Paradox Valley Unit of the Colorado River Basin Salinity Control Program

DRAFT
Environmental Impact Statement
Volume I

Estimated lead agency costs for preparing this EIS: $1,844,000

U.S. Department of the Interior
Bureau of Reclamation
Upper Colorado Region
Western Colorado Area Office
Grand Junction, Colorado

December 2019

MISSION STATEMENTS

The mission of the Department of the Interior is to protect and manage the nation's natural resources and cultural heritage; provide scientific and other information about those resources; and honor 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.

Paradox Valley Unit of the Colorado River Basin Salinity Control Program Draft Environmental Impact Statement

Proposed action:	Construct, operate, and maintain the Paradox Valley Unit, Montrose County, Colorado, in compliance with the Colorado River Basin Salinity Control Act
Lead agency:	Bureau of Reclamation, Upper Colorado Region
Responsible official:	U.S. Department of the Interior, Secretary of the Interior

Cooperating agencies:

Federal:
- U.S. Army Corps of Engineers
- U.S. Bureau of Land Management
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service
- U.S. Geological Survey

State:
- Arizona Department of Water Resources
- Colorado Department of Natural Resources
- Colorado Department of Public Health and Environment
- Colorado River Board of California
- Colorado River Commission of Nevada
- New Mexico Interstate Stream Commission
- Utah Department of Environmental Quality
- Wyoming Department of Environmental Quality
- Wyoming State Engineer's Office

Quasi-State and Local:
- Colorado River Water Conservation District
- Montrose County, Colorado
- Southern Nevada Water Authority
- Southwestern Water Conservation District

For further information, contact:

Ms. Lesley McWhirter
Bureau of Reclamation, Upper Colorado Region
Western Colorado Area Office
445 West Gunnison Ave., Suite 221
Grand Junction, CO 81501
(970) 248-0608
lmcwhirter@usbr.gov

Comment period: The comment period begins with the Federal Register Notice of Availability and extends for 60 days after that date.

This page intentionally left blank.

ACRONYMS AND ABBREVIATIONS

A

AADT	annual average daily traffic
Acre-feet/year	acre-feet per year
Amec	Amec Foster Wheeler Environment & Infrastructure, Inc.
APE	area of potential effect
APEN	Air Pollutant Emission Notice
AUM	Animal Unit Month

B

Basin states	Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming
BIF	brine injection facility
BLM	Bureau of Land Management
BMPs	best management practices

C

CAA	Clean Air Act of 1970
$CaCO_3$	calcium carbonate
CCF	hundred cubic feet
CCR	Code of Colorado Regulations
CDOT	Colorado Department of Transportation
CDPHE	Colorado Department of Public Health and Environment
CEQ	Council on Environmental Quality
CFL	compact fluorescent lamp
CFR	Code of Federal Regulations
cfs	cubic foot/feet per second
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
CPW	Colorado Parks and Wildlife
CRSS	Colorado River Support System
CWA	Clean Water Act of 1972
CWCB	Colorado Water Conservation Board

D

dB	decibel(s)
dBA	a-weighted decibels
DEIS	draft environmental impact statement
DOE	U.S. Department of Energy
DOI	U.S. Department of the Interior
DPOC	Drainage Pump Outlet Channel
DWCD	Dolores Water Conservancy District
DWR	State of Colorado, Department of Natural Resources, Division of Water Resources

E

EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
ESA	Endangered Species Act of 1973
et seq.	and the following

F

FEIS	final environmental impact statement
FERC	Federal Energy Regulatory Commission
FLPMA	Federal Land Policy and Management Act of 1976
FWS	U.S. Fish and Wildlife Service

G

GHG	greenhouse gas
GIS	geographic information system
GLO	Government Land Office
gpd	gallon(s) per day
GPS	global positioning system
gpm	gallon(s) per minute
GWh	gigawatt hour(s)
GWP	global warming potential

H

H_2S	hydrogen sulfide
HUC	hydrologic unit code
Hwy	highway

I

IBWC	International Boundary and Water Commission
IMPLAN	an economic impact analysis input-output model

K

KOP	key observation point
kW	kilowatt(s)

L

lb/day	pound(s) per day
Leadville Formation	Mississippian Leadville Limestone Formation
LED	light-emitting diode

M

M	magnitude (for earthquakes)
M&E	monitoring and evaluation
MASIP	Maximum Allowable Surface Injection Pressure
mg/L	milligram(s) per liter

MODE	Main Outlet Drain Extension
MWh	megawatt hours

N

N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act of 1969
NHPA	National Historic Preservation Act
NIB	Northerly International Boundary
NO_2	nitrogen dioxide
NOI	Notice of Intent
NO_x	nitrogen oxide
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NSR	New Source Review

O

O_3	ozone
O&M	operation and maintenance
OM&R	Operation, Maintenance & Replacement
ORVs	outstandingly remarkable values
OSHA	Occupational Safety and Health Administration

P

pH	potential hydrogen
PKPP	Pilot Knob Power Plant and Wasteway
$PM_{2.5}$	particulate matter 2.5 micrometers or less in diameter
PM_{10}	particulate matter 10 micrometers or less in diameter
ppm	parts per million
PSD	Prevention of Significant Deterioration
PVU	Paradox Valley Unit

R

RCRA	Resource Conservation and Recovery Act
Reclamation	Bureau of Reclamation
RMP	resource management plan
ROD	record of decision
ROW	right-of-way

S

Salinity Control Program	Colorado River Basin Salinity Control Program
SCADA	Supervisory Control and Data Acquisition
SDWA	Safe Drinking Water Act of 1974
Secretary	U.S. Secretary of the Interior
SHPO	State Historic Preservation Officer
SIL	significant impact level

SO_2	sulfur dioxide
STF	surface treatment facility

T

TDS	total dissolved solids
tons/year	tons per year
TRFO	BLM Tres Rios Field Office
TSC	Technical Service Center
TSP	total suspended particles

U

UFO	BLM Uncompahgre Field Office
UIC	Underground Injection Control
U.S.	United States
U.S.-Mexico Agreement	1944 U.S.-Mexico Treaty for the Utilization of the Waters of the Colorado and Tijuana Rivers and of the Rio Grande
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code
USGS	U.S. Geological Survey
UST	underground storage tank

V

VAC	volts alternating current
VOC	volatile organic compound
VRM	visual resource management

W

WCAO	Western Colorado Area Office
WSA	Wilderness Study Area
WSR	Wild and Scenic River

Z

ZLD	zero-liquid discharge

Numbers

3D	3 dimensional

Symbols

°	degree
<	less than
≤	less than or equal to
%	percent
±	plus or minus
§	Section

CONTENTS

Page

Tables

Figures

Appendices

Other supporting technical documents are available on Reclamation's Paradox Valley Unit Environmental Impact Statement webpage at https://www.usbr.gov/uc/progact/paradox/index.html. Documents available on the webpage include, but are not limited to:

- Alternative B
  - Paradox Valley Unit 2nd Well Design Final Report (December 2018) https://www.usbr.gov/uc/envdocs/reports/20181211-ParadoxValley2ndWellDesign-FinalReport-508-WCAO.pdf
  - Technical Studies and Evaluations for the Second Injection Well Alternative at the Paradox Valley Unit (September 2017) https://www.usbr.gov/uc/progact/paradox/docs/related/SecondInjectWell-CRBReport.pdf
  - Evidence for Far-Field Reservoir Pressurization: Report and Injection Data (April 2016) https://www.usbr.gov/uc/progact/paradox/docs/related/Far-field_pressurization_TM.zip
  - Memo – Paradox Valley Unit Second Well Site Investigation Consultant Review Board (February 2014) https://www.usbr.gov/uc/progact/paradox/docs/WCAO-Memo-2ndWellSiteInvestig.pdf
  - Assessment of a Potential Second Injection Well Site – Paradox Valley Unit Saline Water Disposal Project (April 2013) https://www.usbr.gov/uc/progact/paradox/docs/Atkins-Assmt-SecondInjectionWell-04-2013.pdf
  - Review of Geologic Investigations and Injection Well Site Selection, Paradox Valley Unit (November 2012) https://www.usbr.gov/uc/progact/paradox/docs/Block-ReviewGeologicInvestigations-2012.pdf

- Alternative C
    - Paradox Valley Unit Salinity Control Investigations – Hydrogen Sulfide Management 50% Design Final Report (March 2017) https://www.usbr.gov/uc/progact/paradox/docs/related/FINALH2SDesignReport_3.2017.pdf
    - Pond Design Strategy Final Report – Pond Optimization (February 2017) https://www.usbr.gov/uc/progact/paradox/docs/related/R0217-100_FINAL_PondDesignStrategyReport_2.2017.pdf
    - Feasibility and Cost Analysis Findings and Recommendation Report Paradox Valley Unit Byproducts Disposal Study (January 2017) https://www.usbr.gov/uc/progact/paradox/docs/related/FINAL_CombinedByproductsReport_1.2017.pdf
    - Pond Operational Strategy Final Report – Pond Optimization (January 2017) https://www.usbr.gov/uc/progact/paradox/docs/related/R1016-125-R1_FinalPondOperationalStrategyReport_1.2017.pdf
    - Paradox Valley Unit Salinity Control Investigations – Hydrogen Sulfide Management, Bedrock CO, Treatment Options Bench Testing Final Report (November 2016) https://www.usbr.gov/uc/progact/paradox/docs/related/FINAL_H2S_TreatmentBenchTestingReport_11.2016.pdf
    - Site Selection Report Pond Optimization for Paradox Valley Unit Evaporation Ponds (August 2016) https://www.usbr.gov/uc/progact/paradox/docs/related/FINAL_R0516-070.R2_PVU_SiteSelectionReport_8.2016.pdf
- Alternative D
    - Zero Liquid Discharge Demonstration Project Final Report (February 2019) https://www.usbr.gov/uc/envdocs/reports/20190212-ZeroLiquidDischargeDemonstrationProject-FinalReport-508-WCAO.pdf
    - Paradox Valley Unit Brine Crystallization Technology Assessment (September 2016) https://www.usbr.gov/uc/progact/paradox/docs/related/ParadoxValleyUnitBrineCrystallizationTechnologyAssessment.pdf

This page intentionally left blank.

Executive Summary

ES.1 Introduction

The United States (U.S.) Department of the Interior, (DOI) Bureau of Reclamation (Reclamation), has prepared this Draft Environmental Impact Statement (DEIS) to analyze the impacts of construction, operation, and maintenance of the Paradox Valley Unit (PVU) facilities to control saline groundwater in Paradox Valley, Montrose County, Colorado. The PVU is authorized by Title II, 202(a) (1) of the Colorado River Basin Salinity Control Act of 1974 (88 Stat. 266), as amended.

Reclamation is the lead Federal agency for purposes of complying with the National Environmental Policy Act of 1969 (NEPA), as amended (42 United States Code [U.S.C.] §§ 4321, and the following [et seq.]). The Bureau of Land Management (BLM) is a cooperating agency with a connected action of processing Reclamation's application for a right-of-way (ROW) to construct, operate, and maintain facilities to control saline groundwater on public lands. The BLM would also cooperate with Reclamation on processing a petition/application for withdrawal with transfer of jurisdiction to implement the selected alternative, if deemed necessary. This EIS complies with NEPA, 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 DOI's NEPA regulations (43 CFR Part 46), and other relevant Federal, State, and Tribal laws and regulations.

ES.2 Project Description

The PVU is in western Montrose County, Colorado, approximately 50 miles southwest of Grand Junction and 10 miles east of the Colorado-Utah border. The PVU extracts naturally occurring brine groundwater in Paradox Valley, which prevents brine from entering the Dolores River, a tributary to the Colorado River. The brine is then injected deep underground into a permeable, porous rock formation, thus improving water quality in both the Dolores and Colorado Rivers. The PVU currently removes about 95,000 tons of salt per year that would otherwise enter the Colorado River. This tonnage represents 7 percent (%) of the current salinity control in the Colorado River at Imperial Dam, just upstream of the Northerly International Boundary (NIB) with Mexico. As a result, the PVU is the largest single contributor to the Colorado River Basin Salinity Control Program (Colorado River Basin Salinity Control Forum 2017).

Since 1996, the PVU has been injecting brine into the Mississippian Leadville Limestone (Leadville) Formation via a Class V deep injection well. The existing PVU deep injection well is nearing the end of its serviceable life, therefore Reclamation is investigating alternative ways to protect and enhance the quality of water in the Colorado River.

The Colorado River's water salinity content must be safe for use in the United States and the Republic of Mexico, in compliance with the Colorado River Basin Salinity Control Act, and U.S.

obligations under the August 30, 1973, Minute 242 U.S.-Mexico Agreement on the Permanent and Definitive Solution to the International Problem of the Salinity of the Colorado River, pursuant to the 1944 U.S.-Mexico Treaty for the Utilization of the Waters of the Colorado and Tijuana Rivers and of the Rio Grande (U.S.-Mexico Agreement).

ES.3 Setting

The geographic context in which the alternatives are analyzed is Paradox Valley and adjacent areas in Montrose County, Colorado, as shown on **Figure ES-1**, "Action Alternative Study Areas" (also found in **Appendix B**). Salts emanating from formations in Paradox Valley enter the Dolores River that flows through the valley. The Dolores River is a tributary to the Colorado River. Paradox Valley was specifically identified in Title II of the Colorado River Basin Salinity Control Act as an important area to locate salinity control facilities because it overlies a salt anticline, which is a major contributor of salinity in the Colorado River Basin.

As shown on **Figure ES-1**, the geographic extent of analysis for all action alternatives in this EIS encompasses a larger area than the combined total of the permanent and temporary impacts anticipated for each action alternative; analyzing effects on a larger area gives Reclamation the necessary flexibility to appropriately design and locate facilities and to avoid and minimize impacts of the selected alternative. The exception is if the geographic extent is otherwise defined by resource, as described in Chapter 3, "Affected Environment and Environmental Consequences," and Chapter 4, "Cumulative Impacts and Other NEPA Considerations."

Reclamation has analyzed non-Federal land acquisitions as if the acreage of non-Federal lands to experience temporary and permanent land disturbance would be acquired (see **Section 2.2**, "Summary of Action Alternative Project Components"). However, the full range of available land acquisition allowed under law would be explored with landowners to ensure, to the extent reasonable, that project goals could be achieved by means of land acquisitions that are mutually agreeable.

As needed, Reclamation would conduct further site-specific NEPA analyses that would be tiered to this environmental impact statement (EIS) in order to analyze more specific details of any selected alternative once project designs are finalized.

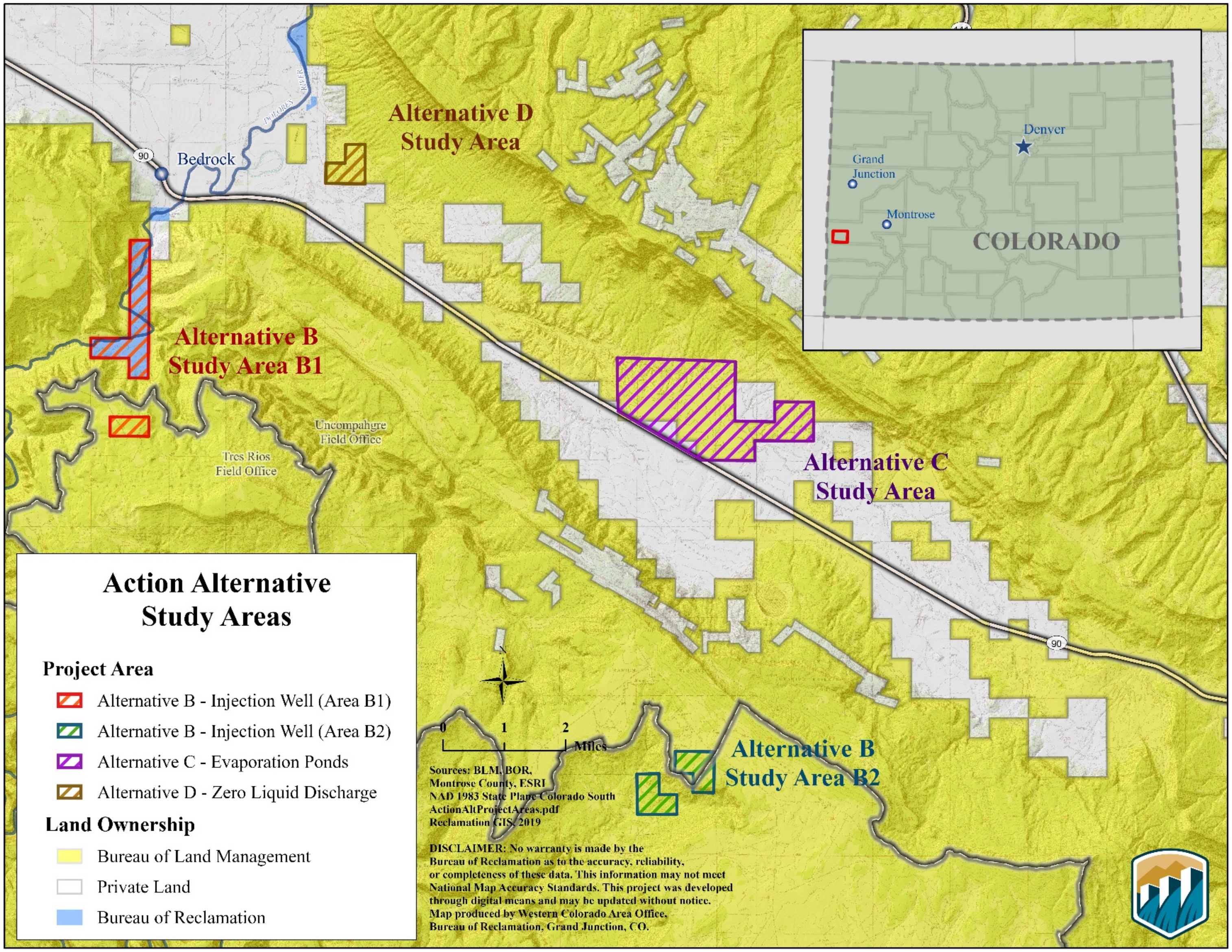

Figure ES-1 Action Alternative Study Areas

ES.4 Summary of Proposed Federal Action

Reclamation, the lead Federal agency, currently operates the PVU. Reclamation's proposed action is to construct, operate, and maintain facilities for the collection and disposal of saline groundwater of Paradox Valley, as authorized by Title II, Section 202(a)(1), of the Colorado River Basin Salinity Control Act. Project alternatives are described in chapter 2.

The Bureau of Land Management (BLM) is a cooperating agency, with a connected action. The BLM's connected action is to process Reclamation's request for land use authorization on public lands for collection and disposal of saline groundwater of Paradox Valley, as authorized by Title II, Section 202(a)(1), of the Colorado River Basin Salinity Control Act.

ES.5 Purpose of and Need for Action

The need for the proposed action is to control salinity in the Colorado River contributed by sources in the Paradox Valley to decrease the adverse effects of high salt concentrations in the Lower Colorado Basin. The PVU has injected naturally occurring brine from Paradox Valley into a deep subsurface reservoir since 1996, but the injection well may be nearing the end of its useful life. Because the underground reservoir pressure and induced seismicity have increased, and brine disposal rates have had to be substantially reduced in response, a new brine control and disposal facility is needed to protect and enhance the quality of water available in the Colorado River for use in the United States and the Republic of Mexico.

The purpose of the proposed action is to comply with Title II, Section 202(a) (1), of the Colorado River Basin Salinity Control Act and the approved state water quality standards in accordance with the Clean Water Act (CWA).

The purpose of the BLM's action is to respond to Reclamation's application for a ROW and/or Reclamation's petition/application for a withdrawal to construct, operate, and maintain facilities to control saline groundwater on public lands. The need for this action is to fulfill the BLM's responsibility in accordance with the Federal Land Policy and Management Act of 1976 (FLPMA) and its implementing regulations in 43 CFR Parts 2300 and 2800.

ES.6 Goals and Objectives

In addition to the purpose and need, the U.S. Secretary of the Interior (Secretary) will consider the following goals and objectives:

- Remove approximately 100,000 or more tons of salt per year that would otherwise enter the Dolores River and the downstream Colorado River
- Optimize the annual cost per ton of salt removed
- Avoid and minimize adverse impacts on physical, biological, social, economic, cultural, and tribal resources in the affected environment

- Minimize the use of nonrenewable resources, including land and energy
- Be consistent with existing BLM resource management plans (RMPs), where applicable
- Be in the best interest of the public, including considerations of health and safety and the local community's desired future conditions

ES.7 Alternatives

As shown in **Figure ES-1**¸ this EIS assesses the potential environmental impacts of four alternatives: the No Action Alternative (Alternative A) and three action alternatives (Alternatives B, C, and D). A common element of all alternatives is that the existing well would be plugged and abandoned. Each alternative is summarized below. Throughout the EIS, all values presented are approximate.

ES.7.1 Alternative A—No Action

Under Alternative A, the existing deep injection well would not be replaced. This would represent no salinity control in Paradox Valley.

The existing well would be plugged and abandoned in accordance with the EPA Underground Injection Control (UIC) Permit. The pipelines and existing brine production wells would be capped or plugged and abandoned, and the buildings would be assessed for possible future use. Reclamation would retain its land associated with the PVU until a future date when the land would be reevaluated for other uses. Reclamation land that is determined no longer needed for future Reclamation purposes would be disposed of in accordance with applicable Federal law and Reclamation Manual Directives and Standards LND 08-02 (Reclamation 2002) and LND 08-03 (Reclamation 2009a). Currently authorized BLM ROWs or easements on private lands would be reviewed to determine if they could be put to other uses. Any Federal facilities on BLM-administered lands that are also abandoned by Reclamation under Subpart E of 41 CFR Part 102-75 would be reclaimed by Reclamation. Reclamation would retain its water rights and would assess the need for their possible future use. Monitoring for seismic events via the Paradox Valley Seismic Network would continue until Reclamation determines it is no longer necessary.

ES.7.2 Alternative B—New Deep Injection Well

Under Alternative B, brine would be collected from the existing brine production well field and piped to the existing surface treatment facility (STF). Then it would be piped from the STF to a new deep injection well and injected into a currently unpressurized block of the Leadville Formation (Reclamation 2018).

Two areas (B1 and B2) are analyzed as potential locations for a new injection well. Area B1 includes a combination of Reclamation land near the existing injection well and BLM-administered land on Skein Mesa (**Figure 2-2**, "Alternative B New Injection Well Area B1," **Appendix B**); Area B2 is on BLM-administered land on Monogram Mesa or Fawn Springs Bench (**Figure 2-3**, "Alternative B New Injection Well Area B2," **Appendix B**).

Seismic reflection data, well log data, aeromagnetic survey data, gravity data, and induced seismicity data show that the Leadville Formation, a deep geologic structure of the Paradox Valley region that would be intersected by the potential new wells, should have sufficient permeability and porosity to accept the injected brine at a continuous rate of 200 gallons per minute (gpm) (323 acre-feet per year), while keeping wellhead pressures below 5,000 pounds per square inch over 50 years (Reclamation 2017a, 2018; Detournay and Dzik 2017; Detournay and Damjanac 2018). Assuming the brine would be continuously diverted, 200 gpm equates to up to 114,000 tons of salt that would be prevented from entering the Colorado River system annually.

If Alternative B is selected in the ROD, additional 3 dimensional (3D) seismic geologic investigations would be completed to identify the final location of the well and would require additional site-specific NEPA analysis, tiered to this EIS. The 3D seismic survey would cover an area of 175 square miles surrounding the proposed injection well location.

Area B1 would occur predominantly on Reclamation land and would require construction of a new deep injection well, surface facilities, access roads (including two new bridges over the Dolores River), a powerline extension, and a low-pressure pipeline to transport the brine. A ROW from BLM and/or withdrawal of 80 acres for use by Reclamation would be required.

Area B2 would require construction of a new deep injection well, surface facilities, access roads, a low-pressure pipeline, pipeline pump stations, and powerline extensions from nearby lines to the pump stations. A ROW from BLM and/or withdrawal of 616 acres for use by Reclamation would be required. Reclamation would need to acquire 49 acres of non-Federal lands.

