-155, 4-156, 4-157, 4-159, 4-164, 4-165, 4-166, 4-168, 4-169, 4-174, 4-175, 4-180, 4-181, 4-193, 4-194, 4-196, 4-224, 4-225, 4-226, 4-236, 4-238, 4-239, 4-241, 4-247, 4-248, 4-257, 4-258, 4-276, 4-277, 4-278, 4-284, 4-285, 4-287, 4-291, 4-292, 4-293, 4-297, 4-298, 4-299, 4-300, 4-301, 4-303, 4-304, 4-305, 4-306, 4-307, 4-308, 4-309, 4-310, 4-311, 4-312, 4-313, 4-314, 4-315, 4-316, 4-317, 4-318, 4-319, 5-7

Rip rap, 2-5, 2-35, 2-48, 2-58, 2-69, 2-79, 2-86, 2-87, 4-5, 4-8, 4-9, 4-10, 4-11, 4-16, 4-29, 4-32, 4-35, 4-74, 4-114, 4-116, 4-155, 4-235, 4-245, 4-299
Riverine, 3-85, 4-140, 4-318
RWS service area, ES-13, 1-13, 2-2, 2-4, 2-5, 2-7, 2-90, 2-111, 2-113, 2-115, 2-116, 2-117, 3-21, 3-119, 4-4, 4-18, 4-19, 4-20, 4-23, 4-78, 4-79, 4-80, 4-84, 4-251, 4-255, 4-295, 4-297, 4-298, 4-299, 4-308, 4-314, 4-317
San Juan-Chama project, ES-7, ES-8, ES-12, 1-2, 1-8, 2-4, 2-5, 2-20, 2-22, 2-28, 2-29, 2-30, 2-44, 2-46, 2-55, 2-57, 2-64, 2-67, 2-117, 3-7, 3-8, 3-9, 3-10, 3-14, 3-38, 3-62, 4-3, 4-5, 4-9, 4-12, 4-141, 4-148, 4-149, 4-150, 4-177, 4-294, 4-302, 4-307, 4-308
San Juan-Chama Project, ES-7, ES-8, ES-12, 1-2, 1-8, 2-4, 2-5, 2-20, 2-22, 2-28, 2-29, 2-30, 2-44, 2-46, 2-55, 2-57, 2-64, 2-67, 2-117, 3-7, 3-8, 3-9, 3-10, 3-14, 3-38, 3-62, 4-3, 4-5, 4-9, 4-12, 4-141, 4-148, 4-149, 4-150, 4-177, 4-294, 4-302, 4-307, 4-308
Santa Fe, ES-1, ES-2, ES-4, ES-5, ES-21, 1-1, 1-2, 1-3, 1-4, 1-7, 1-8, 1-14, 2-2, 2-4, 2-6, 2-8, 2-12, 2-13, 2-67, 2-71, 2-112, 2-113, 2-115, 2-116, 3-1, 3-6, 3-9, 3-12, 3-13, 3-14, 3-18, 3-19, 3-20, 3-26, 3-28, 3-31, 3-35, 3-36, 3-37, 3-38, 3-43, 3-45, 3-48, 3-49, 3-54, 3-55, 3-57, 3-58, 3-59, 3-60, 3-71, 3-74, 3-77, 3-85, 3-86, 3-88, 3-90, 3-92, 3-93, 3-94, 3-95, 3-97, 3-98, 3-102, 3-104, 3-108, 3-109, 3-110, 3-111, 3-112, 3-113, 3-114, 3-115, 3-116, 3-117, 3-118, 3-119, 3-120, 3-121, 3-122, 3-123, 3-124, 3-125, 3-126, 3-128, 4-3, 4-5, 4-6, 4-9, 4-10, 4-11, 4-18, 4-20, 4-78, 4-95, 4-96, 4-113, 4-116, 4-117, 4-118, 4-119, 4-170, 4-183, 4-184, 4-185, 4-186, 4-187, 4-188, 4-190, 4-191, 4-193, 4-194, 4-195, 4-241, 4-244, 4-245, 4-251, 4-260, 4-261, 4-263, 4-264, 4-266, 4-268, 4-269, 4-271, 4-272, 4-274, 4-280, 4-293, 4-294, 4-295, 4-296, 4-302, 4-310, 5-2, 5-3, 5-4, 5-7, 5-8
Santa Fe Opera, ES-5, 1-14, 2-71, 3-92, 3-98, 3-104, 3-108