ES.7.3 Alternative C—Evaporation Ponds

Under Alternative C, brine would be collected from the existing brine production well field and piped to the existing STF. Then it would be piped from the STF to a series of evaporation ponds 7 miles southeast of the production well field. The facility would be operated to evaporate the water from the brine, thereby allowing the solid salt to be harvested for disposal in an onsite salt landfill or to be used as a commodity. The evaporation pond system would be designed to accommodate a continuous flow of up to 300 gpm of brine (484 acre-feet/year). This equates to up to 171,000 tons of salt that would be prevented from entering the Colorado River system annually, assuming the brine would be continuously diverted.

The conceptual pond system design includes a 27-acre surge pond, a 39-acre concentrator pond, 290 acres of crystallizer ponds, 24-acre bittern (remaining liquid) concentration pond, and a 10-acre-foot bittern storage pond. A hydrogen sulfide (H_2S) treatment system would be included to remove H_2S before brine is discharged to the evaporation ponds. Salt would be harvested from the evaporation ponds and disposed of in a 60-acre, onsite salt landfill. The salt landfill would reach an ultimate vertical height of 100 feet above the ground surface, plus 15 feet below the ground surface.

A freshwater wildlife pond would be constructed in the evaporation pond complex, and the bittern ponds would be netted to mitigate impacts on wildlife, particularly waterfowl. The evaporation pond complex would be located within 1,530 acres, with an actual footprint of 600 acres. A ROW from BLM and/or withdrawal of 1,300 acres for use by Reclamation would be required. Reclamation would need to acquire 281 acres of non-Federal lands.

ES.7.4 Alternative D—Zero-Liquid Discharge Technology

Under Alternative D, brine would be collected from the existing brine production well field and piped to the STF. Then it would be piped from the STF to a centralized treatment plant, consisting of a series of thermally driven crystallizers. The zero-liquid discharge facility would be operated to evaporate (and later condense) water from the brine, resulting in a solid salt and produced freshwater stream. The solid salt would be transported to an onsite, 60-acre salt landfill, which would reach an ultimate vertical height of 100 feet above the ground surface. The permanent facility would cover 80 acres. A ROW from BLM and/or withdrawal of 267 acres for use by Reclamation would be required. Reclamation would need to acquire 56 acres of non-Federal lands.

The facility would be designed to accommodate a continuous flow of up to 300 gpm of brine (484 acre-feet/year). This equates to up to 171,000 tons of salt that would be prevented from entering the Colorado River system annually, assuming the brine would be continuously diverted. The conceptual design includes the use of multiple crystallizers operating in parallel that would reduce the brine to a solid product suitable for landfill disposal. The crystallizers would be constructed as modular units and installed on a flat slab. Approximately 150,000 square feet of building space would be required at a height of about 40 feet to protect the equipment from the weather and prevent freezing. This footprint includes the space required for drying salt in drain bins before disposing of it in a landfill. A treatment facility would be included to remove H_2S from the brine.

ES.8 Major Conclusions and Areas of Controversy

Table ES-1 lists the ability of each alternative to meet the goals and objectives of the proposed action. Other issues and areas of controversy associated with each alternative are discussed below the table. A detailed summary of the potential impacts from construction, operation, and maintenance of the alternatives is included in **Table 2-7**, "Summary of Impacts, by Alternative" in **Chapter 2** and incorporated by reference here.

Table ES-1. Ability of each alternative to meet the goals and objectives of the proposed action

Goals and Objectives	Alternative A	Alternative B		Alternative C	Alternative D
		Area B1	Area B2		
Remove 100,000 or more tons of salt per year that would enter Dolores River and downstream Colorado River	No salt control in Paradox Valley; up to 95,000 tons of salt would load into Colorado River annually.	Up to 114,000 tons of salt controlled annually in the Paradox Valley, decreasing salt loading downstream in the Colorado River.	Up to 114,000 tons of salt controlled annually in Paradox Valley, decreasing salt loading downstream in Colorado River.	Up to 171,000 tons of salt controlled annually in Paradox Valley, decreasing salt loading downstream in Colorado River.	Up to 171,000 tons of salt controlled annually in Paradox Valley, decreasing salt loading downstream in Colorado River.
Optimize annual cost per ton of salt removed	No salt control in Paradox Valley.	Salt controlled at annual cost of $57-59/ton.	Salt controlled at annual cost of $67/ton.	Salt controlled at annual cost of $63/ton.	Salt controlled at annual cost of $94/ton.
Avoid and minimize adverse impacts on physical, biological, social, economic, cultural, and tribal resources in affected environment	Projected salinity increase of 9.2 milligrams per liter (mg/L) at Imperial Dam, which equates to $0 of economic benefit and increase of $23.236 million in economic damages in Lower Colorado Basin annually. 4,090 acre-feet of water saved in Lake Mead annually, while meeting International Boundary and Water Commission (IBWC) Minute 242 salinity differential.	Induced seismicity anticipated, though at lower rate than for existing well and at greater distance to populated areas. Projected salinity reduction of 11.1 mg/L at Imperial Dam, which equates to average economic benefit of $27.738 million in Lower Colorado Basin annually. 438 acre-feet of water from Lake Mead released annually to meet IBWC salinity differential. Scenic outstandingly remarkable values (ORVs) for river segments, with preliminary classification of recreational and wild, negatively affected by construction of proposed	Induced seismicity rates expected to be lower than those in Area B1. Increased human activity may affect Federally threatened Gunnison sage-grouse. Projected salinity, economic benefit, and Lake Mead water release would be same as described for Area B1. Temporary, minor impacts on scenic ORV for river segments with a preliminary classification of recreational during pipeline construction within Wild and Scenic River (WSR) boundary.	Greatest potential of all action alternatives to cause wildlife mortality, especially for migratory birds. Greatest visual impact. 60-acre salt landfill would rise 100 feet above the ground surface. Greatest indirect impacts on cultural resources. Projected salinity reduction of 16.7 mg/L at Imperial Dam. Average economic benefit of $41.658 million in Lower Colorado Basin annually. 2,927 acre-feet of water from Lake Mead released annually to meet IBWC salinity differential. Temporary, minor impacts on scenic ORV	60-acre salt landfill would rise 100 feet above ground surface. Projected salinity, economic benefit, and Lake Mead water release would be same as described for Alternative C. Temporary, minor impacts on scenic ORV for river segments with preliminary classification of recreational during pipeline construction within WSR boundary. CWA Section 404 Permit would be obtained from the USACE prior to any activities in Waters

Goals and Objectives	Alternative A	Alternative B: Area B1	Alternative B: Area B2	Alternative C	Alternative D
(see above)	*(see above)*	facilities. Impacts permanent but minor. Directional injection well and high-pressure transmission pipeline connecting the brine injection facility (BIF) to well head on Skein Mesa would result in permanent placement of subsurface facilities in the Dolores River Canyon Wilderness Study Area (WSA). Facilities would not affect wilderness characteristics or cause undue degradation so would not impair area's suitability for preservation as wilderness. CWA Section 404 Permit would be obtained from US Army Corps of Engineers (USACE) prior to any activities in Waters of the United States. Nationwide or Individual Permit depending on activity and impacts.	CWA Section 404 Permit would be obtained from USACE prior to any activities in Waters of the United States. Nationwide or Individual Permit depending on activity and impacts.	for river segments with a preliminary classification of recreational during pipeline construction within WSR boundary. CWA Section 404 Permit would be obtained from USACE prior to any activities in Waters of the United States. Individual Permit required unless USACE, in coordination with EPA and FWS, waives evaluation and authorizes activity under Nationwide Permit.	of the United States. Individual Permit required unless USACE, in coordination with EPA and FWS, waives evaluation and authorizes activity under Nationwide Permit.
Minimize the use of nonrenewable resources, including land and energy	No energy requirements.	8.1 megawatt hours (MWh) of energy use, 920 kilowatts (kW) of electrical demand, and 2,000 gallons of propane required annually.	9.8 MWh of energy use, 1,120 kW of electrical demand, and 2,500 gallons of propane required annually.	3.1 MWh of energy use, 290 kW of electrical demand, and 8,000 gallons of propane required annually.	26,700 MWh of energy use, 4,630 kW of electrical demand, and 4,200,000 hundred cubic feet (CCF) of natural gas required annually.

Goals and Objectives	Alternative A	Alternative B		Alternative C	Alternative D
		Area B1	Area B2		
Be consistent with existing BLM RMPs, where applicable	In conformance with both the BLM Tres Rios Field Office (TRFO) RMP and Uncompahgre Field Office (UFO) RMP, no change in land management or status.	In conformance with both the TRFO RMP and the UFO RMP, ROW acquisition and/or withdrawal of 80 acres of BLM-administered land would be required.	In conformance with both the TRFO RMP and the UFO RMP. ROW acquisition and/or withdrawal of 616 acres of BLM-administered land would be required.	Not in conformance with the interim visual resource management objectives of the UFO RMP. An amendment to the UFO RMP would be required. ROW acquisition and/or withdrawal of 1,300 acres of BLM-administered land would be required. No portion of the Alternative C study area falls within the TRFO jurisdictional area.	In conformance with the UFO RMP. ROW acquisition and/or withdrawal of 267 acres of BLM-administered land would be required. No portion of the Alternative D study area falls within the TRFO jurisdictional area.
Be in the best interest of the public, including considerations of health and safety and the local community's desired future conditions	Pending public comment	Pending public comment	Pending public comment	Pending public comment	Pending public comment

ES.8.1 Alternative A—No Action

Alternative A represents no salinity control in the Paradox Valley. This increase of 95,000 tons of salt annually entering the Dolores River and the downstream Colorado River would result in a 9.2 mg/L increase in salinity. Modeling indicates increased economic damages in the lower Colorado River basin by $23.236 million annually. Modeling indicates that 4,090 acre-feet of freshwater would not need to be released annually from Lake Mead to meet the salinity differential at the NIB of Mexico. However, it is uncertain if Reclamation's Yuma Area Office Water Operations staff are able to forecast the year-end salinity differential to an accurate enough degree to adjust the annual volume of groundwater directed to the river (or bypassed) for delivery to Mexico within a level of accuracy of a few thousand acre-feet.

ES.8.2 Alternative B—New Deep Injection Well

Removing up to 114,000 tons of salt per year would result in 11.1 mg/L of salinity control at Imperial Dam. Modeling indicates that this would result in an economic benefit in the lower Colorado River basin of $27.738 million annually. Modeling also indicates that an additional 438 acre-feet of freshwater would be released from Lake Mead annually to meet the salinity differential for water deliveries to Mexico.

There is uncertainty regarding the final location of the brine injection well, as assumptions have been made about the suitability of subsurface geology in Areas B1 and B2 based on preliminary investigations. This alternative would require future 3D seismic investigations to verify geologic assumptions; however, some uncertainties would remain until suitability of the site is verified when the well is drilled. A new well would have less potential for induced seismicity than the existing well, and any seismicity would be at a greater distance to populated areas, which would reduce the level of shaking experienced by residents. Area B1 is located within 360 acres of Reclamation land and 80 acres of BLM-administered land. There would be 16 acres of permanent surface disturbance, which would require ROW acquisition and/or withdrawal of 80 acres of BLM-administered lands. This 80 acres is a larger area than what is required for the facilities to provide flexibility in final facility siting and to protect facilities from incompatible land uses. Implementing Alternative B in Area B1 would result in a minor noise impact on the Dolores River Canyon WSA during construction, and a permanent indirect impact due to human imprints (new facilities or surface disturbance) within and observable from the WSA. There would be minor impacts on the scenic, recreational, and vegetation ORVs on segments of the Dolores River that have been determined eligible for inclusion in the National Wild and Scenic River System.

Area B2 would require a ROW acquisition and/or withdrawal of 616 acres of BLM-administered lands. This 616 acres is a larger area than what is required for the facilities to provide flexibility in final facility siting and to protect facilities from incompatible land uses. Additionally, 49 acres of non-Federal land would be acquired. There would be 7 acres of permanent surface disturbance. Area B2 would require a 24-mile pipeline, which would parallel State Highway 90 and county roads, and would pass through designated critical habitat for the Federally threatened Gunnison sage-grouse. The pipeline would include approximately six pump stations to lift the brine 2,000 feet from the valley floor to the top of Monogram Mesa. Because data suggest

Monogram Mesa is unoccupied or at least not actively used by Gunnison sage-grouse, and because temporary surface disturbance would occur only in previously disturbed areas and would be revegetated, Alternative B in Area B2 may affect, but is not likely to adversely affect, Gunnison sage-grouse and its critical habitat.

ES.8.3 Alternative C—Evaporation Ponds

Removing up to 171,000 tons of salt per year would result in 16.7 mg/L of salinity control at Imperial Dam. Modeling indicates that this would result in an economic benefit in the lower Colorado River basin of $41.658 million annually. Modeling also indicates that an additional 2,927 acre-feet of freshwater would be released from Lake Mead annually to meet the salinity differential for water deliveries to Mexico. There would be 600 acres of permanent surface disturbance, which would require a ROW acquisition and/or withdrawal of 1,300 acres of BLM-administered lands. This 1,300 acres is a larger area than what is required for the facilities to provide flexibility in final facility siting and to protect facilities from incompatible land uses. Additionally, 281 acres of non-Federal land would be acquired. Reclamation may need to purchase the privately held mineral estate in the Alternative C study area. A 60-acre onsite salt landfill would be required for permanent disposal of the harvested salt.

The evaporation ponds and salt landfill would negatively affect the visual landscape of the Paradox Valley. This would not be in conformance with the UFO RMP, so an RMP amendment would be required. Alternative C would have the greatest indirect impacts of all the action alternatives on cultural resources, due to the potential visual impacts on cultural resources whose landscape, setting, and feeling are part of their importance. Alternative C would also have the greatest impact of all the action alternatives on wildlife, particularly migratory birds.

ES.8.4 Alternative D—Zero Liquid Discharge Technology

Removing up to 171,000 tons of salt per year would result in 16.7 mg/L of salinity control at Imperial Dam. Modeling indicates that this would result in an economic benefit in the lower Colorado River basin of $41.658 million annually. Modeling also indicates that an additional 2,927 acre-feet of freshwater would be released from Lake Mead annually to meet the salinity differential for deliveries to Mexico.

There would be 80 acres of permanent surface disturbance, which would require a ROW or withdrawal of 267 acres of BLM-administered lands. This 267 acres is a larger area than what is required for the facilities to provide flexibility in final facility siting and to protect facilities from incompatible land uses. Additionally, 56 acres of non-Federal land would be acquired. A 60-acre onsite landfill would be required for permanent disposal of the harvested salt. Alternative D would have the largest energy use and demand of all the action alternatives. It would require 26,700 MWh for electrical energy use, 4,630 kW for electrical demand, and 4,200,000 CCF of natural gas annually.

Chapter 1 – Purpose of and Need for Action

1.1 Background and Project History

Historically (from 1940-2017), the Colorado River carried an average salt load of approximately 9 million tons annually past Hoover Dam in Nevada. From 1988-2017, the average annual salt load was 7.7 million tons (USGS 2019). The salts in the Colorado River Basin are naturally occurring and pervasive. High salt concentrations in the lower Colorado River Basin adversely affect more than 40 million people and about 5.5 million acres of irrigated farmland in the southwestern U.S. and Mexico. In 1975, the Colorado River Basin states—Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming— (Basin states) proposed, and the approved state water quality standards for salinity concentrations in the Colorado River (Colorado River Basin Salinity Control Forum 2017).

The PVU consists of a series of brine production wells and a deep injection well. Naturally occurring saline groundwater is intercepted and injected 16,000 feet below the ground surface to prevent it from entering the Dolores River and the Colorado River (see **Figure ES-1** for a location map and **Figure 2-1**, "Alternative A Paradox Valley Unit Existing Facilities," for a map of existing facilities, **Appendix B**). The PVU currently removes about 95,000 tons of salt per year that would otherwise ultimately enter the Colorado River. This tonnage represents 7% of the current salinity control in the Colorado River at Imperial Dam, just upstream of the NIB with Mexico. As a result, the PVU is the largest single contributor to the Colorado River Basin Salinity Control Program (Salinity Control Program; Colorado River Basin Salinity Control Forum 2017).

Table 1-1 "Activities related to Colorado River Basin salinity control and the PVU", identifies major actions in the past that have led to salinity control in the Colorado River Basin and Paradox Valley and that are relevant to this EIS.

Table 1-1. Activities related to Colorado River Basin salinity control and the PVU

Date	Event	Description
1972	Federal Water Pollution Control Act (CWA, 33 U.S.C. §1251 et seq.)	Established water quality standards.
1973	Colorado River Basin Salinity Control Forum established	Formed for interstate cooperation and to provide the Basin states with the information necessary to comply with Sections 303(a) and 303(b) of the CWA.
1974	The EPA promulgated a regulation that set forth a basin-wide salinity control policy for the Colorado River Basin.	Required the Basin states to adopt and submit for approval to the EPA water quality standards for salinity, including numeric criteria and a plan of implementation. The regulation was codified in 40 CFR Part 120. However, 40 CFR Parts 35, 120, and 131 were consolidated, effective December 8, 1983. See 48 Fed. Reg. 51405.

Date	Event	Description
1974	Colorado River Basin Salinity Control Act, Title II (43 U.S.C. §1571 et seq.)	Authorized salinity control measures, including the construction, operation, and maintenance of the PVU, to reduce salinity and improve water quality in the Dolores River and, ultimately, the Colorado River.
1975	Water quality standards approved for the Colorado River	The basin states each developed water quality standards which were subsequently approved by the EPA.
1978	Draft PVU Environmental Statement	Evaporation ponds recommended as the preferred alternative for control brine due to the assumption that a continuous pumping rate of 5 cubic feet per second (cfs) would be required to achieve the desired reduction of brine flow into the Dolores River.
1978	EPA comments on the Draft Environmental Statement	The EPA submitted comments to Reclamation that deep-well injection is the environmentally preferred alternative (Reclamation 1979).
1979	Final PVU Environmental Statement	Reclamation identified evaporation ponds as the preferred alternative due to its ability to control brine at a 5 cfs pumping rate. The document included the caveat that once the brine collection wells were constructed and tested, a lower effective pumping rate could lead to the implementation of a more environmentally sound disposal method (Reclamation 1979).
Early 1980s	Continuing investigations and feasibility study	Reclamation's continued investigations and testing of the newly constructed brine collection wells indicated the desired reduction of brine flow into the Dolores River could be met by pumping 2 cfs of brine (Reclamation 1986). Based on this new information, Reclamation initiated an action to conduct a feasibility study for the environmentally preferred deep-well injection alternative rather than implementing the evaporation ponds alternative at a 5 cfs pumping rate.
1986	Final Environmental Assessment and Finding of No Significant Impact	Issued by Reclamation for developing a deep-well brine injection testing program in Paradox Valley. The resulting injection well would become the PVU.
1990	PVU facilities are constructed	Reclamation completed the PVU facilities.
Early 1990s	PVU facilities are tested	Reclamation tested the PVU facilities. These tests provided information about necessary injection pressure and expected life of the well.
1996	Reclamation begins brine injection at the PVU	Initiated continuous brine injection in August.
1997	Final Environmental Assessment and Finding of No Significant Impact	Issued by Reclamation for long-term operation of the PVU.

Date	Event	Description
2006–12	Notable increases in well injection pressure	Reclamation conducted various studies and independent external review panels to investigate potential alternatives.
2012	Notice of Intent (NOI) to prepare PVU EIS	Published in the *Federal Register* (Reclamation 2012a).

1.2 Summary of Proposed Federal Action

Reclamation, the lead Federal agency, currently operates the PVU. Reclamation's proposed action is to construct, operate, and maintain facilities for the collection and disposal of saline groundwater of Paradox Valley, as authorized by Title II, Section 202(a)(1), of the Colorado River Basin Salinity Control Act. Project alternatives are described in **Chapter 2**.

The BLM is a cooperating agency, with a connected action. The BLM's connected action is to process Reclamation's request for land use authorization on public lands for collection and disposal of saline groundwater of Paradox Valley, as authorized by Title II, Section 202(a)(1), of the Colorado River Basin Salinity Control Act.

1.3 Purpose of and Need for Action

The need for the proposed action is to control salinity in the Colorado River contributed by sources in the Paradox Valley to decrease the adverse effects of high salt concentrations in the Lower Colorado Basin. The PVU has injected naturally occurring brine from Paradox Valley into a deep subsurface reservoir since 1996, but the injection well may be nearing the end of its useful life. Because the underground reservoir pressure and induced seismicity have increased, and brine disposal rates have had to be substantially reduced. In response, a new brine control and disposal facility is needed to enhance and protect the quality of water available in the Colorado River for use in the United States and the Republic of Mexico.

The purpose of the proposed action is to comply with Title II, Section 202(a)(1), of the Colorado River Basin Salinity Control Act and the approved state water quality standards under the CWA.

The purpose of the BLM's action is to respond to Reclamation's application for a ROW and/or Reclamation's petition/application for a withdrawal to construct, operate, and maintain facilities to control saline groundwater on public lands. The need for this action is to fulfill the BLM's responsibility in accordance with FLPMA and its implementing regulations in 43 CFR Parts 2300 and 2800.

1.4 Goals and Objectives

In addition to the purpose and need, the Secretary will consider the following goals and objectives:

- Remove approximately 100,000 or more tons of salt per year that would otherwise enter the Dolores River and the downstream Colorado River

- Optimize the annual cost per ton of salt removed
- Avoid and minimize adverse impacts on physical, biological, social, economic, cultural, and tribal resources in the affected environment
- Minimize the use of nonrenewable resources, including land and energy
- Be consistent with existing BLM RMPs, where applicable
- Be in the best interest of the public, including considerations of health and safety and the local community's desired future conditions

1.5 Federal Decisions to be Made

Both Reclamation and the BLM will make recommendations to the Secretary, who is the deciding official, based on the analysis in this EIS. Given the purpose of and need for the action, Reclamation's Upper Colorado Regional Director will make recommendations to the Secretary regarding whether and how to construct, operate, and maintain facilities for the collection and disposal of saline groundwater of Paradox Valley, in compliance with Title II, Section 202(a)(1) of the Colorado River Basin Salinity Control Act.

Reclamation has submitted a ROW application for the proposed action alternatives (COC-78766) to the BLM, pursuant to Title V of the FLPMA, as amended, and implementing regulations (43 CFR Part 2800). Reclamation may also file a petition/application with the BLM for a withdrawal of lands from the general mining and land laws and for a transfer of administrative jurisdiction for the selected facility alternative.

The BLM will make recommendations to the Secretary regarding whether to approve a ROW grant for the construction, operation, and maintenance of the selected alternative for the PVU and ancillary facilities and, if so, under what terms and conditions.

In addition, the BLM would process any withdrawal application filed by Reclamation in accordance with Section 204 of the FLPMA and its implementing regulations at 43 CFR Part 2300. This would include withdrawing lands from entry under the public land laws, including mining laws and mineral leasing, and a jurisdictional transfer from the BLM to Reclamation for the withdrawn lands.

Actions in which the scope of resource uses, or terms and conditions, would be inconsistent with Federal agency land use plans, would require an amendment of one or more RMPs. As required by 43 CFR Part 1610.2(c), the BLM will notify the public of any potential amendments to RMPs via an NOI to complete a plan amendment. All plan amendments are subject to a 30-day protest period, a 60-day Governor's consistency review, and a resolution of protests. The BLM would need to adopt any plan amendments after public review before implementing decisions in the record of decision (ROD).

Chapter 2 – Alternatives

This chapter describes the No Action Alternative (Alternative A) and three action alternatives, Alternative B—New Injection Well, Alternative C—Evaporation Ponds, and Alternative D—Zero-Liquid Discharge Technology (ZLD) (**Figure ES-1**, **Appendix B**). The temporal scope of analysis of each alternative is 50 years, which is the life of the project. Reclamation typically requires a minimum design life of 50 years for all salinity control projects; for analysis purposes, all action alternatives are analyzed as having a 50-year life.

This chapter also describes alternatives that were considered but eliminated from further analysis and identifies permits, permissions, consultations, and mitigation measures that would be implemented. Reclamation and the cooperating agencies developed the alternatives through the scoping process and subsequent analyses, including peer reviews and independent external review panels, requests for information, engineering and technical studies, a value planning study, and a design, estimating, and construction review.

Each action alternative has been developed to a conceptual (30%) level of design due to the extensive costs required for additional investigations and design of each action alternative. Therefore, all values presented are approximate. Numbers have been rounded where appropriate. The final design will be completed after an alternative is selected in the ROD. The evaluation of impacts is based on approaches and research methods generally accepted in the scientific community. The information provided herein is sufficient to evaluate reasonably foreseeable significant adverse impacts on the human environment, as per 40 CFR 1502.22. After an alternative is selected in the ROD, additional site-specific NEPA analysis may be required in order to finalize the alternative design and ensure any impacts not foreseen in this EIS are disclosed. Any additional NEPA analysis would be tiered to this EIS.

2.1 Assumptions and Data Limitations

2.1.1 Effect on Dolores River Salinity Levels

Since 1996 when Reclamation began operating the PVU, Reclamation has observed the effect of brine pumping and disposal on salinity levels in the Dolores River. In general, whenever the brine production wells are pumped, the total dissolved solids (TDS) level in the Dolores River downstream of the production wells is reduced. However, because of the many variables associated with quantifying the effect of pumping on the river's salinity (such as base salt load conditions, river flows, irrigation practices, and groundwater flow into the river), the change in TDS levels between the two U.S. Geological Survey (USGS) stations at Paradox Valley (09169500 and 09171100) does not exactly correlate with the volume of brine pumped from the brine production wells. More information can be found in **Section 3.6.1.1**, "Salinity in the Dolores River."

Reclamation has funded USGS investigations to evaluate salt loading in the Paradox Valley. However, no complete models of salt control in the Paradox Valley exist with which to determine the salinity control effect of PVU operations; therefore, based on best available scientific information, Reclamation is continuing to estimate salt control in the Paradox Valley based on its historical determination. Historically, Reclamation has determined that the quantity of brine intercepted and disposed of by the PVU is equal to the quantity of brine that would eventually find its way to the river and thereby increase its total salt load; that is, one ton of disposed salt is equal to one ton of salt prevented from entering the Dolores River (Reclamation 1997a, p. III-6).

Alternative B is evaluated at 200 gpm due to the Leadville Limestone Formation's inability to accept brine at a higher disposal rate (Reclamation 2017a). Alternatives C and D are evaluated at a disposal rate of 300 gpm because the production well field successfully operated at this capacity from 1997 to 2001, and these alternatives can be designed to accommodate this capacity. It should be noted that the actual salt load controlled under each action alternative could be less than the amounts evaluated in this EIS, with decreasing confidence at higher pumping rates. In other words, Alternatives C and D could be designed to accept a lower disposal rate (e.g., 200 gpm).

The average TDS of the brine is 260,000 mg/L. A constant pumping rate of 300 gpm would result in 171,000 tons per year (tons/year) of salt removed, and a constant pumping rate of 200 gpm would result in 114,000 tons/year of salt removed from the system; however, if the amount of salt potentially available for control in the Paradox Valley is described as the total volume of salt intercepted by the PVU, combined with the estimated volume of salt not captured and entering the river, this combined volume has been consistently less than 171,000 tons/year since 1988 (see **Table 2-1**, "Amount of salt intercepted by the PVU and estimated amount of salt continuing to enter the Dolores River from 1971 to 2018"); therefore, the full 300 gpm flow rate may not yield a 171,000-ton reduction in salt load. Further research from USGS would guide design features or operational changes needed to optimize future pumping rates at the PVU.

Table 2-1. Amount of salt intercepted by the PVU and estimated amount of salt continuing to enter the Dolores River from 1971 to 2018.

Year(s)	PVU Operations	Salt Intercepted by the PVU (tons/year)	Estimated Salt Continuing to enter the Dolores River (tons/year)	Estimated Amount of Salt Potentially Available for Control in the Paradox Valley[1] (tons/year)
1971–1977	Prior to PVU construction	Not applicable (n/a)	205,000[2]	205,000
1980–1985	Test pumping of the well field	n/a	149,380[3]	149,380
1988	Prior to PVU construction	n/a	206,424[3]	206,424
1989–1996	Intermittent injection testing at rates up to 400 gpm[4]	26,000[5]	111,510[3]	137,510
1997–2001	Long term operation began with an average brine disposal rate of 210 gpm with numerous well shut in times.[4]	100,000[3]	61,628[3]	161,628

Year(s)	PVU Operations	Salt Intercepted by the PVU (tons/year)	Estimated Salt Continuing to enter the Dolores River (tons/year)	Estimated Amount of Salt Potentially Available for Control in the Paradox Valley[1] (tons/year)
2002–2012	Operations changed to an average rate of 200 gpm with reduced well shut in times.	108,000[3]	40,590[3]	148,590
2013–2015	Operations changed to an average rate of 175 gpm.	95,000[3]	22,450[3]	117,450
2016–2018	Operations changed to an average rate of 168 gpm.	95,240	41,480[6] (Provisional USGS data)	136,720[6] (Provisional USGS data)

[1] In theory, this is the amount of salt potentially available for control in the Paradox Valley during the specified years. As discussed above, this number is typically lower than 171,000 tons/year.
[2] Reclamation 1978, p. 47
[3] USGS 2017, p. 15
[4] During this time, the PVU was injecting a 70% brine/30% freshwater mix.
[5] Reclamation 1992a, 1992b, 1993a, 1993b, 1993c, 1994a, 1994b, 1994c, 1994d, 1995a, 1995b, 1995c, 1995d, 1996, 1997b
[6] This number was calculated from the USGS provisional water quality data.

2.1.2 Estimates of Affected Acres

Acres of permanent impacts are calculated based on 30% designs for each alternative (see **Table 2-2,** "Summary of Permanent and Temporary Surface Disturbance by Action Alternative," in **Section 2.2**). Actual numbers may differ once an alternative is selected and designs are finalized; therefore, all numbers included in this EIS are estimates. Temporary impacts are calculated based on preliminary engineering estimates and are intended to show a relative difference between alternatives for the purpose of comparing impacts; therefore, actual figures may differ once an alternative is selected and designs are finalized (see **Table 2-2** in **Section 2.2**).

2.2 Summary of Action Alternative Project Components

Table 2-2 is a summary of permanent and temporary surface disturbance associated with each action alternative (Busch 2019a).

Table 2-2. Summary of Permanent and Temporary Surface Disturbance by Action Alternative.

Project Component		Alternative B (Area B1)	Alternative B (Area B2)	Alternative C	Alternative D
Study area (acres)		440	810	1,530	480
Permanent Disturbance[1]					
Land Administration (acres)	Reclamation	9	0	0	0
	BLM	7	7	527	80
	Private Ownership	0	0	73	0
Total (acres)		**16**	**7**	**600**	**80**

Project Component		Alternative B (Area B1)	Alternative B (Area B2)	Alternative C	Alternative D
Temporary Disturbance[2]					
Land Administration (acres)	Reclamation	10	1	1	1
	BLM	0	95	192	39
	Private Ownership	0	49	38	56
Total (acres)		**10**	**145**	**231**	**96**

Source: Busch 2019a.

[1] Permanent disturbance areas include:

Alternative B, Area B1: BIF, injection well, roads.
Alternative B, Area B2: BIF, injection well, pumping stations, roads.
Alternative C: Evaporation pond complex, landfill, roads.
Alternative D: ZLD facility complex, landfill, roads.

[2] Temporary disturbance areas include:

Alternative B, Area B1: Staging areas to construct the access road and bridges, brine pipelines, and electrical lines.
Alternative B, Area B2: Staging areas to construct the pumping stations, brine pipelines, and electrical lines.
Alternative C: Staging areas and material stockpiles, brine pipelines, freshwater pipeline, and electrical lines.
Alternative D: Staging area and material stockpiles, brine pipelines, service water supply pipelines, produced freshwater pipeline, natural gas pipelines, and electrical lines.

It is important to note that the combined total of permanent and temporary surface disturbance acres is less than the study area analyzed for each alternative. The reasoning for evaluating a study area larger than the area that would be impacted is to allow for siting flexibility once additional surveys/studies are completed and final designs are developed.

2.3 Alternative A—No Action Alternative

Under Alternative A, the existing deep injection well would not be replaced. Alternative A represents no salinity control in Paradox Valley.

2.3.1 Land and Location

The existing PVU facilities are located within 759 acres of land, of which 458 acres is Reclamation land. Reclamation also holds 106 acres of ROWs on BLM-administered land and 195 acres of perpetual easements on private land for some of the brine production wells and ancillary facilities, such as pipelines and monitoring infrastructure.

2.3.2 Existing Facilities

The existing PVU facilities consist of the following:

- Brine Production Well Field—Reclamation currently operates nine brine production wells.
- Surface Treatment Facility—The 1-acre STF receives the brine from the well field and temporarily stores the brine in a 25,000-gallon underground storage tank (UST). Currently, no treatment is performed at this facility. The brine is pumped from that tank to the BIF via the transfer pump and a 3.5-mile brine transfer pipeline.

- Brine Injection Facility—The 5-acre BIF includes two 25,000-gallon brine USTs, an injection pump building, freshwater treatment plant, injection well, well annulus monitoring system building, and additional ancillary facilities. The BIF receives the brine from the STF and stores it temporarily in the two 25,000-gallon USTs, after which the brine is filtered, pressurized, and injected 14,000 feet underground.
- Pipelines—The brine production wells are individually piped to the STF in 3- to 4-inch-diameter pipes. A 10-inch diameter brine transfer pipeline conveys brine 3.5 miles from the STF to the BIF.
- Headquarters Building—Reclamation and operation and maintenance (O&M) contractor personnel use this 2,300-square-foot modular building.
- Seismicity Monitoring System—The Paradox Valley Seismic Network monitors earthquakes via 20 stations equipped with broadband digital seismometers, in a roughly 20-mile radius around the BIF.

2.3.3 Operation and Maintenance

Under Alternative A, operations would cease, and salinity control would no longer occur in the Paradox Valley.

2.3.4 Closure/Decommissioning

2.3.4.1 Injection Well Abandonment

After injection has ceased for 2 years, the UIC Permit requires that the well be plugged and abandoned, as described in Reclamation's Plugging and Abandonment Plan (EPA 2011). In the event that Reclamation chooses not to permanently abandon the well at that time, the UIC Permit requires Reclamation to notify the EPA, to demonstrate that the well would be used in the future, and to describe actions or procedures that Reclamation would take to ensure the well does not endanger underground sources of drinking water during temporary abandonment.

2.3.4.2 Other Facilities

The pipelines and existing brine production wells would be capped or plugged and abandoned in place. Reclamation would cap and plug any abandoned collection wells pursuant to 2 CCR 402-2. The brine USTs, freshwater treatment plant, well annulus monitoring system, and additional ancillary facilities would be removed and disposed of in an approved location. All injection well equipment, including filter vessels, pumps, plumbing (except bathroom), controls, and electrical cabinets, would be removed from the buildings. The buildings themselves, their foundations, and electrical transformers would remain in place, and the buildings would be assessed for possible future use.

Appropriate safety and security measures would be installed, such as fencing across access roads, to prevent trespassing on Reclamation land. Reclamation would retain its land associated with the PVU until a future date, when the land would be reevaluated for other uses. Reclamation land that is determined no longer needed for future Reclamation purposes would be handled in accordance with applicable Federal law and Reclamation Manual Directives and Standards LND

08-02 and LND 08-03. Currently authorized BLM ROWs or easements on private lands would be reviewed to determine if they could be put to other uses. Any Federal facilities on BLM-administered lands that are also abandoned by Reclamation under Subpart E of 41 CFR Part 102-75 would be reclaimed by Reclamation. Reclamation would retain its water rights and would assess the need for their possible future use. Monitoring for seismic events via the Paradox Valley Seismic Network would continue until Reclamation determines it is no longer necessary.

2.4 Alternative B—New Deep Injection Well

Under Alternative B, brine would be collected from the existing brine production well field and piped to the existing STF. Then it would be piped from the STF to a new deep injection well and injected into a currently unpressurized block of the Leadville Formation. Areas B1 and B2 are analyzed in this EIS as potential locations for a new injection well: Area B1 is a combination of Reclamation land near the existing injection well and BLM-administered land on Skein Mesa; Area B2 is on BLM-administered land on Monogram Mesa (**Figure 2-2**, **Appendix B**) or Fawn Springs Bench (**Figure 2-3**, "Alternative B New Injection Well Area B2," **Appendix B**).

2.4.1 Land and Location

Seismic reflection data, well log data, aeromagnetic survey data, gravity data, and induced seismicity data show that the Leadville Formation, a deep geologic structure of the Paradox Valley region that would be intersected by the potential new well, should have sufficient permeability and porosity to accept the injected brine at a continuous rate of 200 gpm, while keeping wellhead pressures below 5,000 pounds per square inch over 50 years[1] (see **Appendix F**, "Geomechanical and Flow Modeling for Paradox Valley Unit Study for USBR: Summary Report";) (Reclamation 2017a, 2018; Detournay and Damjanac 2018). Reclamation selected two potential areas for a new well, based on the geological suitability of the underground reservoir for injection, the feasibility of drilling an injection well to reach the underground reservoir, and the ability to minimize environmental impacts. If Alternative B were selected in the ROD, Reclamation would complete additional geological investigations to identify the final location of the well.

2.4.1.1 Area B1

As shown on **Figure 2-2**, Area B1 includes Reclamation land and an area on Skein Mesa about 2 miles south of the injection well. The 440-acre study area (360 acres of Reclamation land and 80 acres of BLM-administered land) analyzed for Area B1 covers the maximum area within which the new facilities would be located. The permanent footprint of the surface facilities would be 16 acres. Implementation of this alternative would require a ROW and/or withdrawal of 80 acres of BLM-administered land (see **Section 3.11**, "Land Acquisition and Land Use"). Reclamation would acquire a ROW from BLM for areas with temporary disturbance (e.g., pipeline construction), and withdrawals would be processed for areas with permanent disturbance (e.g.,

[1]The assumptions used in modeling and determining the life of a new well come directly from the observed properties of the existing PVU facility. In addition, the proposed locations of a new well are expected to have a larger reservoir, leading to a longer lifetime. The lifetime of the injection well is determined largely by the average injection rate. For this analysis, an injection rate was selected that would last 50 years assuming the properties of the existing injection well are present in the new injection well.

permanent surface facilities). Temporary disturbance areas, such as staging and construction work areas, would be located within the 440-acre study area.

2.4.1.2 Area B2

As shown on **Figure 2-3**, Area B2 is on Monogram Mesa, predominantly on BLM-administered land. The 810-acre study (9 acres of Reclamation land, 616 acres of BLM-administered land, and 185 acres of non-Federal land) area analyzed for Area B2 covers the maximum area in which the Area B2 facilities would be located and is comprised of a combination of Reclamation land, BLM-administered land, and non-Federal land. The permanent footprint of the surface facilities would be 7 acres. Implementation of this alternative would require a ROW and/or withdrawal of 616 acres of BLM-administered land and acquisition of 49 acres of non-Federal land (see **Section 3.11**). Reclamation would acquire a ROW from BLM for areas with temporary disturbance (e.g., pipeline construction), and withdrawals would be processed for areas with permanent disturbance (e.g., permanent surface facilities). Temporary disturbance areas, such as staging and construction work areas, would be within the 810-acre study area.

2.4.2 Design and Construction

Alternative B would prevent up to 114,000 tons of salt from entering the Dolores River annually, if the brine were continuously diverted. A new deep injection well would be constructed over approximately 2 to 3 years.

2.4.2.1 3 Dimensional Seismic Survey

Reclamation would complete a 3D seismic survey prior to final selection of a new well-head site. Completion of the survey would require additional site-specific NEPA analysis, tiered to this EIS. The 3D seismic survey would cover an area of 175 square miles surrounding the proposed injection well locations (see **Figure 2-4**, “Alternative B Potential 3D Seismic Survey Area,” **Appendix B**). The survey would be completed to obtain a high-resolution picture of the subsurface geology to verify the extent of the Leadville Formation and the locations of faults. Small wireless portable seismic sensors would be temporarily deployed in a grid pattern on the ground surface throughout the survey area. The sensors would record signals generated by seismic sources, such as thumper trucks[2], Vibroseis[3], or explosives. Trucks would operate on existing roads in the survey area, and the seismic sensors would be manually deployed to their appropriate grid location.

The survey would take approximately 3 months and would not permanently disturb the ground surface. All equipment and materials would be removed at the completion of the survey. Once the details of the survey are known, Reclamation would coordinate with the BLM on completion of site-specific NEPA to analyze effects of the 3D seismic survey and to develop an appropriate 3D seismic survey plan that would include methods to avoid and minimize impacts to resources, including WSA, Federally-listed species, wildlife, vegetation, and cultural resources. Once the details of the survey are known, Reclamation would obtain the necessary use authorizations for the seismic survey from BLM, the U.S. Fish and Wildlife Service (FWS), private landowners,

[2] Thumper trucks drop heavy weights to produce the seismic source
[3] Vibroseis sources have large metal plates that are placed on the ground and vibrate to create the seismic source

the Colorado Department of Transportation (CDOT), and Montrose County prior to initiating the survey, and would comply with any associated terms and conditions.

2.4.2.2 Injection Well Facilities

The following new facilities would be required:

- Area B1 facilities would include a new deep injection well, a BIF, an access road, bridges, a brine pipeline, and powerline extension. The new BIF would be at the southern portion of Reclamation land. The access road to the new BIF would extend 1.3 miles past the existing BIF and would require two new bridge crossings of the Dolores River. A buried low-pressure pipeline and aboveground electric distribution lines would be constructed from the existing BIF to the new proposed BIF location.

  Final locations of the injection well components within the study area would depend on the findings of additional geological investigations. The target injection zone is under BLM-administered lands to the south of Reclamation land. If the suitable target injection zone is identified within a reasonable horizontal distance from the new BIF, then the injection well head would be next to the new BIF and a directional injection well would begin on Reclamation lands, pass beneath the surrounding BLM-administered lands, and end in the target zone; this is the Directional Well Option. If a suitable target injection zone were a farther horizontal distance from Reclamation lands, it may be more technically feasible, and involve less drilling risk, to complete a subsurface directional bore from the new BIF to the top of Skein Mesa on BLM-administered land. This directional bore would contain a high-pressure brine transmission pipeline connecting the BIF to the well head. An underground electrical line would be included in the directional bore to supply the well head. The injection well would then be drilled from the top of Skein Mesa into the identified target injection zone; this is the Vertical Well Option.

  These two options for the injection well are depicted on **Figure 2-5**, “Conceptual schematic of two options for an injection well at Area B1.”

  Accessing the top of Skein Mesa would require widening sections of County Road DD15 and County Road DD9, to a total width of 30 feet and installing road base along a 10-mile segment. A new ½-mile access road would be constructed from the county road to the well head location. Of these two options, the Vertical Well Option is analyzed in this EIS for Area B1 because the Vertical Well Option represents the largest potential for impacts in Area B1. Construction of the facility would require numerous pieces of heavy equipment, such as a drilling rig, pile driver, dozers, excavators, motor graders, compactors, dump trucks, backhoes, pipe layers, and forklifts.

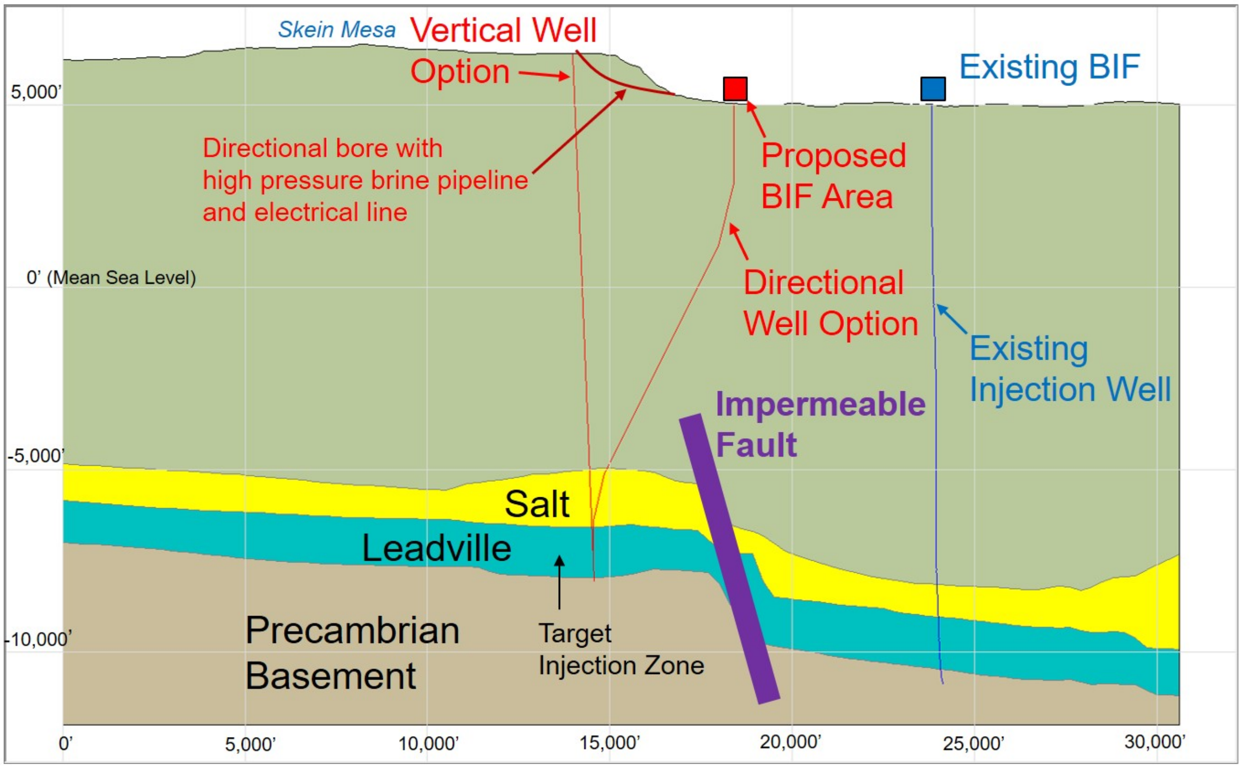

Figure 2-5. Conceptual schematic of two options for an injection well at Area B1.

- Area B2 facilities would include a new injection well, BIF, an 8-inch-diameter, 24-mile-long pipeline, pipeline pump stations, and powerline extensions from nearby lines to the pump stations. The pump stations would be 10'x20' concrete buildings housing an electric pump. There would be approximately six pumping stations to lift the brine from the STF either to the top of Monogram Mesa (Monogram Mesa Well Option) or to Fawn Springs Bench (Fawn Springs Bench Well Option). The location would depend on the findings of additional geological investigations.

  For the Monogram Mesa Well Option, a new 0.2-mile-long access road would be constructed from County Road DD19. For the Fawn Springs Bench Well Option, a new 0.4-mile-long access road would be constructed from County Road GG15. The buried brine pipeline from the STF to the new injection well would be routed along County Road Y11, Colorado Highway (Hwy) 90, County Road EE21, and County Road DD19 and would follow the alignment of the new access road. Heavy equipment requirements would be the same as Area B1 with the exception of the pile driver.

2.4.3 Operation and Maintenance

O&M requirements for both the Area B1 and Area B2 options would be similar to those at the existing well; however, greater automation would provide continuous data collection and monitoring, reporting, and pump, valve, and other equipment control to support safe operation and automated emergency shutdown. Onsite operators may be required to start the brine injection pumps.

2.4.4 Closure/Decommissioning

At the end of the injection well's useful life, its closure would be subject to the provisions of the EPA under the UIC Program.