Scoping, ES-17, 1-9, 2-1, 2-29, 2-115, 2-116, 2-117, 3-1, 3-118, 5-1, 5-2, 5-3
Screening criteria, ES-6, 2-1, 2-2, 5-5
Sedimentation, 2-6, 2-46, 2-49, 2-58, 2-68, 2-70, 2-95, 3-4, 3-26, 3-31, 4-139, 4-140, 4-144, 4-146, 4-152, 4-154, 4-158
Selenium, 3-27, 3-109
Sensitive species, 3-45, 3-49, 3-69
Short-term storage, ES-6, ES-8, ES-11, ES-12, ES-13, 1-10, 1-11, 2-3, 2-6, 2-7, 2-8, 2-9, 2-10, 2-11, 2-14, 2-17, 2-20, 2-23, 2-29, 2-37, 2-38, 2-39, 2-41, 2-42, 2-43, 2-44, 2-49, 2-50, 2-51, 2-53, 2-54, 2-55, 2-59, 2-60, 2-61, 2-63, 2-64, 2-65, 2-67, 2-71, 2-72, 2-73, 2-74, 2-75, 4-5, 4-20, 4-32, 4-41, 4-42, 4-64, 4-80, 4-171, 4-183, 4-185, 4-186, 4-188, 4-189, 4-190, 4-191, 4-196, 4-198, 4-201, 4-202, 4-203, 4-204, 4-205, 4-206, 4-207, 4-209, 4-210, 4-211, 4-212, 4-213, 4-214, 4-215, 4-216, 4-218, 4-219, 4-220, 4-221, 4-232, 4-251, 4-273, 4-308, 4-311, 4-317, 4-318
Side-channel surface diversion structure, ES-8, 11, 4-6
Silver, 3-27, 3-31
Sinuosity, 2-86, 3-15, 3-16, 3-17, 3-62, 3-63, 3-64, 4-3
Socioeconomic resources, ES-4, ES-17, ES-21, 2-105, 2-110, 3-1, 3-5, 3-110, 3-111, 3-113, 3-114, 3-117, 3-118, 3-119, 3-120, 3-122, 3-123, 3-124, 3-125, 3-130, 4-260, 4-261, 4-263, 4-267, 4-271, 4-279, 4-280, 4-281, 4-314, 4-315, 6-1, 6-3
Socioeconomics, ES-4, ES-17, ES-21, 2-105, 2-110, 3-1, 3-5, 3-110, 3-111, 3-113, 3-114, 3-117, 3-118, 3-119, 3-120, 3-122, 3-123, 3-124, 3-125, 3-130, 4-260, 4-261, 4-263, 4-267,

4-271, 4-279, 4-280, 4-281, 4-314, 4-315, 6-1, 6-3
Socioeconomics, indirect economic impact, 4-275, 4-276, 4-277, 4-278, 4-279, 4-283, 4-284, 4-286
Sodium, ES-5, 1-10, 2-7, 2-26, 2-40, 2-52, 3-25, 3-27, 4-251
Solar, ES-9, ES-12, ES-13, 2-11, 2-21, 2-24, 2-40, 2-44, 2-53, 2-54, 2-55, 2-62, 2-65, 2-74, 3-129, 4-79, 4-288, 4-289, 4-294, 4-316
Solid and hazardous material, ES-21, 2-105, 2-109, 3-5, 3-108, 3-128, 4-29, 4-249, 4-250, 4-280, 4-313, 6-3, 6-4
Southwest Regional Gap Analysis Project (SWReGAP), 3-45, 3-47, 3-48, 3-49, 3-55, 4-95, 4-96, 4-100, 4-101, 4-102, 4-110
Special status species, 3-43, 3-45, 3-57, 3-69, 4-96, 4-102, 4-133, 4-136, 6-1
Spoil pile, 1-11, 2-12, 2-24, 2-30, 2-44, 2-55, 2-65, 3-17, 4-52, 4-75, 4-91, 4-108, 4-127, 4-225, 4-238, 4-248, 4-278
Stationary source, 3-35, 4-66, 4-301