2.5 Alternative C—Evaporation Ponds

Under Alternative C, brine would be collected from the existing brine production well field and piped to the existing STF. Then it would be piped from the STF to a series of evaporation ponds 7 miles southeast of the production well field. The facility would be operated to evaporate water from the brine, thereby allowing the solid salt to be harvested for disposal in an onsite salt landfill or to be used as a commodity. Additional NEPA analyses would be completed if, in the future, marketing the salt produced at the evaporation pond complex is determined to be beneficial.

2.5.1 Land and Location

Figure 2-6, ("Alternative C Evaporation Ponds," **Appendix B**) shows the location of Alternative C, and **Figure 2-7** ("Conceptual Layout of the Proposed Evaporation Pond Complex," **Appendix B**) shows a conceptual layout of the evaporation pond complex. The BLM currently manages most of the site, although the study area includes some Reclamation and non-Federal lands. The 1,530-acre study area analyzed for Alternative C covers the maximum area within which the evaporation pond complex and facilities would be located; however, the permanent footprint of the evaporation pond facilities would be 600 acres. The buried pipeline from the STF would be routed along County Road Y11 and Hwy 90. Implementation of this alternative would require a ROW and/or withdrawal of 1,300 acres of BLM-administered land and acquisition of 281 acres of non-Federal land (see **Section 3.11**). Reclamation would acquire a ROW from BLM for areas with temporary disturbance (e.g., pipeline construction), and land withdrawals would be processed, or acquisitions made for areas with permanent disturbance (e.g., permanent surface facilities). Temporary disturbance areas, such as staging and construction work areas, would be located within the 1,530-acre study area.

2.5.2 Design and Construction

Alternative C would prevent up to 171,000 tons of salt from entering the Dolores River annually, if the brine were continuously diverted. The evaporation pond facilities would be constructed over 2 to 5 years.

Alternative C facilities would include a 7-mile-long brine pipeline, an 8-mile-long freshwater pipeline, an electric line extension, a series of evaporation ponds, a hydrogen sulfide (H_2S) treatment system (see **Section 2.5.2.2**, "Hydrogen Sulfide Treatment"), a landfill, perimeter fencing, access roads, pipelines, and ditches. Construction of the facility would require numerous pieces of heavy equipment, such as dozers, excavators, motor graders, compactors, scrapers, haul trucks, dump trucks, backhoes, pipe layers, and forklifts.

2.5.2.1 Evaporation Pond System

The evaporation pond system would be designed to accommodate a continuous flow of up to 300 gpm of brine (484 acre-feet per year [acre-feet/year]). The conceptual pond system design includes a 27-acre surge pond, a 39-acre concentrator pond, four crystallizer ponds on 290 acres, a 24-acre bittern (remaining liquid) concentration pond, and a 10-acre-foot bittern storage pond (Amec Foster Wheeler Environment & Infrastructure, Inc. [Amec] 2017a). The evaporation pond embankments would be designed to withstand seismic events. Drainage ditches would be constructed around the facilities to manage storm water and runoff. The bittern ponds would be netted according to FWS specifications to restrict access by birds and small mammals and to allow for snow loading (P. Ramirez 2018 personal communication). Netting would be replaced at the end of the material's useful life, which is estimated to be every 10 years (Amec 2017b). The buried pipeline from the STF to the evaporation pond site would be routed along County Road Y11 and Hwy 90, and wildlife escape ramps could be incorporated if other preventative measures are ineffective.

In accordance with Colorado Department of Public Health and Environment (CDPHE) requirements, the ponds would require a single liner (compacted clay or synthetic liner), with a percolation rate less than or equal to ($\leq$) 10^{-6} centimeters per second. A geomembrane would be installed to line the ponds (Amec 2017b). Brine and bittern would be transferred between the ponds through open channels lined with a geomembrane.

Roads would be constructed in the evaporation pond complex, and an 8-foot-high fence, designed to exclude small to large wildlife, would surround it (Amec 2017b). County Road BB16 goes through the project site and would need to be rerouted around the perimeter of the site. The existing 2.7-acre stock pond on the project site would be destroyed. If off-site borrow pits or spoil piles were needed for construction of the evaporation pond complex, Reclamation would conduct additional site-specific NEPA analysis once specific locations were identified.

2.5.2.2 Hydrogen Sulfide Treatment

H_2S would be treated at the evaporation pond site to eliminate H_2S and ensure the brine is safe to be exposed to the environment before it is discharged into the evaporation ponds. Sodium hypochlorite would be used to oxidize H_2S to elemental sulfur and polysulfides, which would be removed during crystallization. This process produces solid precipitates that could build up and clog the pipeline, which is why the treatment is proposed to occur at the evaporation pond site. Sodium hypochlorite would be generated onsite using salt produced from the evaporation ponds and freshwater from the Dolores River; however, the overall treatment system could also accept commercially supplied salt and sodium hypochlorite, as needed (Amec 2016, 2017c).

The H_2S treatment system would take the brine through a series of tanks, with each tank introducing a chemical[4] to the brine that would destroy the H_2S and return the brine to a neutral potential hydrogen (pH) before it is discharged to the surge pond. The only byproduct would be elemental sulfur, which would settle out in the surge pond and eventually require disposal in the onsite landfill.

[4] Chemicals introduced would be sodium hypochlorite, ferric chloride, sodium hydroxide, hydrochloric acid, sodium bisulfate

The H_2S treatment system and associated sodium hypochlorite generation system equipment would be housed in an 8,400-square-foot building. Due to the brine's complex chemistry, risks associated with the H_2S removal process would be determined, and appropriate features would be incorporated during final design to avoid or reduce any identified risks. For example, if additional testing identifies a need, H_2S or chlorine gas scrubbers would be incorporated into the tank exhaust systems to eliminate any remnants of those gases from being released to the atmosphere. The H_2S treatment system would include an automated supervisory control and data acquisition (SCADA) alarm and monitoring system to shut down the brine transfer pump if vented H_2S or chlorine levels exceed safety thresholds.

2.5.2.3 Landfill

A 60-acre landfill would be constructed in the evaporation pond complex to permanently store the salt. In addition to the salt, the sulfur byproduct created during the H_2S treatment would be disposed of in the landfill. Reclamation would conduct any required chemical analyses, such as the toxicity characteristic leaching procedure, prior to disposing of the salt, sulfur, and any other solid byproducts in the onsite landfill (40 CFR Part 261.24; Test Method 1311 in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," EPA Publication SW-846). The landfill would contain six 10-acre cells, which would be constructed over the course of the 50-year life of the project. The first cell would be constructed 8 years after the beginning of pond operation.

The salt landfill would reach an ultimate vertical height of about 115 feet, with 100 feet rising above the surrounding ground surface. The landfill would be designed, constructed, and operated in accordance with Resource Conservation and Recovery Act (RCRA) Subtitle D and the CCR for Solid Waste Disposal Sites and Facilities (6 CCR 1007-2, Part 1). The landfill would be double-lined with geomembranes and would include a leak detection and leachate collection and removal system (Amec 2017b).

2.5.2.4 Alternative Habitat—Freshwater Wildlife Pond

A freshwater wildlife pond would be constructed in the evaporation pond complex to mitigate impacts on wildlife, particularly waterfowl (**Appendix J**, "Predictive Ecological Risk Assessment – Proposed Solar Evaporation Pond System"). The freshwater pond would serve as beneficial habitat that would attract wildlife that might otherwise be drawn to the evaporation ponds. The pond would be 6 acres, with a capacity of 25 acre-feet of water. The pond would be aerated and lined with a single geomembrane, which would be covered with a soil layer for protection (Amec 2017b).

2.5.3 Operation and Maintenance

2.5.3.1 Evaporation Pond Operation and Salt Harvest

Brine released from the H_2S treatment system would be stored in the surge pond to regulate brine flow through the pond system. Five to 10 gpm of freshwater would be injected into the brine flow to facilitate movement of the brine each time it is transferred between ponds. Brine would flow out of the surge pond into the concentrator pond at a rate of 200 to 500 gpm.

The evaporation pond complex can be operated with some flexibility depending on weather parameters or on desired byproducts. The proposed operational objectives and produced byproducts are as follows. The concentrator pond would evaporate water until solid sodium chloride starts to precipitate. When crystals begin to form, the brine would be transferred to the crystallizer ponds to precipitate sodium chloride from the brine. Each crystallizer pond would be fed in parallel from the concentrator pond. About 3 inches of salt would precipitate annually in each of the crystallizers. The first 24 inches of salt would remain in the crystallizers until the end of the project life as a protective layer to prevent damage to the liner. Once the salt layer is 12 inches thick above the 24-inch protective layer, it would be harvested using a loader and temporarily stockpiled within a lined storage area close to the crystallizer pond complex. Any drained brine would be placed back into the crystallizers. Once drained, the salt would be removed and transported to the landfill.

Not all the liquid would evaporate in the crystallizer ponds. The remaining liquid (bittern) would be transferred from the crystallizer ponds to a bittern pond where the bittern would continue to concentrate. When the bittern reaches a marketable concentration (about 30% magnesium chloride), it would be pumped to the bittern product storage pond. At full production, one crystallizer pond would be harvested each year. Any remaining bittern solids would be removed to and disposed of in the landfill (Amec 2017d). Additional NEPA analyses would be completed if, in the future, marketing the bittern or other salt produced at the evaporation ponds was determined to be beneficial to consumers.

2.5.3.2 Landfill

Salt would be transferred from the temporary stockpile to the landfill over the 50-year life of the project. To allow time for the crystallizer pond protective layer to develop, the salt destined for the landfill would not be produced until the ninth full year of pond operation. Other solid byproducts, such as elemental sulfur or bittern salts, would be harvested and transferred to the landfill for disposal as necessary. To control wind erosion, brine water would be sprayed on the landfilled salt to form a crust or a thin layer of soil would be placed to cover the salt layer (Amec 2017a). Leachate collected from the landfill would be cycled back through the evaporation pond complex.

2.5.3.3 Alternative Habitat—Freshwater Wildlife Pond

The freshwater wildlife pond would be refilled to its maximum 6-acre size during the winter migratory bird period, and it would be allowed to drop to a minimum pool size of 3 acres during the summer. The pond's aeration system would be used to maintain open water during freezing temperatures. The quality of water in the pond would be monitored, and the pond would be flushed and refilled if necessary to maintain water quality that meets wildlife use standards (Amec 2017b, 2017e; **Appendix J**).

2.5.3.4 Monitoring

Monitoring and assessment of avian deterrence would be an ongoing process and would be adjusted based on species composition/behavior, seasonality, or other factors as appropriate. Personnel on routine patrols around the ponds would disturb birds and create an opportunity to monitor and assess avian use of the evaporation ponds. Monitoring reports would be completed to note bird species, numbers, and frequency of use. The monitoring reports would also include all other wildlife observations made during the patrol, including mammals, reptiles, and amphibians either seen in proximity to the ponds or found dead in or near the ponds. Monitoring and assessment would continue to occur during all mitigation activities, and adaptive management would be used to determine if additional mitigation activities are required (see **Appendix J**; Amec 2017e).

2.5.4 Closure/Decommissioning

Closure of the evaporation ponds would follow the applicable requirements of the State of Colorado. This could require removing pumping and piping systems, the protective salt layer in the crystallizer ponds, and the geomembrane liner, grading the site to restore the ground to a natural appearance, and reseeding disturbed areas. The liner would be disposed of in the landfill described in **Section 2.5**.

Based on current requirements, closure of the landfill would include constructing an earthen cover system, grading, and establishing surface water management structures to control erosion.

All other appurtenant features of Alternative C, including the H_2S treatment facility, freshwater wildlife pond, access roads, and pipelines, would be evaluated for removal or abandonment in place or for other uses by Reclamation.

2.6 Alternative D—Zero-Liquid Discharge Technology

Under Alternative D, brine would be collected from the existing brine production well field and piped to the STF. Then it would be piped from the STF to a centralized treatment plant consisting of a series of thermally driven crystallizers. The facility would be operated to evaporate and later condense water from the brine, resulting in a solid salt and produced freshwater stream. This produced freshwater stream would be released into the Dolores River via a return pipeline, pending a discharge permit from CDPHE. The solid salt would be disposed of in an onsite landfill. Additional NEPA analyses would be completed if, in the future, marketing the salt produced at the ZLD facility is determined to be beneficial.

2.6.1 Land and Location

Figure 2-8 (“Alternative D Zero Liquid Discharge,” **Appendix B**) shows the location of Alternative D. The proposed study area is managed by the BLM, although the pipelines may cross non-Federal lands or be located within county and State road easements. The 480-acre study area analyzed in this EIS covers the maximum area in which the ZLD facilities would be located; however, the permanent footprint would be 80 acres (see **Figure 2-9**, “Conceptual Layout of the Proposed Evaporation Pond Complex,” **Appendix B**, for a conceptual layout of the proposed facilities). Implementation of this alternative would require a ROW and/or withdrawal of 267 acres of BLM-administered land and acquisition of 56 acres of non-Federal land (see **Section 3.11**). Reclamation would acquire a ROW for areas with temporary disturbance (e.g., pipeline construction), and withdrawals would be processed for areas with permanent disturbance (e.g., permanent surface facilities). Temporary disturbance areas, such as staging and construction work areas, would be located within the 480-acre study area.

2.6.2 Design and Construction

Alternative D would prevent up to 171,000 tons of salt from entering the Dolores River annually, if brine is continuously diverted. The ZLD facilities would be constructed over approximately 2 to 3 years.

The facilities would include a 1-mile-long service water supply pipeline, a 1-mile-long produced freshwater return pipeline, an access road, a 150,000-square-foot ZLD facility building, and a salt landfill. In addition, Alternative D would require installation of a buried interconnect and 14 miles of buried natural gas distribution line from the main gas transmission line in the southeast Paradox Valley to the project area, upgrades to electrical lines and substation protection, and construction of new regulators near the substation. Facilities would be designed to withstand seismic events. Construction of the facility would require numerous pieces of heavy equipment, such as dozers, excavators, motor graders, compactors, scrapers, dump trucks, backhoes, pipe layers, and forklifts.

2.6.2.1 Zero-Liquid Discharge Facility

The ZLD facility would be designed to accommodate a continuous flow of up to 300 gpm of brine (484 acre-feet/year). The conceptual design includes the use of multiple crystallizers operating in parallel that would reduce the brine to a solid product suitable for landfill disposal (see **Figure 2-10**, “Flow diagram of a ZLD crystallizer process”).

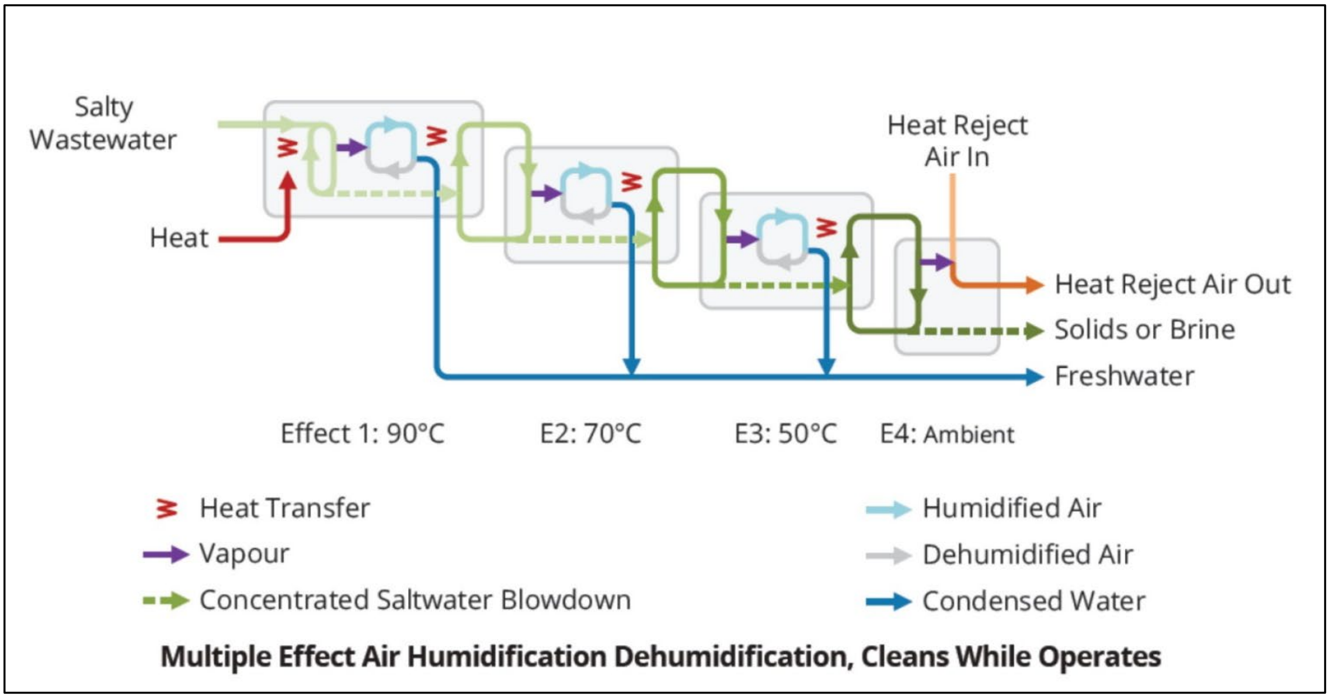

Figure 2-10. Flow diagram of a ZLD crystallizer process (SaltWorks 2019)

The crystallizers would be constructed as modular units and would be installed on a flat slab. Approximately 150,000 square feet of building space would be required, at a height of 40 feet, to protect the equipment from the weather and to prevent freezing. This footprint includes the space required for drying salt in drain bins before disposing of it in a landfill.

The crystallizers would require a heat source to drive the evaporation process, and additional heat may be required in the building to prevent equipment from freezing in winter. A natural gas pipeline crosses the southeastern portion of Paradox Valley, and a 14-mile extension of the gas line would need to be constructed along the Colorado Hwy 90 corridor and to the proposed site to service the facilities. Electrical power (480 volts alternating current [VAC] power, three phase, 60 hertz) would also be needed for equipment operation, and a telemetry system for remote monitoring or operation.

2.6.2.2 Hydrogen Sulfide Treatment

Sodium hypochlorite would be used to oxidize H_2S to elemental sulfur and polysulfides, which would be removed during crystallization. Sodium hypochlorite would be generated onsite using salt and produced freshwater from the crystallizers; however, the overall treatment system could also accept commercially supplied salt and sodium hypochlorite if needed. Since the brine is never exposed to the environment, sodium hypochlorite is the only treatment step needed.

The H_2S treatment system would be housed in the ZLD Facility building. It would include an automated SCADA alarm and monitoring system to shut down the brine transfer pumps if vented H_2S or chlorine levels exceed safety thresholds. Appropriate features and operational measures would be incorporated during final design to address any identified risks associated with the H_2S treatment process. This could include alteration of the chemical oxidation process or incorporation of H_2S or chlorine gas scrubbers into the tank exhaust systems.

2.6.2.3 Landfill

A 60-acre landfill would be constructed to permanently store the evaporated salt. The landfill would contain six 10-acre cells, which would be constructed over the course of the 50-year life of the project. Processing 300 gpm of brine would generate 470 tons of salt per day.

The salt landfill would reach an ultimate vertical height of about 115 feet, with 100 feet rising above the surrounding ground surface. The landfill would be designed, constructed, and operated in accordance with RCRA Subtitle D and CCR for Solid Waste Disposal Sites and Facilities (6 CCR 1007-2 Part 1). The landfill would be double lined with geomembrane liners and would include a leak detection and leachate collection and removal system (Amec 2017b).

2.6.3 Operation and Maintenance

Brine would be pumped from the production wells to the H_2S treatment system, acid would be used to adjust the pH and minimize carbonate scaling, and the brine would be stored in a crystallizer feed tank. From there, brine would be pumped into thermally driven crystallizers. As water evaporates, the brine would become saturated and salts would begin to precipitate out of the solution. These salts would be deposited into drain bins as a commingled solid comprised of all constituents in the brine as well as byproducts from the H_2S treatment process. To increase energy efficiency, each evaporator would consist of multiple stages, with the water vapor from one stage providing the heat for additional brine evaporation in the next stage (see **Figure 2-10**).

Along with the solid product, the crystallizers would produce 250 gpm (80% of brine flow rate) of high temperature (50 degrees [°] Celsius), low to neutral pH (4.5 to 7.5), and low alkalinity (less than [<] 20 mg/L as calcium carbonate [$CaCO_3$]) freshwater, with estimated TDS of 500 mg/L. This produced freshwater stream would be released into the Dolores River, pending a discharge permit from CDPHE. Initial tests have indicated the produced freshwater stream may need additional treatment (e.g., mixing with brine or river water) to meet CDPHE requirements before it can be discharged to the Dolores River.

Skilled staff trained in the O&M of crystallizers would be hired to operate the facility. The highly concentrated brine can be harsh on equipment, and system upsets would require substantial operator attention and effort to correct and bring the system back online. In addition to daily O&M tasks, preventive maintenance would be required to maintain reliable equipment operation.

2.6.3.1 Landfill

Salt would be transferred from the drain bins to the landfill via roll-off trucks over the 50-year life of the project. Salt would be produced and transported to the onsite landfill directly after operations begin. To control wind erosion, brine water would be sprayed on the landfilled salt to form a crust or a thin layer of soil would be placed to cover the salt layer (Amec 2017a). Leachate collected from the landfill would be cycled back through the ZLD facility. The landfill would be designed, constructed, and operated in accordance with RCRA Subtitle D and CCR for Solid Waste Disposal Sites and Facilities (6 CCR 1007-2 Part 1).

2.6.4 Closure/Decommissioning

Closure of the ZLD facility would follow the applicable requirements of the State of Colorado and could include removing constructed features and mechanical equipment, site grading to restore the ground to a natural appearance, and reseeding the disturbed areas with an appropriate seed mixture.

Requirements regarding closing and decommissioning the landfill are the same as those described in Alternative C, **Section 2.5**.

2.7 Costs of Alternatives, Risks, and Funding Mechanisms

2.7.1 Cost of Alternatives

The costs of the alternatives presented in this section are based on the initial capital construction costs, the annual operation, maintenance, and replacement (OM&R) costs, and closure costs. Costs are presented as a cost per ton of salt prevented from entering the Colorado River. For all action alternatives, construction costs include expenses ranging from real estate purchases to design and construction costs. O&M-related expenditures are projected over each year of the 50-year project lifespan. Replacement costs would occur based on the life expectancy of the major components of the systems. Closure of the existing injection well and BIF would be required under all alternatives; however, these costs are not included in the cost estimates of the action alternatives.

Costs of each alternative were calculated using initial capital construction and closure costs amortized over 50 years and annual OM&R costs. The alternatives evaluated in this EIS have been developed to a conceptual (~30%) level of design. The interest rate used for this analysis (2.875%) was approved at the initial congressional authorization of the PVU project. If the life of any element of an alternative is not expected to be at least 50 years, replacement costs were included in the cost estimate. The sum of the annual amortized costs plus the annual OM&R is then divided by the tons of salinity reduction, resulting in an annual cost per ton.

Table 2-3, "Costs of Alternatives" summarizes costs and cost effectiveness of the action alternatives.

Table 2-3. Costs of Alternatives[1]

Result	A	B—Area B1	B—Area B2	C	D
Salt reduction (tons/year)	0	114,000	114,000	171,000	171,000
Construction cost[2] (million dollars)	$3.7	$99 - $106	$116	$132	$112
Annualized[3] construction cost (million dollars)	0	$3.8 - $4	$4.4	$5	$4.2
Annual OM&R costs[4] (million dollars)	0	$2.7	$3.2	$5.7	$11.8
Total annual cost (million dollars)	0	$6.5 - $6.7	$7.6	$10.7	$16
Annual cost per ton of salt removed	n/a	$57 - $59/ton	$67/ton	$63/ton	$94/ton

[1] Costs of the proposed action alternatives are reflected in 2017 dollars and are based on the initial capital construction costs, the annual OM&R costs, and closure costs. The construction costs identified for Alternative A include all costs of actions identified in Section 2.3 and are part of the existing PVU project. Of these costs, the cost to close the existing well and BIF is $3M. This $3M is not included in the costs identified for the action alternatives because closing the existing well, while necessary under any alternative, is not a cost that would be incurred by the action alternatives. The remaining $0.7M identified under Alternative A would not need to be spent under any of the action alternatives.

[2] Construction costs include planning studies, NEPA, environmental commitments, permitting, design data, engineering and other costs. A 10% contingency was included to cover unlisted items and an additional 25% design contingency was also added.

[3] Annualized at an interest rate of 2.875% over 50 years.

[4] If there is a need to replace Lake Mead water to meet the salinity differential, such replacement would come at a monetary cost. Cost ranges could vary substantially depending on a wide variety of factors. For example, in the System Pilot Conservation Program in the Upper Basin, average costs were approximately $200/af. Though the replacement costs in this instance could vary greatly from that figure depending on the factual circumstances.

2.7.2 Risks to Cost

The costs estimated for each action alternative could be substantially affected by risks which, if encountered, could affect the overall cost of the alternative.

For Alternative B, the assumption is that the injection well can be successfully drilled on the first attempt. Initial analyses identified the cost of drilling an exploratory well to be similar to the cost of drilling an injection well, so the benefit of drilling an exploratory well would not justify the cost. It is also assumed the target injection formation and the existing injection formation have similar in situ characteristics, and that the target injection formation is suitable for proposed operations. These assumptions can only be verified by drilling the injection well. Should these assumptions turn out to be incorrect, an additional well would need to be drilled, which would significantly impact the cost effectiveness of Alternative B. Another consideration is the injection well would need to be operated at a constant rate. This rigid operating criterion makes the O&M, and thereby the cost effectiveness, difficult to optimize.

For Alternative C, the assumption is that suitable soils exist on the project site to construct the pond embankments. It is also assumed no rock layers which would require blasting or significant effort to excavate would be encountered during construction. If additional borrow sources are determined to be necessary, the overall project cost could increase significantly. It is also assumed the proposed wildlife mitigation plans would be sufficient to minimize impacts to wildlife. The cost effectiveness of this alternative could be impacted if adaptive management leads to implementation of additional mitigation measures or increased operational demands for monitoring and patrols. The evaporation pond complex can receive brine at various flow rates throughout the year, and therefore the O&M can be optimized to account for the natural variations of brine flow into the river. The ability to optimize operations could lead to an improved cost effectiveness.

For Alternative D, the annual energy costs are based upon the average commercial price of natural gas over the last 10 years. Energy costs can fluctuate, and unknown future energy costs could have a significant direct impact on the cost effectiveness of this alternative. The ZLD technology can receive brine at various flow rates throughout the year, and therefore the O&M can be optimized to account for the natural variations of brine flow into the river. The ability to optimize operations could lead to an improved cost effectiveness.

2.7.3 Funding Mechanism

The PVU was constructed under the authority of the Colorado River Basin Salinity Control Act, and this EIS is prepared under the assumption that any action alternative which may be selected would be funded under the same authority as the original PVU. That is, 100% of the funding for construction would be obtained upfront through Federal appropriations. Once constructed, 25% of the construction costs would be repaid to the United States Treasury, without interest, from the Colorado River Basin Development Funds (Basin Funds), with 85% of the repayment coming from the Lower Basin Fund and 15% from the Upper Basin Fund. The Lower Basin states are Nevada, Arizona, and California, and the Upper Basin states are Wyoming, Colorado, Utah, and New Mexico. The Salinity Control Act directs that the costs allocated to the Basin Funds be repaid within a 50-year period or within a period equal to the estimated life of the unit.

Assuming the repayment would be without interest, Reclamation anticipates the Basin Fund costs would be repaid in the last years of the repayment period.

Since operation of the PVU began, Reclamation has funded the O&M costs of the PVU using 75% Federal appropriations and 25% cost share from the Basin Funds, and it is anticipated this cost share would continue after the construction of an action alternative.

For the Upper Basin Fund the repayment costs and years to be repaid and the annual O&M cost share would be included in the rate setting studies. The mill levy on electrical power sold from the hydroelectric powerplants along the Colorado River in the Upper Basin would be adjusted to provide funds when needed for the repayment and cost share.

In the Lower Basin, the Basin Funds receive their funding through mill levies established on electrical power sold from hydroelectric powerplants along the Colorado River. A mill levy of 2½ mills was established on hydroelectric powerplants in the Lower Basin to provide funding to the Lower Basin Fund. Due to the funding of salinity control projects through Reclamation and the U.S. Department of Agriculture Natural Resources Conservation Service, surplus funds in the Basin Funds have been expended and any available funds are those which are generated each year. The Lower Basin Fund currently has a $13 million deficit, and this deficit has been increasing by approximately $1 million each year.

2.8 Permits and Approvals Needed

Table 2-4, "Permits, reviews, and approvals required to implement the alternatives" lists the permits, reviews, and approvals that would be required to implement the alternatives.

Table 2-4. Permits, reviews, and approvals required to implement the alternatives

Agency	Permit/Approval/Consultation	Applicable Alternative
BLM	ROW and/or processing of withdrawal with transfer of jurisdiction	B, C, D
	Modification to grazing permits	B, C, D
	RMP amendment	C
	Short-term ROW for pre-construction technical investigations and surveys	B, C, D
Montrose County	Certificate of designation to designate the landfill as a solid waste disposal site, per 6 CCR 1007-2, Part 1 Solid Waste Sites and Facilities	C, D

Agency	Permit/Approval/Consultation	Applicable Alternative
CDPHE	National Pollutant Discharge Elimination System (NPDES) permit to discharge produced freshwater to Dolores River (CWA Section 402 NPDES permit)	D
	CWA Section 401 water quality certification (if CWA Section 404 standard individual permit is required); CWA Section 402 NPDES permit	B, C, D
	Air Pollutant Emission Notice (APEN) reporting for criteria pollutant emissions above the reporting threshold	B, C, D
	Minor source permit for criteria pollutant emissions above the relevant threshold	B, C, D
	Stormwater permits for ground disturbances >1 acre	B, C, D
Colorado State Historic Preservation Officer (SHPO)	Title 54, National Historic Preservation Act (NHPA) Section 106 consultation on historic properties	B, C, D
Federal Energy Regulatory Commission (FERC)	BLM to request entry/construction on lands classified as a FERC power site.	B, C, D
Hopi Tribe, Ute Mountain Ute Tribe, Southern Ute Indian Tribe, Ute Indian Tribe, Zuni Pueblo, Navajo Nation	Consultation required by the NHPA, Section 106, and Executive Orders 13007 and 13175	B, C, D
State of Colorado, Department of Natural Resources, Division of Water Resources (DWR)	Determine if the augmentation plan is sufficient to cover water needs; If deemed necessary, develop new augmentation plan and obtain DWR approval.	C, D
	Colorado water court approval of supplemental point of diversion and/or amended augmentation plan	C, D
	State approval for water storage	C
U.S. Army Corps of Engineers (USACE)	Section 404 CWA Permit for the discharge of dredged or fill material into Waters of the United States	B, C, D
EPA	UIC Permit for Class V injection well	A[1], B
FWS	Biological assessment preparation and consultation under Section 7(a)(2) of the Endangered Species Act of 1973 (ESA)	B
Non-federal landowners	Purchase non-Federal land	B (Area B2), C, D

[1] PVU currently has a UIC permit for existing Class V injection well. Alternative A injection well will be plugged and abandoned in accordance with its existing UIC Permit.

2.9 Environmental Commitments

Table 2-5, "Environmental Commitments" describes environmental commitments (best management practices [BMPs] and other avoidance and minimization measures) incorporated into the conceptual design of each applicable alternative. To reduce duplication, the environmental commitments are incorporated into the analysis of the effects of the alternatives, including the No Action Alternative, and are not restated in each resource area. Reclamation would implement these measures to avoid and minimize effects on known resources, including special designations, water resources, and private property. Consideration of these measures influenced the location and preliminary design of the alternatives.

Table 2-5. Environmental Commitments

Commitment Description	Resources (Section in Chapter 3 discussing resource)	Applicable Alternative
Dust suppression measures would be used to reduce daily particulate matter 2.5 micrometers or less in diameter ($PM_{2.5}$) emissions and fugitive dust during construction. For all dust suppression, the water would be obtained from Reclamation's existing diversions and be within Reclamation's water rights. Water usage would be tracked by Reclamation (and their contractor) and coordinated with DWR.	Air quality, odors, meteorology, and climate (**Section 3.1**), vegetation (**Section 3.7**), terrestrial and aquatic wildlife (**Section 3.9**), Federally listed species (**Section 3.10**)	Common to all
To control wind erosion, brine water would be sprayed on the landfilled salt to form a crust, or a thin layer of soil would be placed to cover the salt layer.	Air quality, odors, meteorology, and climate (**Section 3.1**)	C, D
The design would include an automated system, which would maintain flows and tank levels at equilibrium to reduce storage tank emissions below the CDPHE permit threshold for H_2S of 2 tons/year.	Air quality, odors, meteorology, and climate (**Section 3.1**)	B, C, D
Due to the brine's complex chemistry, risks associated with the H_2S removal process would be determined and appropriate features incorporated during final design to avoid or reduce any identified risks. For example, if additional testing identifies a need, H_2S and/or chlorine gas scrubbers would be incorporated into the tank exhaust systems to eliminate any remnants of those gases from being released to the atmosphere. The H_2S treatment system would include an automated alarm and monitoring system to shut down the brine transfer pump if vented H_2S or chlorine levels exceed safety thresholds.	Air quality, odors, meteorology, and climate (**Section 3.1**)	B, C, D
The evaporation pond embankments would be designed to withstand seismic events.	Geology and geological hazards (**Section 3.3**)	C
Monitoring for seismic events via the Paradox Valley Seismic Network would continue until Reclamation determines it to be no longer necessary.	Geology and geological hazards (**Section 3.3**)	Common to all

Commitment Description	Resources (Section in Chapter 3 discussing resource)	Applicable Alternative
A risk analysis would be conducted to verify the potential impacts of pond failure.	Geology and geological hazards (**Section 3.3**)	C
Augmentation water reserved for surface water depletions of the PVU would be investigated for other uses.	Surface water and water rights (**Section 3.4**)	Common to all
Reclamation would request the State of Colorado to review the existing augmentation plan to determine if it provides sufficient resources to cover the additional water per year required by the system. If additional resources are needed to cover the consumptive use, an amended augmentation plan would be developed.	Surface water and water rights (**Section 3.4**)	C, D
Reclamation would minimize impacts on the Dolores River flows as measured at the downstream USGS gage station (Station 09171100) (Dolores River Near Bedrock) by implementing a State-approved augmentation plan when PVU water rights are out of priority.	Surface water and water rights (**Section 3.4**)	B, C, D
Drainage ditches would be constructed around the facilities to manage storm water and runoff.	Wetlands and other waters (**Section 3.5**), water quality (**Section 3.6**)	C
An onsite delineation of Waters of the United States would be completed after a preferred alternative is selected.	Wetlands and other waters (**Section 3.5**)	B, C, D
Facilities would be sited to avoid and minimize impacts on Waters of the United States to the maximum extent practicable.	Wetlands and other waters (**Section 3.5**), water quality (**Section 3.6**)	B, C, D
A Section 404 CWA Permit would be obtained before Waters of the United States are disturbed.	Wetlands and other waters (**Section 3.5**)	B, C, D
Erosion control BMPs would be implemented to prevent or reduce nonpoint source pollution during and following construction.	Water quality (**Section 3.6**), vegetation (**Section 3.7**), special status plant species (**Section 3.8**), terrestrial and aquatic wildlife (**Section 3.9**), Federally listed species (**Section 3.10**)	Common to all
Storm water management plans and drainage design plans would include BMPs for storm water control to minimize soil erosion and sedimentation.	Water quality (**Section 3.6**), vegetation (**Section 3.7**), special status plant species (**Section 3.8**), terrestrial and aquatic wildlife (**Section 3.9**)	B, C, D
A NPDES Permit would be obtained from the CDPHE, and an erosion control plan would be developed and implemented prior to construction.	Water quality (**Section 3.6**)	B, C, D

Commitment Description	Resources (Section in Chapter 3 discussing resource)	Applicable Alternative
Should it be determined, after the ROD is issued, that implementing the selected alternative would require additional water to be released from Lake Mead to comply with IBWC Minute No 242, Reclamation will work with affected stakeholders to implement appropriate mitigation measures.	Water quality (**Section 3.6**)	B, C, D
Water samples would be obtained at the freshwater pond. Should selenium levels become an issue in the freshwater pond, Reclamation will make sure sufficient water is available. Additional water may be required if determined necessary to maintain good water quality.	Water quality (**Section 3.6**)	C
Reclamation would work with CDPHE to ensure that the composition and temperature of the produced freshwater stream meets CWA standards prior to its discharge to the Dolores River.	Water quality (**Section 3.6**)	D
Disturbed lands would be recontoured to minimize erosion, and topsoil, where available, would be stockpiled during construction for later use in revegetation. Reclamation would revegetate disturbed lands with a Reclamation-approved seed mix.	Vegetation (**Section 3.7**), special status plant species (**Section 3.8**), terrestrial and aquatic wildlife (**Section 3.9**), Federally listed species (**Section 3.10**)	B, C, D
Utilities would be located in existing ROWs to the greatest extent practicable.	Vegetation (**Section 3.7**), special status plant species (**Section 3.8**), terrestrial and aquatic wildlife (**Section 3.9**), Federally listed species (**Section 3.10**)	B, C, D
Siting and design would include measures to minimize adverse effects on the riparian vegetation community.	Vegetation (**Section 3.7**), areas of special designation (**Section 3.13**)	B, C, D
Noxious weeds would be controlled within the limits of the facility for the 50-year life of the project. The use of pesticides and herbicides would comply with applicable Federal and State laws. Pesticides and herbicides would be used only in accordance with their registered uses and within limitations imposed by the Secretary.	Vegetation (**Section 3.7**)	Common to all
All construction equipment would be power washed and free of soil and debris before being driven onto the construction site to reduce the spread of noxious and invasive weeds.	Vegetation (**Section 3.7**)	Common to all

Commitment Description	Resources (Section in Chapter 3 discussing resource)	Applicable Alternative
Reclamation would coordinate with the BLM on completion of site-specific NEPA to analyze effects of the 3D seismic survey and to develop an appropriate 3D seismic survey plan that would include methods to avoid and minimize impacts to resources, including WSA, Federally-listed species, BLM sensitive species, and other wildlife, vegetation, and cultural resources. The 3D seismic survey would be designed to be compatible with preserving the WSA wilderness characteristics and would meet the non-impairment standard.	Vegetation (**Section 3.7**), special status plant species (**Section 3.8**), terrestrial and aquatic wildlife (**Section 3.9**), Federally listed species (**Section 3.10**), areas of special designation (**Section 3.13**), and cultural resources (**Section 3.19**)	B
Trucks would operate on existing roads in the seismic survey area, and the seismic sensors would be manually deployed to their appropriate grid location.	Vegetation (**Section 3.7**), special status plant species (**Section 3.8**), terrestrial and aquatic wildlife (**Section 3.9**), Federally listed species (**Section 3.10**), areas of special designation (**Section 3.13**), and cultural resources (**Section 3.19**)	B
Surveys for special status plants would be conducted on BLM-administered land prior to construction or other ground-disturbing activities. Measures would be taken to avoid special status plants on such land, when feasible.	Special status plant species (**Section 3.8**)	B, C, D
Vegetation would be removed outside of peak breeding season (May 15 to July 15) to avoid impacts on migratory birds. Surveys would be conducted if vegetation has to be removed during the peak breeding season.	Terrestrial and aquatic wildlife (**Section 3.9**)	B, C, D
Prior to construction, raptor surveys would be conducted. Measures would be taken to avoid nesting raptors.	Terrestrial and aquatic wildlife (**Section 3.9**)	B, C, D
Utility lines would be constructed according to avian protection plan guidelines (APLIC and FWS 2005).	Terrestrial and aquatic wildlife (**Section 3.9**)	B, C, D
The freshwater pond would be designed and operated to keep the water surface open during early or late winter storms that could force migrating waterfowl to seek refuge.	Terrestrial and aquatic wildlife (**Section 3.9**)	C
The bittern pond would be netted to FWS specifications to restrict access for birds and other small animals.	Terrestrial and aquatic wildlife (**Section 3.9**)	C
Routine patrols of the evaporation ponds would be conducted to serve as both a deterrence and a method to monitor and assess wildlife use of the ponds.	Terrestrial and aquatic wildlife (**Section 3.9**)	C

Commitment Description	Resources (Section in Chapter 3 discussing resource)	Applicable Alternative
If monitoring reveals the freshwater pond and netting do not minimize and mitigate impacts on wildlife, including migratory birds, Reclamation would coordinate with FWS regarding an adaptive management approach, as outlined in the Predictive Ecological Risk Assessment (Amec 2016), to determine alternative methods to minimize impacts to wildlife.	Terrestrial and aquatic wildlife (**Section 3.9**)	C
To help minimize sources of light pollution during ongoing O&M, light control BMPs would be used, such as downcast lighting or covered bulbs to direct light to the ground surface rather than projecting it to the surrounding areas and low-glare external lighting features. No light hazing features (such as strobe lights) would be used.	Terrestrial and aquatic wildlife (**Section 3.9**), visual resources (**Section 3.12**), artificial light (**Section 3.17**)	B, C, D
Seismic surveys within Gunnison sage-grouse critical habitat would occur outside of sage-grouse nesting and brood-rearing season (March 1 to July 30).	Federally listed species (**Section 3.10**)	B
If threatened or endangered species are discovered during construction, activities would be halted until consultation with FWS is completed and protection measures are implemented.	Federally listed species (**Section 3.10**)	B, C, D
Reclamation would coordinate with the BLM on appropriate mitigation for the stock pond removal, such as reconstruction of the stock pond in an alternate location that could utilize the same water right.	Land acquisition and land use (**Section 3.11**)	C
Procedures to avoid conflicts during construction with landowners adjacent to the project area would be established and followed. Unavoidable or unintentional damage to any facilities would be replaced or restored.	Land acquisition and land use (**Section 3.11**)	B, C, D
Reclamation would coordinate with mining claimants if an active mining claim is identified in the project’s construction area and, if appropriate, would prepare a plan to avoid or minimize interference with mining operations.	Land acquisition and land use (**Section 3.11**)	B, C
Reclamation would exercise as much flexibility as allowed by law to enable landowners/ranchers to retain use of private or public lands as long as possible, which in some cases may extend even after the land has been acquired by Reclamation.	Land acquisition and land use (**Section 3.11**)	B, C, D
In the event there is a loss of Animal Unit Months (AUMs), Reclamation would coordinate closely with ranchers to identify reliable target dates for ranchers to count on for planning purposes so they know when they might need to begin adjusting herd size or making other arrangements.	Land acquisition and land use (**Section 3.11**)	B, C, D

Commitment Description	Resources (Section in Chapter 3 discussing resource)	Applicable Alternative
If an unidentified well or mine is encountered, Reclamation would stop all work in the area, contain any spill or release of product, secure the area, and notify the BLM, U.S. Department of Energy (DOE), State, and well or mine owner or operator about the incident.	Land acquisition and land use (**Section 3.11**)	B
Reclamation would coordinate with the BLM regarding appropriate mitigation of the stock pond.	Land acquisition and land use (**Section 3.11**)	C
Timing of bridge construction would occur during low flow conditions.	Land acquisition and land use (**Section 3.11**), areas of special designation (**Section 3.13**)	B
Design features and mitigation measures to minimize impacts on visual resources are included in the visual resources analysis report (**Appendix K,** “Visual Resources Analysis Report”) and are incorporated by reference here.	Visual resources (**Section 3.12**), areas of special designation (**Section 3.13**)	B, C, D
Bridges would span the active river channel of the Dolores River and would be designed to maintain the free-flowing condition.	Areas of special designation (**Section 3.13**)	B
Engineering controls for H_2S and other hazardous gas detection would include audible and visual alarms, automatic ventilation systems, and H_2S monitoring instrumentation.	Solid waste, hazardous substances, and environmental media (**Section 3.14**)	B, C, D
Respiratory protection and personal H_2S detection devices would be provided to employees. Use of this equipment would be required.	Solid waste, hazardous substances, and environmental media (**Section 3.14**)	Common to all
Reclamation would minimize or prevent hazards or human exposure to H_2S through engineering designs and would comply with applicable laws, regulations, and BMPs identified in the Clean Air Act of 1970 (CAA), the Comprehensive Environmental Response, Compensation, and Liability Act, the Emergency Planning and Community Right-to-Know Act, the Occupational Safety and Health Administration (OSHA), and the RCRA.	Solid waste, hazardous substances, and environmental media (**Section 3.14**)	B, C, D
A spill response plan would be developed and implemented to minimize the potential for unanticipated soil contamination or release of solid or hazardous substances to the environment during construction or operation.	Solid waste, hazardous substances, and environmental media (**Section 3.14**)	B, C, D
Reclamation would conduct a toxicity characteristic leaching procedure analysis before the salt and any other solid byproducts are disposed of in a landfill; this would be done to characterize the waste and ensure it is appropriate for disposal in the onsite, nonhazardous waste landfill.	Solid waste, hazardous substances, and environmental media (**Section 3.14**)	C, D

Commitment Description	Resources (Section in Chapter 3 discussing resource)	Applicable Alternative
Prior to acquiring land, a Phase I environmental site assessment would be conducted to identify the potential for existing environmental contamination liabilities.	Solid waste, hazardous substances, and environmental media (**Section 3.14**)	B, C, D
To minimize noise impacts, most construction would occur during the normal working hours of 7:00 a.m. until 7:00 p.m.	Noise (**Section 3.16**)	B, C, D
Reclamation would coordinate with Montrose County and/or CDOT on any necessary traffic control or temporary road closures to accommodate construction activities.	Traffic and transportation (**Section 3.18**)	B, C, D
Any necessary oversize/overweight permits would be obtained. Degraded roads would be mitigated, in coordination with the CDOT or Montrose County, Colorado.	Traffic and transportation (**Section 3.18**)	B, C, D
Reclamation determined the project could have an adverse effect on historic properties; consequently, Reclamation has developed a programmatic agreement with the Colorado SHPO and the BLM in order to consider the effects of the undertaking on historic properties. Reclamation would conduct a Class III intensive cultural resource inventory in the direct effects area of potential effect (APE) and a Class II inventory of the indirect effects APE for the alternative selected in the ROD to determine the presence of any cultural resources (see **Appendix M,** "Signed Programmatic Agreement with the SHPO" for description of direct and indirect effects APEs). Avoidance of historic properties would be the preferred approach. A treatment plan would be developed under the terms of the Programmatic Agreement (**Appendix M**) for all historic properties determined to be subject to adverse direct and indirect effects by the project.	Cultural resources (**Section 3.19**)	B, C, D
In the event of discovery of evidence of possible human remains or cultural or paleontological resources during construction, all ground-disturbing activities in the area would immediately cease, and Reclamation would be notified. Work would not resume until Reclamation authorizes it. Additional surveys would be required for cultural resources if construction plans or proposed disturbance areas are changed.	Cultural resources (**Section 3.19**)	B, C, D

2.10 Summary of Potential Impacts Associated with the Alternatives

Table 2-6. Summary of impacts, by alternative

Resources and Issues	Alternative A	Alternative B—New Injection Well Area B1	Alternative B—New Injection Well Area B2	Alternative C—Evaporation Ponds	Alternative D—Zero-Liquid Discharge Technology
Air Quality					
Anticipated emissions and corresponding emissions thresholds and permitting requirements	Temporary (construction): Total suspended particles (TSP) would exceed the APEN reporting threshold. Long term (O&M): No emissions. Carbon dioxide equivalent (CO_2e) emissions would be below the 25,000 metric tons/year threshold for EPA reporting during well closure.	Temporary (construction): Particulate matter 10 micrometers or less in diameter (PM_{10}), $PM_{2.5}$, and TSP would exceed the APEN reporting threshold; minor source permit required for PM_{10} and TSP. Long term (O&M): TSP would exceed the APEN reporting threshold; no minor source permits required. CO_2e emissions would be below the 25,000 metric tons/year threshold for EPA reporting.	Temporary (construction): , PM_{10} and TSP would exceed the APEN reporting threshold. Long term (O&M): PM_{10} and TSP would exceed the APEN reporting threshold; a minor source permit may be required for TSP. CO_2e emissions would be below the 25,000 metric tons/year threshold for EPA reporting.	Temporary (construction): PM_{10}, $PM_{2.5}$, and TSP would exceed the APEN reporting threshold. Long term (O&M): PM_{10} and TSP would exceed the APEN reporting threshold; minor source permit required for these emissions. CO_2e emissions would be below the 25,000 metric tons/year threshold for EPA reporting.	Temporary (construction): PM_{10} and TSP would exceed the APEN reporting threshold. Long term (O&M): Nitrogen oxide (NO_x), carbon monoxide (CO), PM_{10}, and TSP would exceed the APEN reporting threshold; minor source permit required for NO_x and CO emissions. CO_2e emissions would be below the 25,000 metric tons/year threshold for EPA reporting. CO_2e emissions would be the greatest across all the alternatives.