Storage tank, ES-5, ES-11, ES-12, ES-13, ES-20, 1-10, 1-11, 1-12, 2-3, 2-6, 2-7, 2-8, 2-9, 2-10, 2-11, 2-14, 2-17, 2-20, 2-23, 2-26, 2-27, 2-29, 2-37, 2-38, 2-39, 2-40, 2-41, 2-44, 2-49, 2-51, 2-53, 2-54, 2-59, 2-61, 2-62, 2-63, 2-65, 2-71, 2-72, 2-73, 2-74, 2-115, 3-110, 4-187, 4-188, 4-198, 4-204, 4-205, 4-206, 4-207, 4-212, 4-216, 4-221, 4-228, 4-252, 4-253, 4-271
Storage tank, Bishop's Lodge HKM/Sugarloaf Road, 2-60, 2-64
Storage tank, Camel Rock Casino, 1-11, 1-12, 2-38, 2-43, 2-50, 2-54, 2-60, 2-71, 2-73, 2-74, 2-75, 3-93, 3-130, 4-219, 4-221
Storage tank, El Rancho, ES-6, ES-8, ES-12, 1-4, 1-11, 2-12, 2-20, 2-23, 2-38, 2-42, 2-43, 2-44, 2-49, 2-50, 2-54, 2-59, 2-60, 2-64, 2-70, 2-71, 2-75, 2-90, 2-110, 3-86, 3-88, 3-89, 3-94, 3-104, 3-107, 3-120, 3-123, 3-124, 3-128, 3-129, 4-117, 4-187, 4-201, 4-202, 4-204, 4-205, 4-209, 4-212, 4-214, 4-218, 4-219, 4-220, 4-262, 4-295, 5-2
Storage tank, Flea Market, 1-10, 1-11, 2-30, 2-38, 2-43, 2-50, 2-54, 2-59, 2-60, 2-64, 2-65, 2-71, 4-203, 4-206, 4-207, 4-211, 4-213, 4-215, 4-216
Storage tank, Jacona HKM, 2-10, 2-38, 2-43, 4-202, 4-205, 4-212
Storage tank, Lower Tesuque, 2-40, 2-41, 2-43, 4-202, 4-206
Storage tank, Nambé, 1-4, 1-7, 1-11, 1-12, 2-4, 2-7, 2-9, 2-11, 2-28, 2-30, 2-32, 2-37, 2-38, 2-40, 2-41, 2-43, 2-50, 2-52, 2-54, 2-55, 2-60, 2-61, 2-62, 2-63, 2-64, 2-71, 2-72, 2-73, 2-74, 2-75, 2-112, 2-113, 3-7, 3-8, 3-9, 3-12, 3-13, 3-14, 3-18, 3-21, 3-23, 3-29, 3-30, 3-58, 3-61, 3-65, 3-68, 3-69, 3-71, 3-86, 3-89, 3-92, 3-94, 3-97, 3-98, 3-114, 3-118, 3-120, 3-123, 3-124, 3-128, 3-129, 4-4, 4-5, 4-29, 4-143, 4-296, 4-297, 5-2, 5-4
Storage tank, Nambé South, 1-11, 2-7, 2-38, 2-43, 2-50, 2-54, 2-60, 2-64, 2-71, 2-75
Storage tank, New Bishop's Lodge, 2-60, 2-64
Storage tank, New Buffalo Thunder, 2-60, 2-64
Storage tank, New Central Pojoaque, 2-60, 2-64
Storage tank, New Te Tsu Geh Oweenge School, 2-60, 2-64
Storage tank, Pojoaque Industrial Park, 1-11, 1-12, 2-10, 2-40, 2-41, 2-43, 2-50, 2-52, 2-54, 2-55, 2-60, 2-62, 2-63, 2-64, 2-71, 2-73, 2-74, 2-75, 4-202, 4-205, 4-210, 4-212, 4-215
Storage tank, Pojoaque Main, 2-38, 2-43, 2-50, 2-54, 2-60, 2-64, 4-188
Storage tank, Pojoaque Main HKM, 2-38, 2-43
Storage tank, Pojoaque Main Southeast, 2-60, 2-64
Storage tank, Pojoaque Main Southwest, 2-50, 2-54

Storage tank, San Ildefonso North HKM, 2-38, 2-43
Storage tank, San Ildefonso Northwest, 2-50, 2-54, 2-60, 2-64
Storage tank, Tesuque, ES-13, ES-16, 1-4, 1-7, 1-12, 2-1, 2-4, 2-9, 2-11, 2-13, 2-27, 2-28, 2-30, 2-37, 2-38, 2-39, 2-40, 2-41, 2-43, 2-49, 2-52, 2-54, 2-55, 2-59, 2-60, 2-62, 2-63, 2-64, 2-71, 2-73, 2-74, 2-75, 2-81, 2-82, 2-87, 2-88, 2-89, 2-93, 2-98, 2-116, 3-9, 3-13, 3-14, 3-15, 3-18, 3-19, 3-20, 3-21, 3-22, 3-25, 3-26, 3-54, 3-61, 3-62, 3-63, 3-64, 3-68, 3-87, 3-88, 3-89, 3-92, 3-93, 3-97, 3-98, 3-104, 3-108, 3-113, 3-114, 3-119, 3-120, 3-123, 3-125, 3-128, 3-129, 4-4, 4-15, 4-36, 4-37, 4-50, 4-52, 4-53, 4-89, 4-90, 4-93, 4-108, 4-124, 4-127, 4-136, 4-138, 4-143, 4-157, 4-166, 4-191, 4-193, 4-194, 4-203, 4-206, 4-210, 4-215, 4-219, 4-221, 4-225, 4-257, 4-271, 4-277, 4-278, 4-280, 4-282, 4-295, 4-298, 4-301, 4-309, 4-312, 4-314, 4-315, 4-316, 5-2, 5-3, 5-4
Storage tank, Tesuque Village, ES-13, 1-4, 2-37, 2-38, 2-43, 2-49, 2-59, 2-60, 2-64, 2-71, 2-116, 3-88, 3-89, 3-92, 3-93, 3-119, 3-120, 3-129
Storage tank, Tesuque Village Griego Hill, 2-60, 2-64
Storage tank, Tewa West, 2-60, 2-64
Storage tank, Upper Cuyamungue, 2-40, 2-41, 2-43, 2-52, 2-54, 2-55, 2-62, 2-63, 2-64, 2-74
Storage tank, Upper Tesuque Pueblo, 1-12, 2-40, 2-41, 2-43, 2-52, 2-54, 2-55, 2-62, 2-63, 2-64, 2-73, 2-74, 2-75
Storage tank, White Sands, 1-11, 1-12, 2-38, 2-43, 2-50, 2-51, 2-54, 2-60, 2-61, 2-64, 2-72, 4-171, 4-172, 4-188, 4-295, 4-298, 4-310, 4-312, 4-314, 4-315, 4-316
Storage tank, White Sands HKM, 2-38, 2-43, 4-171
Stormwater, 2-5, 2-10, 3-24, 3-27, 3-28, 4-28, 4-32, 4-42, 4-47, 4-50, 4-54, 4-66
Stormwater best management practice, 4-28
Stormwater pollution prevention plan (SWPP), 4-32, 4-42, 4-47, 4-50, 4-54, 4-66
Strontium, 3-25, 3-27
Sulfate, 3-26, 3-27, 3-29, 3-109, 4-31
Superfund site, 3-109, 4-253, 4-255, 4-257
Supervisory control and data acquisition (SCADA) system, 1-10, 1-11, 2-9, 2-39, 2-51, 2-59, 2-73, 4-68, 4-80
Taos, 1-8, 3-9, 3-22, 3-45, 3-83, 3-98, 4-315, 5-2
Tesuque Village, ES-13, 1-4, 2-37, 2-38, 2-43, 2-49, 2-59, 2-60, 2-64, 2-71, 2-116, 3-88, 3-89, 3-92, 3-93, 3-119, 3-120, 3-129
Threatened and endangered species, ES-6, ES-19, 1-13, 1-14, 2-109, 3-4, 3-43, 3-55, 3-61, 3-69, 3-71, 3-72, 3-73, 3-74, 4-130, 4-138, 4-139, 4-159, 4-160, 4-161, 4-162, 4-163, 4-164, 4-165, 4-166, 4-306, 4-307, 4-318, 6-4, 6-5