Resources and Issues	Alternative A	Alternative B—New Injection Well Area B1	Alternative B—New Injection Well Area B2	Alternative C—Evaporation Ponds	Alternative D—Zero-Liquid Discharge Technology
Anticipated releases of H_2S (2 tons/year or more requires permit)	<2 tons/year	<2 tons/year	<2 tons/year	<2 tons/year	<2 tons/year
Energy Demand and Utility Systems					
Annual energy use	3.6 MWh reduction 580 kW reduction 0 propane	8.1 MWh 920 kW 2,000 gallons of propane	9.8 MWh 1,120 kW 2,500 gallons of propane	3.1 MWh 290 kW 8,000 gallons of propane	This alternative would have the most energy use. 26,700 MWh 4,630 kW 4,200,000 CCF natural gas
Miles of new or upgraded transmission lines	None.	0.8 miles of new electrical line	1.3 miles of new electrical line	0.8 miles of new electrical line	0.3 miles of new electrical line; 14 miles of natural gas pipeline
Geology and Geological Hazards					
Induced seismicity	Seismic events expected to continue for up to several years after injection is halted, then gradually decline. The seismically active area may continue to expand geographically until that time.	Seismic events expected to be induced in the area around the new injection well. Lower potential for induced earthquakes near currently populated areas than for the current injection well. Impermeable barrier faults expected to isolate induced earthquakes away from populated areas in Paradox Valley.	Same as Area B1.	Would not induce seismicity or cause geological hazards. Pond embankments would be designed and constructed to Reclamation’s standards to minimize risk of failure.	Would not induce seismicity or cause geological hazards.

Resources and Issues	Alternative A	Alternative B—New Injection Well Area B1	Alternative B—New Injection Well Area B2	Alternative C—Evaporation Ponds	Alternative D—Zero-Liquid Discharge Technology
Surface Water and Water Rights					
Change in flows at the Dolores River Near Bedrock gage station	An increase in flow of 0.5 cfs would occur.	No change in flows	No change in flows	An amended augmentation plan would be required at a pumping rate of 300 gpm, but there would be no change in flows.	Same as Alternative C
Sufficiency of existing water rights to implement the alternatives	Existing water rights would be sufficient for the anticipated consumptive use.	Same as Alternative A.	Same as Alternative A.	DWR and Colorado Water Court would need to approve an amended augmentation plan and application for a supplemental point of diversion.	DWR and Colorado Water Court would need to approve an amended augmentation plan.

Resources and Issues	Alternative A	Alternative B—New Injection Well Area B1	Alternative B—New Injection Well Area B2	Alternative C—Evaporation Ponds	Alternative D—Zero-Liquid Discharge Technology
Wetlands and Other Waters					
Disturbance to wetlands and other waters (acres and linear feet)	No effect	Permanent stream channel disturbance: 60 linear feet (<0.1 acre) perennial; 32 linear feet (<0.1 acre) ephemeral Temporary stream channel disturbance: 342 linear feet (0.6 acre) perennial; 121 linear feet (0.1 acre) ephemeral <0.1 acre permanent wetland disturbance A CWA Section 404 Permit would be obtained from USACE prior to any activities in Waters of the United States. Alternative B would likely require a Nationwide Permit.	Permanent stream channel disturbance: None Temporary stream channel disturbance: 3,146 linear feet (0.2 acre) ephemeral A CWA Section 404 Permit would be obtained from USACE prior to any activities in Waters of the United States. Alternative B would likely require a Nationwide Permit.	Permanent stream channel disturbance: 3,985 linear feet (0.3 acre) ephemeral Temporary stream channel disturbance: 1,671 linear feet (0.1 acre) ephemeral A CWA Section 404 Permit would be obtained from the USACE prior to any activities in Waters of the United States. Alternative C would require an Individual Permit unless USACE, in coordination with EPA and FWS, waives evaluation and authorizes the activity under a Nationwide Permit.	Permanent stream channel disturbance: 1,920 linear feet (0.1 acre) ephemeral Temporary stream channel disturbance: 2,459 linear feet (0.2 acre) ephemeral A CWA Section 404 Permit would be obtained from the USACE prior to any activities in Waters of the United States. Alternative D would require an Individual Permit unless USACE, in coordination with EPA and FWS, waives evaluation and authorizes the activity under a Nationwide Permit.
Water Quality					
Amount of salt entering the Dolores River	Salinity loading would increase by 95,000 tons/year.	Up to 114,000 tons/year of salt prevented from entering the river	Up to 114,000 tons/year of salt prevented from entering the river	Up to 171,000 tons/year of salt prevented from entering the river	Up to 171,000 tons/year of salt prevented from entering the river
Salt reduction downstream at Imperial Dam	9.2 mg/L increase in salt	11.1 mg/L	11.1 mg/L	16.7 mg/L	16.7 mg/L

Resources and Issues	Alternative A	Alternative B—New Injection Well Area B1	Alternative B—New Injection Well Area B2	Alternative C—Evaporation Ponds	Alternative D—Zero-Liquid Discharge Technology
Achievement of state numeric standards	**Below Hoover Dam (Criterion 723 mg/L):** 632.3 mg/L **Below Parker Dam (Criterion of 747 mg/L):** 652.1 mg/L **At Imperial Dam (Criterion of 879 mg/L):** 786.1 mg/L	**Below Hoover Dam (Criterion 723 mg/L):** 623.5 mg/L **Below Parker Dam (Criterion of 747 mg/L):** 642.9 mg/L **At Imperial Dam (Criterion of 879 mg/L):** 775.0 mg/L	**Below Hoover Dam (Criterion 723 mg/L):** 623.5 mg/L **Below Parker Dam (Criterion of 747 mg/L):** 642.9 mg/L **At Imperial Dam (Criterion of 879 mg/L):** 775.0 mg/L	**Below Hoover Dam (Criterion 723 mg/L):** 619.0 mg/L **Below Parker Dam (Criterion of 747 mg/L):** 638.2 mg/L **At Imperial Dam (Criterion of 879 mg/L):** 769.4 mg/L	**Below Hoover Dam (Criterion 723 mg/L):** 619.0 mg/L **Below Parker Dam (Criterion of 747 mg/L):** 638.2 mg/L **At Imperial Dam (Criterion of 879 mg/L):** 769.4 mg/L
Total Water Released from Lake Mead	None	4,528 acre-feet/year	Same as Area B1.	7,017 acre-feet/year	Same as Alternative C.
Change in Water Released from Lake Mead compared to existing conditions	4,090 acre-feet/year saved	438 acre-feet/year released	Same as Area B1	2,927 acre-feet/year released	Same as Alternative C

Resources and Issues	Alternative A	Alternative B—New Injection Well Area B1	Alternative B—New Injection Well Area B2	Alternative C—Evaporation Ponds	Alternative D—Zero-Liquid Discharge Technology
Changes to Colorado 303(d) listings and classified uses	Alternative A would increase salinity in the Dolores River, but the change in concentration is unknown. The increase in salinity may have an adverse effect on the segment's classified uses but is not anticipated to affect the listing of the streams of Colorado's 303(d) list. No effect on the segment's primary contact recreation or potable water supply classified uses. Downstream segments of the Colorado River on state 303(d) lists for TDS or salinity would be further impacted due to salinity at Paradox no longer being controlled.	No effect	No effect	No effect except that a stock pond would be destroyed.	No change in monitoring and evaluation (M&E) listing of the Dolores River. Up to 240 gpm of produced freshwater would be discharged back into the Dolores River, which would dilute naturally occurring constituents.
Potential to affect private drinking water wells	Cone of depression created by production wells would no longer occur, and groundwater would return to pre-salinity control conditions.	No effect.	No effect.	No effect.	No effect.

Resources and Issues	Alternative A	Alternative B—New Injection Well Area B1	Alternative B—New Injection Well Area B2	Alternative C—Evaporation Ponds	Alternative D—Zero-Liquid Discharge Technology
Vegetation					
Permanent loss of riparian vegetation	None	<1 acre	None	None	None
Ground disturbance	No change	Permanent: 16 acres; temporary: 10 acres	Permanent: 7 acres; temporary: 145 acres	Permanent: 600 acres; temporary: 231 acres	Permanent: 80 acres; temporary: 96 acres
Special Status Plant Species					
Known populations in project areas	None	No known populations, but potential to impact suitable habitat	Same as Area B1	Same as Area B1	Potential to impact BLM sensitive species: Paradox (Aromatic Indian) breadroot (*Pediomelum aromaticum*) population mapped in study area
Terrestrial and Aquatic Wildlife					
Acres of habitat loss	No change	Permanent: 16 acres; temporary: 10 acres	Permanent: 7 acres; temporary: 145 acres	Permanent: 600 acres; temporary: 231 acres	Permanent: 80 acres; temporary: 96 acres
Potential for wildlife disturbance, injury, or mortality	Wildlife disturbance would occur; negligible injury or mortality likely.	Same as Alternative A	Same as Alternative A	Wildlife disturbance would occur; major injury or mortality (particularly migratory birds) likely	Same as Alternative A
Acres of big game sensitive habitat mapped in study area and proximity to known raptor nests	This alternative would affect the least mapped habitat. There would be no change to habitat.	285 acres of deer severe winter range; 90 acres of elk severe winter range; 123 acres of desert bighorn sheep production area; no known raptor nests	810 acres of elk severe winter range; 464 acres of deer severe winter range; >0.5 mile from bald eagle nest	This alternative would affect the most mapped habitat. 1,530 acres of deer and elk severe winter range; 535 acres of deer winter concentration; 70 acres of elk winter concentration; >0.5 mile from bald eagle nest	480 acres of deer and elk severe winter range; 220 acres of deer winter concentration; 165 acres of elk winter concentration; >0.5 mile from bald eagle nest

Resources and Issues	Alternative A	Alternative B—New Injection Well Area B1	Alternative B—New Injection Well Area B2	Alternative C—Evaporation Ponds	Alternative D—Zero-Liquid Discharge Technology
Federally Listed Species					
Effects to Gunnison sage-grouse and critical habitat	No effect	May affect, not likely to adversely affect	May affect, not likely to adversely affect	No effect	No effect
Land Acquisition and Land Use					
RMP conformance	In conformance with both the TRFO RMP and UFO RMP.	In conformance with both the TRFO RMP and UFO RMP.	In conformance with both the TRFO RMP and the UFO RMP.	Not in conformance with the interim visual resource management objectives of the UFO RMP. An amendment to the UFO RMP would be required. No portion of the Alternative C study area falls within the TRFO jurisdictional area.	In conformance with the UFO RMP. No portion of the Alternative D study area falls within the TRFO jurisdictional area.
Acres of Federal land affected	No change	80 acres of BLM-administered land; 360 acres of Reclamation land	616 acres of BLM-administered land; 9 acres of Reclamation land	1,300 acres of BLM-administered land; 5 acres of Reclamation land	267 acres of BLM-administered land; 2 acres of Reclamation land
Acres of non-Federal land to be acquired	0 acre	0 acre	49 acres	281 acres	56 acres
Existing claims or mineral leases present	None	1 existing claim	96 existing claims	5 existing claims	None
Potential mineral development	None	New mining claims could not be located in withdrawn areas. For lands subject to a ROW, the BLM would evaluate mineral leasing as long as it does not interfere with a prior existing right.	New mining claims could not be located in withdrawn areas. For lands subject to a ROW, the BLM would evaluate mineral leasing as long as it does not interfere with a prior existing right.	New mining claims could not be located in withdrawn areas. For lands subject to a ROW, the BLM would evaluate mineral leasing as long as it does not interfere with a prior existing right.	New mining claims could not be located in withdrawn areas. For lands subject to a ROW, the BLM would evaluate mineral leasing as long as it does not interfere with a prior existing right.

Resources and Issues	Alternative A	Alternative B—New Injection Well Area B1	Alternative B—New Injection Well Area B2	Alternative C—Evaporation Ponds	Alternative D—Zero-Liquid Discharge Technology
Changes in recreational opportunities	No change	No change in recreational opportunities on Reclamation lands. Recreation would be prohibited in the withdrawn areas; however, impacts on recreational use would be minimal because access to designated recreational trails and boating opportunities in the study area would not be affected. No effect on access routes leading to recreation areas outside the study area.	No change in recreational opportunities on Reclamation lands. Recreation would be prohibited in the withdrawn areas; however, impacts on recreational use would be minimal because there are no designated recreational trails in the study area. No effect on access routes leading to recreation areas outside the study area.	No change in recreational opportunities on Reclamation lands. Recreation would be prohibited in the withdrawn areas; however, impacts on recreational use would be minimal because there are no designated recreational trails in the study area. No effect on access routes leading to recreation areas outside the study area.	No change in recreational opportunities on Reclamation lands. Recreation would be prohibited in the withdrawn areas; however, impacts on recreational use would be minimal because there are no designated recreational trails in the study area. No effect on access routes leading to recreation areas outside the study area.
AUMs lost or permits affected	None	Up to 23 AUMs lost, affecting 1 BLM grazing permit; 5% reduction in currently permitted AUMs in the study area.	Up to 136 AUMs lost, affecting 1 permit; 27% reduction in currently permitted AUMs in the study area.	Greatest impact on livestock grazing. Up to 361 AUMs lost, affecting up to 5 permits; 29% reduction in currently permitted AUMs in the study area.	Up to 30 AUMs lost, affecting 1 permit; 24% reduction in currently permitted AUMs in the study area.

Resources and Issues	Alternative A	Alternative B—New Injection Well Area B1	Alternative B—New Injection Well Area B2	Alternative C—Evaporation Ponds	Alternative D—Zero-Liquid Discharge Technology
Visual Resources					
Degree of contrast from key observation points (KOPs)	No change	No contrast; proposed facilities on BLM-administered land would not be seen from the KOPs because they would be obstructed by the existing landscape conditions.	Weak contrast; proposed facilities would either not be seen from the KOPs because they would be obstructed by the existing landscape conditions, or they would conform with visual resource management (VRM) Class objectives.	This alternative would result in the greatest impact on visual resources. Strong contrast; proposed facilities would not conform with VRM Class objectives.	Same as Area B2.
Areas of Special Designation					
Effects to WSR values	Cessation of salinity control would degrade water quality; this is unlikely to change tentative classification or lead to ineligibility.	Scenic, recreational, vegetation ORVs and free-flowing condition for eligible river segments negatively affected (minor); this is unlikely to change the tentative classification or lead to ineligibility.	Temporary minor impacts on scenic ORVs for eligible river segments; this is unlikely to change the tentative classification or lead to ineligibility.	Same as Area B2	Same as Area B2

Resources and Issues	Alternative A	Alternative B—New Injection Well Area B1	Alternative B—New Injection Well Area B2	Alternative C—Evaporation Ponds	Alternative D—Zero-Liquid Discharge Technology
Effects on wilderness characteristics in WSAs	Reduction in noise, which would increase opportunities for solitude	Minor temporary impact from increase in noise during construction and field investigations; permanent indirect impacts due to infrastructure observable from and infrastructure placed beneath the Dolores River Canyon WSA. Would not impair the area's suitability for preservation as wilderness.	No change	Minor temporary impact from increase in noise during construction of freshwater pipeline	No change
Solid Waste, Hazardous Substances, and Environmental Media (i.e., component of the natural environment)					
Generation of solid or hazardous waste and potential for release of hazardous substances	No effect	No effect	No effect	98 acre-feet of salt would be generated annually; the salt is classified as a solid waste.	Same as Alternative C

Resources and Issues	Alternative A	Alternative B—New Injection Well Area B1	Alternative B—New Injection Well Area B2	Alternative C—Evaporation Ponds	Alternative D—Zero-Liquid Discharge Technology
Socioeconomics					
Change in economic activity and employment in the three-county region	34 jobs generated in multiple sectors during deconstruction; total economic labor income $1.2 million; total economic impact $3 million	253 jobs generated in multiple sectors during construction; total economic labor income $11.5 million; total economic impact $28.6 million 21 jobs generated during O&M; total economic labor income $879,536 million; total economic output of $2.9 million	351 jobs generated in multiple sectors during construction; total economic labor income $15.8 million; total economic impact $44.1 million 23 jobs generated during O&M; total economic labor income $973,852; total economic output $3.2 million	766 jobs generated in multiple sectors during construction; total economic labor income $31.8 million; total economic impact $124.4 million 20 jobs generated during O&M; total economic labor income $843,138; total economic output $2.8 million 140 jobs generated during replacement activities (roughly every 8 years); total economic labor income $6.2 million; total economic output $23.5 million	442 jobs generated in multiple sectors during construction; total economic labor income $20.9 million total economic impact $62.4 million 157 jobs generated during O&M; total economic labor income $6.5 million; total economic output $21.1 million. 27 jobs generated during replacement activities (roughly every 8 years); total economic labor income $1.1 million; total economic output $4.9 million
Total average annual economic benefit of controlling salt at the PVU	No economic benefit	$27.738 million	$27.738 million	$41.658 million	$41.658 million
Change in property values and payments in lieu of taxes	No effect	No effect	No effect; up to 49 acres of non-Federal land may be acquired. Reclamation would pay less than $5 annually to Montrose County in lieu of taxes.	No effect; up to 281 acres of non-Federal land may be acquired. Reclamation would pay less than $20 annually to Montrose County in lieu of taxes.	No effect; up to 56 acres of non-Federal land may be acquired. Reclamation would pay less than $5 annually to Montrose County in lieu of taxes.

Resources and Issues	Alternative A	Alternative B—New Injection Well Area B1	Alternative B—New Injection Well Area B2	Alternative C—Evaporation Ponds	Alternative D—Zero-Liquid Discharge Technology
Noise					
Compliance with the State of Colorado's noise standards and guidance in Montrose County's zoning resolution	No effect	Noise produced during construction would temporarily exceed standards and guidance and would be considered a public nuisance where exceedance occurred.	Same as Area B1	Noise produced during construction would temporarily exceed standards and guidance and would be considered a public nuisance where exceedance occurred. Noise produced during harvesting of salt would exceed standards and guidance on an ongoing basis but only very close to the project site.	Same as Alternative C

Resources and Issues	Alternative A	Alternative B—New Injection Well Area B1	Alternative B—New Injection Well Area B2	Alternative C—Evaporation Ponds	Alternative D—Zero-Liquid Discharge Technology
Artificial Light					
Change in the intensity and duration of artificial light	Lighting levels associated with operation of the PVU would diminish, but security lighting would remain around the facilities.	Temporary direct effects limited by area topography, which provides a natural screen between the light source and the Town of Bedrock. Indirect effects from increases in overall sky glow which would result in short-term impacts on night skies. Minimal permanent impacts from O&M. Intensity of impacts would vary depending on the design and installation of lighting and type of equipment used during the night.	Same as Area B1	Moderate temporary and permanent impacts of artificial lighting from increases in overall sky glow and intermittent lighting during O&M. Intensity of impacts would vary depending on the design and installation of lighting and type of equipment used during the night.	Minimal temporary and permanent impacts of artificial lighting because topography would provide a natural screen.

Resources and Issues	Alternative A	Alternative B—New Injection Well Area B1	Alternative B—New Injection Well Area B2	Alternative C—Evaporation Ponds	Alternative D—Zero-Liquid Discharge Technology
Traffic and Transportation					
Change in traffic patterns, vehicles, or volumes	Once PVU operations discontinue, traffic would decrease on County Road Y11.	Temporary 7% increase in daily traffic on Colorado Hwy 90 during construction compared with current conditions; temporary increases in traffic on EE21 Road, DD19 Road, DD16 Road, DD15 Road, and DD9 Road; no long-term change in traffic	Temporary 7% increase in traffic on Colorado Hwy 90 during construction compared with current conditions; temporary increases in traffic on EE21 Road, DD19 Road, FF16 and GG15 Road during construction; noticeable long-term increase in use of EE21 Road, DD19 Road, and GG15 Road	Temporary 7% increase in traffic on Colorado Hwy 90 during construction compared with current conditions; long-term 2% increase in use of Colorado Hwy 90; BB16 Road would be rerouted around the perimeter of the project area	Temporary 6% increase in traffic on Colorado Hwy 90 during construction compared with current conditions; long-term 1% increase in use of Colorado Hwy 90
Cultural Resources					
Impacts on historic properties	No effect	Medium-to-high site density; smaller footprint easier to avoid impacts on historic properties; induced seismicity has the potential to impact standing structures in the indirect APE; potential to affect historic properties within 175-square-mile area for a 3D seismic survey	Same as Area B1	Lower density of historic properties; largest footprint of direct disturbance and high potential of visual impacts on sites in the indirect APE	Lower density of historic properties; large footprint of direct disturbance and potential visual impacts on sites in the indirect APE
Impacts on or changes in access to Indian sacred sites	No effect	No change in access; no known impacts at this time	No change in access; no known impacts at this time	No change in access; highest potential visual impact	No change in access; second highest potential visual impact

2.11 Alternatives Considered but Eliminated from Further Consideration

Since publication of the NOI in 2012 (Reclamation 2012a), Reclamation, cooperating agencies, and the public have suggested or studied different approaches and alternatives to address the need for salt control in Paradox Valley. All alternatives raised during scoping were considered and 14 were eliminated from further discussion in this EIS for the reasons shown in **Table 2-7,** "Summary of other alternatives considered and reason for elimination". A list of suggested alternatives received during the scoping process can be found in the December 2016 Supplement to the January 2013 Scoping Report, Paradox Valley Unit EIS (Reclamation 2016a). Project objectives and other considerations were used to further refine a reasonable range of alternatives to be analyzed in this document.

Table 2-7. Summary of other alternatives considered and reason for elimination

Proposed Alternative	Reason for Elimination*	Concerns
Alternative locations for controlling salt other than Paradox Valley, Montrose County, Colorado.	2, 3, 4	Environmental, economic, technical, and landownership (avoidance of private land). The Salinity Control Act authorizes construction and O&M of the PVU specifically in Montrose County, Colorado.
Construct new facilities to control saline groundwater and maintain operation of the existing well; evaluate dual facility operations to optimize operations.	4	The existing well is nearing the end of its useful life and would not be operational in combination with other alternatives.
Implement a combination of alternatives.	2, 3	At this time, it would be cost prohibitive to implement a combination of alternatives; however, implementation of a combination of alternatives would be considered in the future should a specific combination be determined to be cost effective.
Restore and continue to use the existing injection well.	1, 3, 4	Would not substantially reduce wellhead pressure, as determined by technical studies and an independent external review panel (Reclamation 2016b; King et al. 2016; Wang et al. 2015)
Raise the maximum allowable surface injection pressure (MASIP) of the existing well.	4	The existing well is nearing the end of its useful life. Would increase the frequency and severity of induced seismicity (Reclamation 2015).
Reduce the salt load into the Colorado River by changing farming and irrigation practices.	1, 4	Would not remove at least 100,000 tons of salt annually; therefore, alternative does not meet the purpose, need, or objectives.