Threatened and endangered species, Mexican spotted owl (MSO), 3-71, 3-74, 3-77, 3-78, 4-159, 5-7
Threatened and endangered species, New Mexico meadow jumping mouse (NMMJM), 2-101, 3-71, 3-72, 3-74, 3-75, 3-77, 3-78, 4-159, 5-7
Threatened and endangered species, protocol survey, ES-19, 3-71, 3-72, 3-73, 3-74, 3-77, 3-78, 4-159, 4-160, 4-166
Threatened and endangered species, Rio Grande silvery minnow, 2-101, 3-71, 3-75, 3-78, 4-159, 4-306, 4-307, 4-308, 5-7
Threatened and endangered species, Southwestern willow flycatcher (SWFL), ES-19, 3-71, 3-72, 3-73, 3-78, 4-159, 4-160, 4-161, 4-163, 4-165, 5-7

Threatened and endangered species, yellow-billed cuckoo (YBCU), 3-71, 3-72, 3-73, 3-77, 3-78, 4-159, 5-7
Total dissolved solids, 3-109, 4-29, 4-251, 4-255, 4-314
Total maximum daily load (TMDL), 3-24, 3-25, 4-28
Traffic, ES-18, ES-20, ES-21, 2-5, 2-12, 2-104, 2-109, 3-3, 3-5, 3-95, 3-98, 3-103, 4-64, 4-65, 4-67, 4-70, 4-71, 4-72, 4-74, 4-75, 4-76, 4-79, 4-80, 4-86, 4-88, 4-90, 4-91, 4-92, 4-184, 4-187, 4-228, 4-229, 4-230, 4-231, 4-232, 4-234, 4-235, 4-237, 4-238, 4-242, 4-243, 4-244, 4-245, 4-247, 4-249, 4-260, 4-264, 4-271, 4-273, 4-275, 4-276, 4-278, 4-280, 4-281, 4-282, 4-284, 4-286, 4-311, 4-312, 4-314, 4-315, 4-318, 6-4
Tribal Historic Preservation Office(r) (THPO), 3-80
Trust land, 3-88, 3-89, 4-318
United States Army Corps of Engineers (USACE), ES-18, 1-1, 3-7, 3-8, 3-17, 3-26, 3-52, 3-53, 4-16, 4-33, 4-111, 4-113, 4-114, 4-170, 4-293, 4-296, 4-297, 5-5, 5-7, 6-2
United States Fish and Wildlife Service (Service), ES-1, ES-6, 1-1, 1-10, 2-11, 2-14, 2-19, 2-32, 2-33, 2-34, 2-35, 2-39, 2-40, 2-41, 2-47, 2-51, 2-52, 2-53, 2-58, 2-59, 2-62, 2-68, 2-72, 2-74, 2-90, 2-116, 3-21, 3-43, 3-52, 3-57, 3-60, 3-62, 3-66, 3-68, 3-69, 3-70, 3-71, 3-74, 3-75, 3-77, 3-78, 3-92, 3-119, 3-128, 4-19, 4-20, 4-131, 4-133, 4-134, 4-136, 4-144, 4-145, 4-146, 4-147, 4-159, 4-161, 4-261, 4-271, 4-295, 4-296, 4-306, 5-3, 5-4, 5-5, 5-6, 5-7, 6-1, 6-2
United States Geological Survey (USGS), 3-6, 3-7, 3-8, 3-9, 3-10, 3-21, 3-27, 3-30, 3-31, 3-37, 3-53, 4-6, 4-8, 4-9, 4-28, 4-112, 4-115
Upper Rio Grande Water Operations Model, 3-36
Uranium, 3-27, 3-28, 3-29, 3-109, 4-30, 4-31, 4-35, 4-280
Vegetation, ES-5, ES-18, 1-3, 1-14, 2-7, 2-10, 2-81, 2-82, 2-84, 2-86, 2-87, 2-89, 2-98, 2-98, 2-99, 2-98, 2-108, 3-4, 3-12, 3-14, 3-15, 3-16, 3-17, 3-26, 3-30, 3-32, 3-38, 3-43, 3-45, 3-46, 3-47, 3-48, 3-50, 3-51, 3-52, 3-55, 3-57, 3-59, 3-63, 3-64, 3-68, 3-69, 3-72, 3-73, 3-77, 3-97, 4-13, 4-14, 4-16, 4-23, 4-32, 4-34, 4-35, 4-41, 4-47, 4-50, 4-51, 4-52, 4-55, 4-66, 4-74, 4-78, 4-81, 4-82, 4-83, 4-84, 4-85, 4-86, 4-88, 4-89, 4-90, 4-91, 4-92, 4-93, 4-94, 4-95, 4-96, 4-97, 4-98, 4-99, 4-100, 4-101, 4-102, 4-103, 4-104, 4-105, 4-106, 4-107, 4-108, 4-109, 4-110, 4-112, 4-130, 4-131, 4-132, 4-133, 4-135, 4-136, 4-138, 4-139, 4-142, 4-143, 4-147, 4-149, 4-150, 4-152, 4-153, 4-154, 4-155, 4-156, 4-157, 4-158, 4-199, 4-200, 4-204, 4-205, 4-206, 4-207, 4-208, 4-213, 4-217, 4-221, 4-224, 4-225, 4-227, 4-237, 4-247, 4-257, 4-299, 4-300, 4-302, 4-303, 4-304, 4-305, 4-306, 4-310, 4-318, 6-4, 6-5
Vegetation, invasive species/noxious weed, 1-13, 2-108, 3-4, 3-43, 3-51, 4-95, 4-97, 4-99, 4-100, 4-102, 4-103, 4-104, 4-106, 4-107, 4-109, 4-110, 4-112, 4-131, 4-132, 4-133, 4-134, 4-135, 4-136, 4-138, 4-139, 4-161, 4-303, 4-304, 4-305, 4-306
Vegetation, phreatophyte, 3-38, 4-302
Vegetation, Riparian, ES-19, 2-98, 3-13, 3-14, 3-30, 3-31, 3-38, 3-45, 3-48, 3-49, 3-50, 3-57, 3-62, 3-63, 3-64, 3-68, 3-69, 3-72, 3-73, 3-74, 3-77, 3-94, 3-98, 4-13, 4-14, 4-29, 4-96, 4-97, 4-99, 4-100, 4-101, 4-102, 4-104, 4-106, 4-107, 4-108, 4-110, 4-112, 4-114, 4-121, 4-142, 4-143, 4-147, 4-149, 4-150, 4-152, 4-153, 4-154, 4-155, 4-156, 4-157, 4-158, 4-160, 4-296, 4-302, 4-304, 4-306
Vegetation, Santa Fe cholla, 3-48, 3-49, 4-95, 4-96
Visual resources, 1-14, 2-103, 2-109, 3-5, 3-97, 3-98, 4-196, 4-198, 4-199,

4-222, 4-224, 4-227, 4-264, 4-310, 4-311, 4-318, 6-3
Wastewater, ES-2, ES-4, ES-6, ES-13, ES-17, 1-2, 1-3, 1-8, 1-13, 2-70, 2-90, 2-91, 2-92, 2-108, 2-109, 2-114, 3-28, 3-30, 3-65, 3-110, 4-17, 4-27, 4-28, 4-29, 4-30, 4-33, 4-38, 4-39, 4-40, 4-54, 4-55, 4-56, 4-62, 4-76, 4-94, 4-109, 4-110, 4-128, 4-129, 4-139, 4-158, 4-166, 4-169, 4-175, 4-182, 4-183, 4-195, 4-226, 4-227, 4-238, 4-249, 4-250, 4-254, 4-259, 4-279, 4-286, 4-292, 4-294, 4-295, 4-298, 4-299, 4-310, 4-312, 4-313, 4-314, 4-317, 4-319
Water distribution pipeline, 2-3