Proposed Alternative	Reason for Elimination*	Concerns
Develop a management plan for Colorado River water resources that extends beyond the Paradox Valley Project and the Salinity Control Program as a whole.	2, 4	Outside the scope of this EIS because of the specificity of Title II of the Salinity Control Act.
Eradicate tamarisk (*Tamarix* spp.) and plant native phreatophytes.[5]	1, 4	There is no peer-reviewed study showing that this approach would feasibly remove at least 100,000 tons of salt annually.
Include "dewvaporation" technology, per Desalination and Water Purification Research and Development Report No. 120 (Reclamation 2008).	1, 2, 4	The economic niche for this process is identified as 1,000 to 10,000 gallons per day (gpd), while the PVU produces 288,000 to 432,000 gpd (200 to 300 gpm). Would not economically remove at least 100,000 tons of salt annually; therefore, alternative does not meet the purpose, need, or objectives (Reclamation 2016c; Franson Civil Engineers Team 2008). Other desalination technologies and their feasibility in relation to the Paradox brine are discussed in the report "PVU Brine Crystallization Technology Assessment" available on the Paradox website.
Vibratory shear enhanced process	3	Unknown and unproven technical feasibility. The vibratory shear enhanced process can only concentrate the brine and would need to be combined with another method to obtain a solid product for disposal (Franson Civil Engineers Team 2008).
Decommission McPhee Reservoir or manage Dolores River flows by increasing releases from McPhee Reservoir. Consider recommendations in the 2012 Colorado River Basin Water Supply and Demand Study (Reclamation 2012b).	1, 4	Diluting the brine by increasing Dolores River flows or changing other water management approaches would not result in a salinity reduction; therefore, this alternative does not meet the purpose, need, or objectives.
Line the Dolores River through Paradox Valley.	1, 4	Runoff from the La Sal Mountains would still occur, and brine would continue to be produced. Lining the Dolores River may temporarily isolate the river from the brine groundwater; however, it is expected that the brine would eventually accumulate and either flow over or around the liner and into the Dolores River or create salt flats along the river edges in the valley.

[5] Plants with deep root systems that draw water from near the water table.

Proposed Alternative	Reason for Elimination*	Concerns
Construct a low-head dam on the Dolores River to raise the river stage, making this section of the Dolores River a losing reach (a section of river that loses water as it flows downstream due to water infiltrating into the ground).	1, 2, 3, 4	This alternative may temporarily suppress some of the natural inflow of brine, but it would likely result in the brine eventually discharging downstream from the low-head dam.
Authorize interested private companies to haul the brine away from the STF and use the raw brine as road salt or dust suppressant.	1, 3, 4	Using the Paradox brine as a road salt or dust suppressant would allow for it to be returned to the Colorado River. The Final Feasibility and Cost Analysis Findings and Recommendation Report (available on the webpage) evaluated marketability of the brine and determined it has minimal marketability. The feasibility and effectiveness of this alternative is highly uncertain.

*Reason for elimination:

1: Does not remove 100,000 tons or more of salt per year.
2: Does not optimize annual cost of salt removed. Initial or recurring costs would render the option impractical.
3. Eliminated due to impractical or unproven construction, engineering, and technical capability.
4: The proposed alternative would not address the purpose of or need for the project.

Chapter 3 – Affected Environment and Environmental Consequences

This chapter summarizes the physical, biological, social, and economic resources of the study areas and the effects of implementing each alternative on those resources. Environmental commitments associated with each alternative are described in **Section 2.9**, "Environmental Commitments," and incorporated by reference here. The impacts described in **Chapter 3** would remain even after the implementation of the environmental commitments. All numbers included in this EIS are estimates, and therefore actual numbers may differ once an alternative is selected and designs are finalized.

The alternatives evaluated in this EIS have been developed to a conceptual (30%) level of design with an operational length of 50 years; final design would be completed after an alternative is selected in the ROD. The boundaries shown in **Figure ES-1**, **Appendix B**, represent the area of analysis, or "study area," for all action alternatives, unless otherwise defined by the resources described in this chapter. As discussed in **Section 2.2**, the study areas are larger than the combined total of the permanent and temporary impacts anticipated for each action alternative; analyzing effects on a larger area gives Reclamation the necessary flexibility to appropriately design and locate facilities and to avoid and minimize impacts of the selected alternative. Closure activities associated with the action alternatives are described in **Chapter 2**; however, such activities would be analyzed in future NEPA analysis because they are too removed in time to be analyzed here.

The conditions of the resources reflect the effects of past and ongoing actions in the study areas. After an alternative is selected in the ROD and the design is further developed, additional NEPA analysis may be required to ensure any impacts not foreseen in this EIS are disclosed. For example, if Alternative B were selected in the ROD, additional 3D seismic geologic investigations would be completed to identify the final location of the well and would require additional site-specific documentation of NEPA compliance. Any additional NEPA analysis would be tiered to this EIS.

Under each resource topic is a discussion of impact indicators, methods, and the direct and indirect impacts of implementing each alternative. Potential impacts are quantified as appropriate and when supported by existing data or models. Where quantitative data are not available, impacts are described qualitatively, using the following descriptors: negligible or inconsequential—no measurable change from current conditions; minor or minimal—a small but measurable change; moderate—an easily discernible and measurable change; major—a large and measurable change. The duration of impacts is identified as either short term or temporary during construction, or long term or permanent during operations.

3.1 Air Quality, Odors, and Meteorology and Climate

3.1.1 Affected Environment

3.1.1.1 Air Quality and Odors

An Air Quality Technical Report (**Appendix E**, "Air Quality Technical Report") was prepared and contains technical information and a quantitative basis for identifying and comparing the potential differences among air emissions for the four PVU alternatives. The information in this section was derived from this report.

Emission sources associated with the proposed action are subject to regulation by the EPA under the Federal CAA and by the CDPHE. The EPA has set NAAQS for six criteria pollutants—carbon monoxide (CO), particulate matter 10 micrometers or less in diameter (PM_{10}), $PM_{2.5}$, nitrogen dioxide (NO_2), sulfur dioxide (SO_2), ozone (O_3), and lead (Pb). These pollutants can adversely affect human health and visibility if levels are too high.

The EPA's New Source Review (NSR) regulations require that new or modified stationary sources in areas designated as in attainment for the NAAQS must comply with the Prevention of Significant Deterioration (PSD) program elements. These are designed to limit the degradation of air quality in these relatively "clean" locations. Under the CAA, certain parks and wilderness areas are designated as Mandatory Class I areas, in which more stringent air quality protections apply under the PSD regulations. The closest Class I area to Paradox Valley is Arches National Park, approximately 40 miles northwest of Bedrock.

CDPHE regulates H_2S and other hazardous air pollutants listed in Colorado Regulation 3, appendix B (CDPHE 2018a). The EPA has delegated to CDPHE the authority for permitting sources under the CAA. CDPHE has set emissions thresholds that specify when an Air Pollutant Emission Notice (APEN) and an operating permit are required. Operators are required to report emissions through an APEN when emission sources exceed thresholds; operators of sources exceeding the permitting threshold must also obtain an air quality permit. Minor source permits are required for emission sources which exceed CDPHE's permitting threshold but are below EPA's major source permit thresholds. Note that construction emissions are not subject to CDPHE air permitting requirements; however, "land development" projects that include clearing a land area "greater than or equal to 25 contiguous acres and/or 6 months in duration" typically require an APEN, including a fugitive dust control program, unless estimated emissions do not exceed the permitting thresholds.

Air quality in the Paradox Valley area is currently classified by EPA as being in attainment of all criteria pollutants. Existing emissions associated with the PVU are described in **Table 3-1**, "Emissions (tons/year) from operation and maintenance of the PVU." Emissions are derived from mobile sources and fugitive dust, as the facilities themselves are electric.

Table 3-1. Emissions (tons/year) from operation and maintenance of the PVU.

Source	NO_x	SO_2	CO	VOC	PM_{10}	$PM_{2.5}$	CO_2e[c]
Mobile Sources	0.04	0.0002	0.07	0.005	0.003	0.002	24.96
Fugitive Dust	--	--	--	--	2.98	0.32	--

H_2S is defined as a non-criteria reportable pollutant in the State of Colorado and is subject to a permitting threshold of 2 tons/year (CDPHE 2018a). H_2S is flammable, explosive, and an extremely hazardous gas. It is both an irritant and a chemical asphyxiant, with effects on both oxygen utilization and the central nervous system (OSHA 2005). H_2S is a naturally occurring component dissolved in the PVU brine (average 80 to 100 mg/L).

The existing STF and BIF USTs are equipped with weighted exhaust and vacuum breaker valves and automated with a SCADA system to minimize brine level fluctuations thereby minimizing H_2S releases. Reclamation has conducted analyses over the years to quantify existing H_2S releases from the PVU system. Upon review of these analyses, and considering changes in operating procedures (see **Table 2-1**), Reclamation determined that additional evaluations need to be performed to adequately quantify existing H_2S releases. Based on H_2S treatment bench tests performed to date, Reclamation expects that maintaining emissions below 2 tons/year can be accomplished (Busch 2019b); therefore, for the purposes of this EIS, Reclamation assumes that all facilities would be designed and operated such that H_2S releases would always stay below 2 tons/year, which is the CDPHE permit level.

H_2S has a “rotten egg” odor. The CDPHE Air Quality Control Commission regulates odors (5 CCR 1001-4). Odors can be detected even on calm days near the UST vents at the STF and can be detected downwind on breezy days (A. Nicholas 2017 personal communication).

3.1.1.2 Meteorology and Climate

Precipitation in the Colorado River Basin primarily falls during winter/spring and summer. Snow in higher elevations and rain in lower elevations comes in winter and spring from systems over the Pacific Ocean. Monsoons deliver high-intensity rainfall to elevations below about 7,000 feet during the summer (USGS 2004). The El Niño-Southern Oscillation greatly affects temperature and precipitation from year to year in the Colorado River Basin (USGS 2004). Long-term climate trends also affect temperature, precipitation, and runoff. From 1895 to 2006, there was an approximately 1.6°Celsius increase in the 11-year running mean air temperature in the Colorado River Basin. These trends are consistent with those seen in regional and global temperature records; however, the trends in the Colorado River Basin are the largest in the continental United States, when expressed as standard deviations (Reclamation 2007). There was a high degree of variability in annual precipitation from 1896 to 2006; however, the 30 years leading up to 2006 seem to have different variability, as compared with the early part of the record. For instance, both the lowest and highest annual precipitation amounts occurred between 1976 and 2006. Even though there is more variability in the recent record, there does not appear to be an overall trend in annual precipitation over the entire record (Reclamation 2007); however, authors of various studies have noted a decline in April 1 snow water equivalent in the Upper Colorado River basin since the mid-1900s. As a result of warming trends and lower volumes of snowpack, peak runoff rates from snowmelt have begun to trend earlier in the year (Reclamation 2007).

The future water supply of the Colorado River Basin would depend on many climatic factors. Long-term climate trends may alter the quantity and timing of local and regional precipitation. A 2016 Reclamation study of projected impacts of long-term climate trends in the basin predicted the following trends:

- **Temperature** is projected to increase across the basin, with the largest changes in spring and summer and with larger changes in the Upper Basin than in the Lower Basin.
- **Precipitation** patterns continue to be spatially and temporally complex, but projected seasonal trends toward drying are significant in certain regions. A general trend basin-wide is toward drying, although increases in precipitation are projected for some higher elevation and hydrologically productive regions. Consistent and expansive drying conditions are projected for the spring throughout the basin. For much of the basin, drying conditions are also projected in the summer, although slight increases in precipitation are projected for some areas of the Lower Basin, which may be attributed to the monsoonal influence in this region. Fall and winter precipitation is projected to increase in the Upper Basin but to decrease in the Lower Basin.
- **Snowpack** is projected to decrease as more precipitation falls as rain rather than snow, and warmer temperatures cause an earlier melt. Even in areas where precipitation increases or does not change, decreased snowpack is projected in the fall and early winter as warming temperatures result in more rain and less snow. Substantial decreases in spring snowpack are projected to be widespread, due to earlier melt or sublimation of snowpack.
- **Runoff** (both direct and baseflow) is spatially diverse, but is generally projected to decrease, except in the northern Rockies. As with precipitation, runoff is projected to increase significantly in the higher elevation Upper Basin during winter but is projected to decrease during spring and summer. In addition, the timing of runoff is expected to change, occurring earlier in the spring and summer.
- **Droughts**[1] lasting 5 or more years are projected to occur 50 percent of the time over the next 50 years (Reclamation 2016d).

While it is difficult to make certain predictions of change in the overall quantity of precipitation in the region, scientific theory suggests that higher carbon dioxide (CO_2) concentrations intensify the global hydrological cycle (Reclamation 2007). Projected changes in average total annual precipitation are generally small in many areas; however, both wet and dry extremes (heavy precipitation events and length of dry spells) are expected to increase substantially throughout the West (Georgakakos et al. 2014). Evidence also suggests that we can anticipate more year-to-year variability of surface water supplies in at least some areas: for example, the future of the Southwest may include longer, more extreme dry (and wet) periods than previously observed (Georgakakos et al. 2014). Greenhouse gases (GHGs) are compounds that trap heat in the atmosphere and contribute to long-term climate trends. They absorb infrared radiation and radiate a portion of it back to earth's surface, thus trapping heat and warming the atmosphere.

[1] For the purpose of the Basin Study, a drought period occurs whenever the running 2-year average flow at Lees Ferry falls below 15.0 M, the observed historical long-term mean.

The most important naturally occurring GHG compounds are CO_2, methane, nitrous oxide (N_2O), O_3, and water vapor.

Although naturally present in the atmosphere, concentrations of CO_2, methane, and N_2O 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 410 parts per million in 2019 (Global Carbon Project 2014; National Oceanic and Atmospheric Administration 2019).

In the United States, GHG emissions come mostly from CO_2 emissions resulting from energy generation and use. Such emissions result from combustion of fossil fuels for transportation, industrial, commercial, and residential uses. In 2017, the transportation sector was the largest source, accounting for 37% of total energy-related CO_2 emissions. The industrial sector was the second-largest source, with 27% of emissions (EIA 2018).

The EPA estimates that U.S. GHG emissions in 2017 totaled 6,457 million metric tons of CO_2 equivalent (CO_2e; EPA 2019). In 2010 (the most recent year available), Colorado GHG emissions totaled 130 million metric tons of CO_2e. Electric power was the largest contributing sector, accounting for 31% of total Colorado GHG emissions; transportation was the second-largest sector, with 23% (Arnold et al. 2014).

3.1.2 Impacts on Air Quality, Odors, Meteorology and Climate

Issues identified with air quality, odors, and meteorology and climate are emissions of air pollutants (including GHGs), the release of H_2S in reportable quantities, and odor potential. Impacts on these issues are evaluated in terms of 1) anticipated emissions in relation to corresponding emissions thresholds and permitting requirements, and 2) anticipated releases of H_2S beyond reportable quantities. An air quality analysis report was prepared to determine the impacts of each alternative on air quality and climate and meteorology, and a detailed description of methods are included in the report (see **Appendix E**).

3.1.2.1 Emissions Associated with Each Alternative

Emissions estimates were prepared for criteria pollutants (CO, volatile organic compounds [VOCs], nitrogen oxide [NO_x], PM_{10}, $PM_{2.5}$, SO_2) and GHGs (CO_2, methane [CH_4], N_2O). The varying radiative forcing of the different GHGs at a 100-year timescale are accounted for by also reporting GHGs on a CO_2e basis. This is based on widely accepted global warming potentials (GWPs) of 25 for CH_4 and 298 for N_2O (IPCC 2014). Emissions of lead from sources associated with the proposed action alternatives are negligible. This is due to the use of unleaded fuels, and the emissions are not quantified. **Table 3-2**, "Mobile source emissions (tons/year) for each alternative" lists the mobile source emissions associated with construction[2] and O&M of each

[2] The calculations of construction emissions in the action alternatives reflect the total emissions for construction of the alternative. The values identified would likely occur over 2 to 3 years, depending on the alternative.

Table 3-2. Mobile source emissions (tons/year) for each alternative[1]

Pollutant	Alternative A	Alternative B Area B1	Alternative B Area B2	Alternative C	Alternative D	CO_{2e} Threshold for Reporting to the EPA	CDPHE Modelling Threshold (Tons/Year)
Construction Emissions							**Short Term (equivalent annual rate)**
NO_x	3.01	69.59	69.95	53.07	5.45	NA	0.46 lb/hour (2.01 tpy [2])
SO_2	0.0063	0.1492	0.1495	0.0778	0.01	NA	0.46 lb/hour (2.01 tpy [2])
CO	1.85	41.31	41.47	68.32	6.60	NA	23 lb/hour (100.7 tpy [2])
VOC	0.171	3.974	3.966	3.56	0.36	NA	--
PM_{10}	0.103	2.371	2.37	3.45	0.34	NA	82 lb/day (359.2 tpy [2])
$PM_{2.5}$	0.099	2.277	2.29	3.33	0.32	NA	11 lb/day (48.2 tpy [2])
CO_2e	381.6	8,626.5	8,664.22	8,636.05	797.4	27,558 tons/year (25,000 metric tons)	--
Operations and Maintenance Emissions							**Long Term (tons/year)**
NO_x	0.04	0.02	0.07	3.85	1.25	NA	40
SO_2	0.0002	0.0001	0.0004	0.0044	0.0010	NA	40
CO	0.07	0.03	0.13	4.68	2.35	NA	100.7 [2](23 lb/hour)
VOC	0.05	0.002	0.01	0.301	0.197	NA	--
PM_{10}	0.003	0.001	0.004	0.22	0.09	NA	14.97 [2](82 lb/day)
$PM_{2.5}$	0.002	0.001	0.002	0.21	0.09	NA	5
CO_2e	24.96	14.4	48.5	487.2	117.1	27,558 tons/year (25,000 metric tons)	--

[1] Mobile source emissions are from fuel combustion during vehicle use (i.e., “tailpipe emissions). Note: Mobile emission sources do not apply towards APEN reporting facility thresholds.
[2] Equivalent annual emissions based on continuous release at specified short-term rate.

alternative; **Table 3-3**, "Dust emissions (tons/year) from construction activities for each alternative," lists the emissions associated with construction activities for each alternative. It should be noted that emissions of TSP, PM_{10} and $PM_{2.5}$ are not additive. Total suspended particulate (TSP) estimates are inclusive of PM_{10} and $PM_{2.5}$. Similarly, PM_{10} includes $PM_{2.5}$.

Table 3-3. Dust emissions (tons/year) from construction activities for each alternative[1]

Phase	Alternative A	Alternative B Area B1	Alternative B Area B2	Alternative C	Alternative D	APEN Reporting Threshold	Minor Source Air Permit Threshold
TSP							
Re-Entrained Road Dust	0.90	85.13	40.88	72.21	4.0	2	10
Earthmoving	2.1	5.9	5.0	121.0	29.5	2	10
Windblown Dust	--	3.23	16.9	118.8	22.0	2	10
PM_{10}							
Re-Entrained Road Dust	0.18	23.95	11.28	18.29	1.1	2	5
Earthmoving	1.0	3.0	2.5	60.5	14.8	2	5
Windblown Dust	--	1.62	8.5	59.4	11.0	2	5
$PM_{2.5}$							
Re-Entrained Road Dust	0.04	2.55	1.30	2.59	0.12	2	5
Earthmoving	0.1	0.30	0.3	6.0	1.48	2	5
Windblown Dust	--	0.16	0.8	5.94	1.1	2	5

[1]Dust emissions are caused when soils are disturbed from vehicles driving on them.

Construction under all alternatives would result in on-road and off-road mobile source exhaust emissions of NO_x, VOCs, SO_2, $PM_{2.5}$, and PM_{10}, as well as dust emissions of $PM_{2.5}$ and PM_{10} from re-entrained dust from traffic on roads and from earthmoving and wind erosion. These releases would affect air quality temporarily during construction by affecting concentrations of NO_x, SO_2, O_3, $PM_{2.5}$, and PM_{10}. Under all alternatives, construction and operation and maintenance would release < 0.005% of total Colorado annual GHG emissions.

Table 3-4, "Emissions (tons/year) from operation and maintenance for each alternative," lists the emissions associated with stationary sources and fugitive dust (mobile source emissions from operation and maintenance were shown in **Table 3-2**).

Table 3-4. Emissions (tons/year) from operation and maintenance activities for each alternative[1]

Phase	Alternative A	Alternative B Area B1	Alternative B Area B2	Alternative C	Alternative D	APEN Reporting Threshold	Minor Source Air Permit Threshold	CO_{2e} Threshold for Reporting to the EPA
NO_x	--	0.01	0.02	0.05	21.00	2	10	N/A
SO_2	--	0.00003	0.00003	0.00011	0.12600	2	10	N/A
CO	--	0.01	0.01	0.03	17.64	2	10	N/A
VOC	--	0.001	0.001	0.003	1.155	2	5	N/A
PM_{10}	--	1.30	2.88	10.82	2.91	2	5	N/A
$PM_{2.5}$	--	0.14	0.33	1.32	1.94	2	5	N/A
TSP	--	4.64	10.43	39.04	7.11	2	10	N/A
CO_2e	--	12.8	16.0	51.1	25,349.8	--	--	27,558 tons/year (25,000 metric tons)
H_2S	--	<2	<2	<2	<2	2	2	N/A

[1] Operational source emissions include fugitive dust and stationary source emissions; see Table 3-12 in **Appendix E.**

3.1.2.2 Alternative A—No Action Alternative

Under the No Action Alternative, there would be a small and temporary effect on air quality over 1 month due to emissions during well closure from the on-road and off-road vehicles and portable equipment used for plugging and abandoning the injection well and closure of the STF and BIF. This would result in temporary impacts to air quality from increased concentrations of NO_2, SO_2, CO, $PM_{2.5}$, and PM_{10}. While no permits would be required for these activities, APEN reporting thresholds may apply during this phase. The only APEN reporting threshold exceeded would be for TSP. CO_2e emissions would be below the 25,000 metric tons of CO_2e per year threshold for reporting to the EPA.

Emissions due to closure of the facilities would be below all minor source permit thresholds. Therefore, no permit would be needed. Implementation of this alternative would have no effect on the Class I airshed at Arches National Park. The H_2S entrained in the brine would be released to the atmosphere. This would not be considered an emission because the brine is naturally occurring. Overall, emissions would be reduced compared with current conditions.

3.1.2.3 Alternative B—Injection Well

Area B1

Temporary emissions of PM_{10}, $PM_{2.5}$, and TSP during construction would exceed the APEN reporting threshold. During construction, emissions of TSP and PM_{10} would exceed the minor source air permit thresholds and a minor source permit would be required for these emissions. During O&M, long-term emissions of TSP would exceed the APEN reporting threshold, but no minor source permits would be required. . As detailed in **Appendix E**, fugitive dust emissions associated with construction of the access road east of the Dolores River under Alternative B1 were estimated to be 0.91 tons/year, 9.10 tons/year and 32.09 tons/year, for total annual $PM_{2.5}$, PM_{10} and TSP emissions, respectively. These constitute approximately a third of the fugitive dust emissions from all construction sources. The emissions would be distributed over the length of the restricted access road and vehicle speeds would be restricted to 25 miles per hour. Dust suppression measures would be employed to reduce daily PM emissions and fugitive dust during construction. CO_2e emissions would be below the 25,000 metric tons of CO_2e per year threshold for reporting to the EPA. Implementation of this alternative would have no effect on the Class I airshed at Arches National Park.

Potential H_2S emissions would be less than 2 tons/year. Risks to human health would be low due to the low level of H_2S emissions. After implementation of the alternative, if the H_2S emissions are greater than 2 tons/year, appropriate features and operational measures would be incorporated to reduce the emissions (see **Section 2.9**). Overall, releases of air pollutants would affect air quality temporarily during the construction period through increased concentrations of NO_2, SO_2, CO, $PM_{2.5}$, and PM_{10}. During the operational phase, air quality would not be substantially affected. The limits on H_2S emissions, and additional mitigation measures to be implemented if required, would minimize or avoid any odor issues under this alternative.