Water transmission and distribution system, ES-6, ES-9, ES-11, ES-12, ES-13, 2-9, 2-14, 2-18, 2-21, 2-29, 2-39, 2-44, 2-51, 2-55, 2-59, 2-65, 2-73, 4-5, 4-32, 4-64, 4-149, 4-150, 4-151, 4-182, 4-273
Water transmission pipeline, 2-3, 2-9, 2-10, 2-114, 4-32
Water treatment plant, ES-1, ES-9, ES-11, ES-12, ES-13, ES-17, ES-18, 1-10, 1-11, 1-12, 2-3, 2-5, 2-6, 2-9, 2-10, 2-21, 2-29, 2-32, 2-33, 2-35, 2-37, 2-39, 2-40, 2-41, 2-42, 2-44, 2-46, 2-49, 2-51, 2-52, 2-53, 2-54, 2-55, 2-57, 2-58, 2-59, 2-61, 2-62, 2-63, 2-65, 2-68, 2-69, 2-70, 2-73, 2-74, 2-75, 2-91, 2-110, 2-111, 2-113, 2-114, 3-25, 3-80, 4-7, 4-21, 4-30, 4-32, 4-33, 4-34, 4-35, 4-42, 4-64, 4-65, 4-68, 4-79, 4-80, 4-116, 4-117, 4-119, 4-129, 4-140, 4-141, 4-172, 4-183, 4-185, 4-186, 4-187, 4-188, 4-189, 4-190, 4-191, 4-195, 4-196, 4-198, 4-200, 4-201, 4-204, 4-209, 4-212, 4-214, 4-218, 4-219, 4-220, 4-228, 4-230, 4-231, 4-239, 4-245, 4-250, 4-251, 4-252, 4-253, 4-254, 4-262, 4-268, 4-271, 4-272, 4-273, 4-294, 4-299, 4-304, 4-313, 4-314, 4-318
Water, delivery, 3-8
Water, demand, 2-5, 2-7, 2-32, 2-33, 2-67, 3-111, 3-113, 4-5, 4-8, 4-18, 4-22, 4-23, 4-28, 4-29, 4-297, 4-298, 4-302, 4-309
Water, groundwater, ES-4, ES-7, ES-12, ES-17, ES-19, 1-2, 1-3, 1-8, 2-4, 2-28, 2-55, 2-86, 2-94, 2-95, 2-97, 2-98, 2-99, 2-100, 2-101, 2-108, 2-115, 2-116, 3-3, 3-5, 3-13, 3-14, 3-15, 3-17, 3-18, 3-19, 3-20, 3-21, 3-23, 3-27, 3-29, 3-30, 3-38, 3-51, 3-52, 3-64, 3-109, 3-118, 3-119, 3-128, 4-3, 4-4, 4-5, 4-7, 4-17, 4-18, 4-19, 4-20, 4-21, 4-22, 4-23, 4-24, 4-25, 4-26, 4-27, 4-28, 4-30, 4-31, 4-33, 4-35, 4-38, 4-64, 4-78, 4-84, 4-85, 4-96, 4-97, 4-98, 4-103, 4-106, 4-111, 4-112, 4-113, 4-120, 4-130, 4-131, 4-133, 4-140, 4-141, 4-148, 4-149, 4-150, 4-152, 4-160, 4-162, 4-176, 4-177, 4-250, 4-253, 4-259, 4-260, 4-263, 4-269, 4-270, 4-280, 4-281, 4-282, 4-293, 4-294, 4-295, 4-296, 4-297, 4-298, 4-299, 4-301, 4-302, 4-303, 4-304, 4-305, 4-306, 4-307, 4-309, 4-314, 4-317, 6-3, 6-5
Water, impaired, 2-106, 3-3, 3-23, 3-24, 3-25, 4-27, 4-280, 4-286
Water, intermittent, 3-13, 3-22, 3-23, 3-103, 4-63, 4-70, 4-72, 4-73, 4-75, 4-142, 4-230, 4-233, 4-242, 4-244, 4-247, 4-249
Water, perennial stream, 3-23, 4-142
Water, pool, 3-8, 3-9, 3-14, 3-62, 3-63, 3-66, 3-67, 3-69, 4-3, 4-145
Water, rights, ES-1, ES-19, ES-20, 1-1, 1-3, 1-7, 1-8, 2-2, 2-4, 2-5, 2-28, 2-30, 2-48, 2-58, 2-67, 2-69, 2-94, 2-112, 2-116, 3-13, 3-17, 3-88, 3-89, 3-90, 3-117, 4-2, 4-3, 4-4, 4-5, 4-6, 4-7, 4-12, 4-14, 4-30, 4-85, 4-141, 4-176, 4-177, 4-178, 4-179, 4-180, 4-181, 4-182, 4-309, 4-315, 4-317
Water, storage right, 2-112
Water, surface water, ES-4, ES-7, ES-11, ES-17, ES-19, 1-3, 1-4, 1-8, 2-5, 2-28, 2-29, 2-67, 2-76, 2-94, 2-95, 2-108, 3-3, 3-6, 3-7, 3-10, 3-12,

3-13, 3-14, 3-21, 3-26, 3-30, 3-38, 3-52, 3-61, 3-62, 3-72, 4-2, 4-3, 4-4, 4-5, 4-6, 4-7, 4-10, 4-11, 4-12, 4-14, 4-17, 4-19, 4-21, 4-22, 4-24, 4-26, 4-28, 4-29, 4-33, 4-34, 4-35, 4-37, 4-39, 4-42, 4-81, 4-82, 4-83, 4-96, 4-115, 4-125, 4-140, 4-141, 4-144, 4-147, 4-152, 4-177, 4-193, 4-208, 4-213, 4-293, 4-294, 4-297, 4-298, 4-299, 4-302, 4-305, 4-307, 4-317, 4-318, 4-319, 6-3, 6-4
Water, Top of the World water rights, 2-4, 4-3, 4-297
Water, water quality, ES-17, ES-21, 1-11, 2-30, 2-46, 2-90, 2-95, 2-106, 2-108, 3-3, 3-21, 3-22, 3-23, 3-24, 3-25, 3-27, 3-28, 3-51, 3-109, 3-118, 3-128, 4-6, 4-7, 4-13, 4-14, 4-15, 4-16, 4-21, 4-22, 4-27, 4-28, 4-29, 4-30, 4-31, 4-32, 4-33, 4-34, 4-35, 4-36, 4-37, 4-38, 4-182, 4-251, 4-255, 4-260, 4-261, 4-263, 4-264, 4-269, 4-270, 4-271, 4-274, 4-280, 4-281, 4-282, 4-298, 4-299, 4-314, 4-315, 4-316, 5-3, 6-3, 6-4
Water, waters of the United States, ES-6, 1-13, 3-27, 4-296
Watershed, 3-6, 3-7, 3-10, 3-12, 3-14, 3-16, 3-36, 3-37, 4-2, 4-3, 4-4, 4-5, 4-7, 4-35, 4-38, 4-293, 4-302
Wetland, ES-5, ES-6, ES-18, 1-3, 1-13, 2-81, 2-99, 2-108, 3-4, 3-43, 3-45, 3-49, 3-51, 3-52, 3-53, 3-72, 4-15, 4-26, 4-50, 4-92, 4-96, 4-111, 4-112, 4-113, 4-114, 4-115, 4-116, 4-117, 4-118, 4-119, 4-120, 4-121, 4-122, 4-123, 4-124, 4-125, 4-126, 4-127, 4-128, 4-129, 4-130, 4-257, 4-303, 4-318, 4-319, 5-7, 6-1, 6-2, 6-4, 6-5
Wetland, emergent, 3-77
Wetlands and floodplains, ES-18
Wildlife, ES-1, ES-5, ES-20, 1-1, 1-3, 2-81, 2-100, 2-109, 2-111, 3-4, 3-22, 3-23, 3-25, 3-26, 3-30, 3-43, 3-50, 3-52, 3-55, 3-57, 3-59, 3-72, 4-50, 4-96, 4-99, 4-130, 4-131, 4-132, 4-133, 4-134, 4-135, 4-136, 4-137, 4-138, 4-139, 4-160, 4-161, 4-163, 4-167, 4-180, 4-181, 4-257, 4-304, 4-306, 4-307, 4-318, 5-4, 5-6, 5-7, 6-1, 6-4, 6-5
Wildlife, mule deer, 3-55
Workshop, 3-18, 5-3, 5-5
Zinc, 3-25, 3-27