Area B2

Temporary emissions of PM_{10} and TSP during construction would exceed the APEN reporting threshold. During O&M, long-term emissions of PM_{10} and TSP would exceed the APEN reporting thresholds, and a minor source permit may be required for TSP. CO_2e emissions would be below the 25,000 metric tons of CO_2e per year threshold for reporting to the EPA. Implementation of this alternative would have no effect on the Class I airshed at Arches National Park. Overall, releases of air pollutants would affect air quality temporarily during the construction period through increased concentrations of NO_2, SO_2, CO, $PM_{2.5}$, and PM_{10}. During the operational phase, air quality would not be substantially affected.

Potential H_2S emissions would be less than 2 tons/year. Risks to human health would be low due to the low level of H_2S emissions. After implementation of the alternative, if the H_2S emissions are greater than that, appropriate features and operational measures would be incorporated to reduce the emissions (see **Section 2.9**). Impacts on odors would be the same as described under Alternative B, Area B1.

3.1.2.4 Alternative C—Evaporation Ponds

Due to the open-air evaporation of the brine, this alternative would release other hazardous air emissions, as identified in **Table 3-5**, "Hazardous air emissions due to evaporation (pounds per year)."

Temporary emissions of PM_{10}, $PM_{2.5}$, and TSP during construction would exceed the APEN reporting threshold. During O&M, long-term emissions of PM_{10} and TSP would exceed the APEN reporting threshold, and a minor source permit would be required for these emissions. CO_2e emissions would be below the 25,000 metric tons of CO_2e per year threshold for reporting

Table 3-5. Hazardous air emissions due to evaporation (pounds per year)

Analyte	Average Emissions	Maximum Emissions	APEN Reporting Threshold	Minor Source Air Permit Threshold
a,a,a-trifluorotoluene	39.21	42.11	250	Note: Minor source permits are not required for sources of HAPs.
Acetone	10.72	13.16	250	
2- butanone (MEK)	7.45	7.9	250	
Carbon disulfide	1.57	2.63	250	
1,2-dichloroethane-d4 (Surr)	21.32	22.37	250	
Toluene-d8 (Surr)	12.34	12.9	250	
4-bromofluorobenzene (Surr)	12.51	12.76	250	
Dibromofluoromethane (Surr)	16.98	17.11	250	
Total:	122.1	130.9	--	

to the EPA. Implementation of this alternative would have no effect on the Class I airshed at Arches National Park.

Hazardous air emissions would be below the APEN reporting threshold.

Potential H_2S emissions would be less than 2 tons/year. Risks to human health would be low due to the low level of H_2S emissions. After implementation of the alternative, if the H_2S emissions are greater than that, appropriate features and operational measures would be incorporated to reduce them (see **Section 2.9**). Impacts on odors would be the same as described under Alternative B, Area B1.

Overall, releases of air pollutants would affect air quality temporarily during the construction period through increased concentrations of NO_2, SO_2, CO, $PM_{2.5}$, and PM_{10}. During the operational phase, air quality would not be substantially affected.

3.1.2.5 Alternative D—Zero-Liquid Discharge Technology

Temporary emissions of PM_{10} and TSPs during construction would exceed the APEN reporting thresholds. During O&M, long-term emissions of NO_x, CO, PM_{10}, and TSP would exceed the APEN reporting threshold, and a minor source permit would be required for NO_x and CO emissions. CO_2e emissions would be below the 25,000 metric tons of CO_2e per year threshold for reporting to the EPA. Implementation of this alternative would have no effect on the Class I airshed at Arches National Park.

Alternative D has the highest NO_x and CO emissions across all alternatives. An O_3 ambient impact analysis was conducted to determine if the NO_x emissions under Alternative D would contribute to a violation of the NAAQS 8-hour O_3 significant impact level (SIL) critical air quality threshold. Emissions are expected to be well below the EPA recommended 8-hour O_3 SIL. As detailed in **Appendix E**, the estimated percentage of the 8-hr ozone SIL (of 1 ppb) resulting from operational NOx and VOC emissions from the Alternative D stationary source would be 11.5%. Thus, the ozone impacts associated with both NO_x and VOC precursor emissions from Alternative D are expected to be well below the EPA recommended 8-hour ozone SIL. Impacts from 8-hr ozone for the other Alternatives would be even lower. Using less conservative MERP values from the EPA (2019) guidance would result in estimated ozone impacts that are up to 10 times lower. Therefore, it is not anticipated that any of the proposed action alternatives would push the area out of attainment for ozone.

Hazardous air pollutant (HAP) emissions would be similar to those identified for Alternative C, except that formaldehyde emissions from combustion would be greater, with an estimated 0.016 tons/year attributed to the natural gas burner. As detailed in **Appendix E**, the estimated hazardous air pollutant emissions of formaldehyde from natural gas combustion under Alternative D are well below the APEN reporting threshold.

Potential H_2S emissions would be less than 2 tons/year. Risks to human health would be low due to the low level of H_2S emissions. After implementation of the alternative, if the H_2S emissions are greater than 2 tons/year, appropriate features and operational measures would be incorporated to reduce the emissions (see **Section 2.9**). Impacts on odors would be the same as described under Alternative B, Area B1.

Overall, releases of air pollutants would affect air quality temporarily during the construction period through increased concentrations of NO_2, SO_2, CO, $PM_{2.5}$, and PM_{10}. During the operational phase, air quality would not be substantially affected.

3.2 Energy Demand and Utility Systems

3.2.1 Affected Environment

Electrical power in the study area is provided by the San Miguel Power Association, which purchases its electricity from Tri-State Generation and Transmission, a wholesale power supplier owned by the 44 electric cooperatives it serves. Tri-State Generation and Transmission 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. The 2018 rate for electricity was $.080029 per kilowatt hour for energy costs and $14.00 per kW for demand charges.

Energy consumption and costs have declined over the 20 years the PVU injection well has operated, due to a reduced volume of injected brine during that time. Over the last 25 years, the maximum annual energy consumption occurred in 2007 and 2012 at 4.6 gigawatt hours (GWh), with an annual average consumption of 4.15 GWh. A 690-kW maximum demand power requirement occurred in 2004, with an annual average demand of 620 kW. Fiscal year 2018 annual energy consumption averaged 3.7 GWh, with a 589 kW maximum and 554 kW average demand power requirement.

Currently, natural gas service is not available in the study area. A gas transmission line (Nucla Lateral) passes across southeastern Paradox Valley.

3.2.2 Impacts on Energy Demand and Utility Systems

The issue identified in relation to energy demand and utility systems is the service provider's ability to meet the energy demand in Paradox Valley. Impacts on this issue are the changes in average annual energy use, capacity of existing systems versus the required demand, and miles of new or upgraded transmission or distribution lines that would be required. Information was obtained from the San Miguel Power Association, Williams Northwest Pipeline GP, and Black Hills Energy to determine whether the energy service providers' distribution systems are adequate to meet the energy demand of each alternative and any necessary system upgrades. Energy demands were computed based on the design studies conducted for each alternative.

3.2.2.2 Impacts on Energy Demand and Utility Systems (All Alternatives)

Table 3-6, "Annual (approx.) quantity of energy usage estimated for each alternative" summarizes the form and estimated quantity of energy that would be used annually under each alternative (Amec 2017a; SaltWorks 2019; Petrotek 2018; M. Man 2018 personal communication).

Table 3-6. Annual (approx.) quantity of energy usage estimated for each alternative

Alternative	Electrical Energy (MWh)	Electrical Demand (kW)	Fuel (Gallons of Propane or CCF of Natural Gas)	Miles of New Distribution Lines
Alternative A	0	0	0 propane	0
Alternative B—Area B1	8.1	920	2,000 propane	0.8 (electrical)
Alternative B—Area B2	9.8	1120	2,500 propane	1.3 (electrical)
Alternative C	3.1	290	8,000 propane	0.8 (electrical)
Alternative D	26,700	4,630	4,200,000 natural gas	0.3 (electrical) 14 (gas)

The capacity of the existing electrical transmission system is adequate under all alternatives (J. Fox 2018 personal communication). New electrical distribution lines would be necessary to reach individual sites. In addition, line upgrades, new regulators near the substation and substation protection would be required for Alternative D. The capacity of the natural gas main transmission line at the southeast end of Paradox Valley is adequate to support the anticipated requirements of any of the action alternatives (J. Ellsworth 2019 personal communication). Under Alternative D, it would be necessary to tap the main transmission line and build an interconnection and distribution line to the project area.

3.3 Geology and Geological Hazards

3.3.1 Affected Environment

3.3.1.1 Geology

Paradox Valley is in the northeastern part of the Paradox Basin, an elongate northwest-southeast trending basin, which extends from eastern Utah into western Colorado, in the Colorado Plateau region. Rapid subsidence of the Paradox Basin during the Mississippian, Pennsylvanian, and

Permian Periods led to the intrusion of shallow seas, which resulted in the deposition of marine sediments, including thick layers of evaporites. Subsequent erosion of the Uncompahgre uplift to the northeast resulted in deposition of terrestrial sediments.

The northern part of Paradox Basin, known as the Paradox Fold and Fault Belt, contains several northwest-striking, salt-cored anticlines. These developed from plastic flow of the Pennsylvanian-age Paradox Salt formation, which consists of as much as 85% pure salt and behaves as a viscous liquid over geologic periods. Subsequent dissolution of salt beneath the crests of some of the anticlines resulted in downfaulting and the development of salt valleys. Paradox Valley developed from structural collapse along the crest of a salt anticline and is bounded by nearly vertical normal faults (Reclamation 2012c; King et al. 2014).

Parallel, northwest-trending, steeply dipping normal faults are present in the basement and buried Paleozoic rock units of the Paradox Fold and Fault Belt. These northwest-trending basement faults led to the formation of the northwest-trending salt anticlines. The faults developed during the early Paleozoic Period, and activity greatly increased during the Mississippian Period, at the same time as the Paradox Basin began to rapidly subside. Significant faulting continued during the Permian Period and, possibly, into the Triassic Period. The basement faults may have been reactivated as late as the Tertiary Period; however, no evidence has been found to indicate Quaternary reactivation of these faults, nor have they been reactivated due to brine injection at the PVU (Block et al. 2015).

Many geologically young normal faults are present at the surface in Paradox Basin. Some of these surface faults may be the result of tectonic extension during the Tertiary Period, while others are related to salt dissolution and collapse of overlying strata. Surface faults generally trend northwest-southeast, parallel to the salt anticlines and underlying basement faults. Salt diapiric movement, salt dissolution, and the lowering of salt valley floors are continuing. Extensional, northeast-trending, high-angle surface faults, with predominantly vertical offset, have also been mapped at the surface in northern Paradox Basin. According to formation cutting relations, surface faults were active sometime from the Jurassic to Pleistocene time, in strata between the salt section and the surface.

The basement faults provide major geological and flow boundaries to blocks of the Leadville Formation, which is the underground reservoir for the injection well. Faults having the largest vertical displacements generally have their downthrown sides to the northeast, resulting in a deepening of the Paradox Basin toward the northeast. Near Paradox Valley, these northwest-trending basement faults occur on the northeast flank of the Wray Mesa-Sneffels structural high trend and are referred to as the Wray Mesa fault system (Arestad 2016, 2017; List 2016; Ruder 2016, 2017; Reclamation 2018). The location of the existing well was selected partly to take advantage of the expected increased permeability in this highly faulted portion of the Leadville Formation. An unintended consequence of selecting this location, however, is a bounded subsurface reservoir, due to large vertical fault offsets across the Wray Mesa fault that served to divide the Leadville Formation into isolated blocks. Vertical flow boundaries are provided by the Paradox salt formation (Reclamation 2018).

In addition to the deep basement faults and the surface faults in the Paradox Valley area, there are several widespread, extensional joint sets throughout the central Paradox Basin. The joints have a wide range of strikes, and they differ from the strikes of major faults. Because of this range of orientations, some joint sets are favorably oriented for reactivation under the current direction of regional stress, leading to naturally occurring earthquakes. The rates of naturally occurring earthquakes are quite low in the Paradox Basin. Increases in subsurface pore pressure due to brine injection, however, create conditions favorable to more frequent rupture of the joint sets, which are observed as induced earthquakes (Block et al. 2015).

3.3.1.2 Seismicity

The rate of naturally occurring seismicity documented in the region around Paradox Valley has been low (Mahrer et al. 2004). Accurate seismic monitoring of the area around Paradox Valley began in 1985, when Reclamation installed and began operating a 10-station network to establish a pre-injection baseline (Ake et al. 2002). The original network has been upgraded and expanded since then, and it presently includes 20 high-gain seismographs and 3 strong-motion recorders (Block et al. 2014). Installation of the seismic network in 1985 resulted in a detection threshold for the Paradox Valley area of about magnitude M 1.5.

Improvements to the network have increased its sensitivity so that the detection threshold is now about M 0.5. While earthquakes smaller than about M 2.5 are rarely felt by humans, they provide a wealth of scientific information about how earth's crust is currently deforming and where future earthquakes are likely to occur. The rates at which the smaller magnitude quakes occur also can be used to extrapolate the rates at which larger, potentially damaging earthquakes may occur (Reclamation 2016e).

Reclamation had installed a network of sensitive seismic instruments to monitor both natural and induced earthquakes in the area. No earthquakes were detected in these areas for 6 years before injection (King et al. 2014; Reclamation 2016e). Earthquakes were first detected within 1,000 feet of the injection well in July 1991 about 4 days after the start of the first injection test (Ake et al. 2002; Ake et al. 2005); the seismicity was found to be associated with injection operations (Ake et al. 2005; Reclamation 2009b, 2012c; Block et al. 2014, 2015; Yeck et al. 2014). As injection continued, more earthquakes occurred at progressively greater distances from the well. Relatively shallow (less than 6 miles) earthquakes were detected near the injection well shortly after brine injection began at PVU and have continued at varying rates since then. The scientific consensus is that nearly all of the shallow earthquakes recorded in the vicinity of the injection well since 1991 were induced by fluid injection (Wang et al. 2015; Petersen et al. 2016; EMPSi 2017).

It is not possible to accurately predict the frequency of induced seismic events. Most of the 6,000+ induced earthquakes recorded since the start of PVU fluid injection were too small to be felt by residents and no damage was reported; however, at least 75 of these earthquakes were above the M 2.5 threshold where earthquakes can be felt, and at least 5 of them had M ≥3.5 and were strongly felt (Block et al. 2014). Reclamation has a protocol to suspend injection after events of larger magnitudes to determine if changes to operations are warranted.

Reclamation made substantial changes to injection operations in response to the larger earthquakes. In mid-1999, two 20-day injection well shut-ins per year were implemented; in mid-2000, the injection flow rate was decreased by about one-third; and in early 2013, the flow rate was decreased an additional 13%, and a shut-in schedule was implemented to minimize pressure increases (Block et al. 2014; Reclamation 2016e, 2017b).

Earthquakes related to PVU fluid injection now have been observed at distances of up to 12 miles from the injection well (Reclamation 2017b). Induced earthquakes associated with PVU operations are believed to be possible up to M 5.0 to 5.2 (Yeck et al. 2014; Wang et al. 2015). Induced earthquakes resulting from current and past injection are expected to continue to occur in Paradox Valley and the areas to the northeast (Figure 3-1 in Reclamation 2017b).

3.3.2 Impacts on Geological Hazards

The potential for ground shaking from induced seismicity is the primary identified geological hazard for the project. Ground shaking can damage structures and natural features, produce landslides and soil settlement, and disturb the local population. Project impacts are described in terms of the following:

- The potential changes in the frequency, magnitude, and spatial distribution of earthquakes, compared with existing and historical trends
- The potential changes in the probability for loss of human life, as well as economic and environmental impacts due to earthquake ground shaking

3.3.2.1 Alternative A—No Action Alternative

Induced earthquakes resulting from current and past injection are expected to continue to occur in Paradox Valley and areas to the northeast. Only minor damages (less than $500) have been reported due to induced earthquakes from the existing well. The seismically active area may continue to expand geographically until several years after injection is halted, when the number of events per year is expected to gradually decline (Reclamation 2017b).

3.3.2.2 Alternative B—Injection Well

The impacts described for Alternative A are expected to occur under this alternative. Based on the observed history of seismicity associated with the existing injection well, and assuming typical formation properties for the area (Reclamation 2017a), induced seismic events are possible in the area surrounding a new well from injecting into the Leadville Formation at a rate of 200 gpm (see **Appendix F**). The potential for induced earthquakes near currently populated areas is expected to be lower than with the existing injection well. This is because new well sites have been selected that are hydrologically isolated from the existing injection well and have a substantially larger underground reservoir (see **Appendix F**; Reclamation 2018). Impermeable barrier faults to the northeast of the well sites selected for Alternative B are also expected to isolate induced earthquakes away from populated areas in Paradox Valley, thereby lessening the impact of ground shaking on these areas (Reclamation 2018).

Earthquake occurrences are different than ground shaking; the earthquakes are isolated by the impermeable faults. Ground shaking is not expected to be isolated by the impermeable faults. Because ground shaking decreases with distance and the earthquakes would occur farther away from populated areas, less ground shaking is expected to occur in populated areas.

Induced seismicity could cause the settling/collapse of underground historic mine openings, resulting in isolated surface geologic hazards in the project area. In addition, the new injection wells would be located farther from populated areas.

3.3.2.3 Alternative C—Evaporation Ponds

The impacts described for Alternative A are expected to occur under this alternative. Alternative C would not induce seismicity, and pond embankments would be designed and constructed to Reclamation standards to minimize the risk of failure; therefore, Reclamation anticipates that geological hazards would cause no loss of human life and would have minimal effects on economics or the environment (Reclamation 2017c). If a seismic event greater than M 3.0 occurs within 50 miles, Reclamation would require inspections of embankments. A risk analysis would be completed during final design to verify potential impacts of pond embankment failure as well as final classification of all the pond embankments.

3.3.2.4 Alternative D—Zero-Liquid Discharge Technology

The impacts described for Alternative A are expected to occur under this alternative. Alternative D would not induce seismicity nor would it have the potential to cause geological hazards.

3.4 Surface Water and Water Rights

3.4.1 Affected Environment

Releases from McPhee Dam, including fish augmentation water and natural flow, result in mean daily flows that range from less than 1 cfs to 5,240 cfs at the Dolores River Near Bedrock gage station (USGS Station 09171100, water years 1985–2017), which is downstream of the PVU (see **Figure 2-1**, **Appendix B**). The annual mean flow is 245 cfs and the annual median flow is 64 cfs (USGS 2018c).

In 1975, the Colorado Water Conservation Board (CWCB) filed for an instream flow water right on the Dolores River, from McPhee Dam to its confluence with the San Miguel River (which includes the reach of the Dolores River through the Paradox Valley). The resulting decree in Case No. 75-W-1346 was for 78 cfs for the purpose of maintaining minimum flows to preserve the natural environment (CWCB In-Stream Flow No. 45776.0000). In 1978, Reclamation received a water rights decree (Case No. W-3549) for consumptive use by the PVU (No. 46751.44680). The instream flow rights are senior to Reclamation's production well rights because it has an older adjudication date; therefore, in times of shortage, PVU's junior water rights may be subject to a call by the senior instream water rights. In 2003, Reclamation was granted absolute water rights of 1.00 cfs and conditional water rights of 1.34 cfs for the salinity control production wells (Case No. 01-CW-223).

For the PVU to effectively control salinity, it needs to be operated consistently throughout the entire year. Because Reclamation's water rights for the production wells are junior to the instream flow rights, Reclamation's water rights are likely out of priority for much of the year. An augmentation plan allows junior appropriators to obtain water, while protecting senior water rights from depletions. These plans must be approved by a water court and need to allow for proper consideration of all hydrologic and water rights factors.

Reclamation acquired 924 acre-feet of senior water rights with the land that was inundated by McPhee Reservoir. In 1983, Reclamation applied for a change of water rights and plan for augmentation of the PVU in Case No. 83-CW-45 and 83-CW-14. The proposal, known as the 1986 Decree (augmentation plan), was to change the surface water rights for irrigation of land inundated by McPhee Reservoir into replacement storage rights for salinity control and fish and wildlife propagation in McPhee Reservoir. The conditions associated with the 1986 Decree have not always allowed for the full 924 acre-feet of water to be available. However, the augmentation plan, in combination with Reclamation's adjudicated water rights, has provided a sufficient water supply for historical PVU pumping operations up to 220 gpm. Reclamation has additional water stored in McPhee Reservoir which may be used to further augment PVU operations if needed, subject to Colorado Water Court approval.

Climate plays an important role in surface water availability in the Paradox Valley area and the Colorado River Basin (see **Section 3.1**, "Air Quality, Odors, Meteorology and Climate"). Recent extended drought conditions have resulted in low surface flows; the period from 2000 to 2015 was the lowest 16-year period for natural flow in the last century. Paleorecords indicate that this period was also one of the lowest 16-year periods for natural flow in the past 1,200 years (Reclamation 2016d). Evidence suggests that, due to anticipated long-term climate trends in the future, we can anticipate more year-to-year variability of surface water supplies in at least some areas of the west: for example, the future of the Southwest may include longer, more extreme dry and wet periods than previously observed (Georgakakos et al. 2014). Water Demand is also expected to increase due to population growth and changing irrigation needs resulting from the temperature increases and changes in precipitation patterns from long-term climate trends (Reclamation 2016d).

3.4.2 Impacts on Surface Water and Water Rights

All alternatives will be operated in accordance with Colorado Water Law. Issues identified in relation to surface water and water rights are the effects on river flows due to water rights and augmentation water and the sufficiency of water rights to meet water requirements under the alternatives. Project impacts are described in terms of the change in Dolores River flows, as measured at the USGS Dolores River Near Bedrock gage (Station 09171100) and the sufficiency of existing water rights to implement the alternatives. The effects were evaluated through a review of the USGS Dolores River Near Bedrock gage station data and water rights documentation.

3.4.2.1 Alternative A—No Action Alternative

Reclamation would retain its existing water rights. There would be an increase in flow of 0.5 cfs at the Dolores River Near Bedrock gage station. Once the injection well is shut down, Reclamation would explore other beneficial uses for the augmentation water reserved for surface water depletions of the PVU.

3.4.2.2 Alternative B—Injection Well

There would be no change in the use of surface water or water rights, compared with Alternative A; therefore, the existing water rights and augmentation plan are sufficient to implement this alternative. There would be no effects on flows at the Dolores River Near Bedrock gage station.

3.4.2.3 Alternative C—Evaporation Ponds

The water rights held for beneficial use of the production wells would remain in effect. At a pumping rate of 300 gpm, Reclamation would have to acquire an amended augmentation plan for the additional 100 gpm of consumptive use. Reclamation would need to obtain DWR and Colorado Water Court approval for an amended augmentation plan.

To accommodate the consumptive use of the freshwater pond, the DWR and Colorado Water Court would need to approve an application for a supplemental point of diversion to collect the freshwater. They would also need to review the augmentation plan to determine if it provides sufficient resources to cover the additional 20 acre-feet of water per year required by the freshwater pond. If additional resources would be needed to cover the consumptive use, the DWR and Colorado Water Court would need to approve an amended augmentation plan.

In any scenario previously described, Reclamation would minimize impacts on flows at the Dolores River Near Bedrock gage station by implementing the State-approved augmentation plan when the PVU water rights are out of priority. Flows past this gage would remain representative of the flows cited in Affected Environment.

3.4.2.4 Alternative D—Zero-Liquid Discharge Technology

The water rights held for beneficial use in the production wells would remain in effect. At a pumping rate of 300 gpm, Reclamation would need to acquire an amended augmentation plan for the additional 100 gpm of consumptive use. Reclamation would need to obtain DWR and Colorado Water Court approval for an amended augmentation plan.

In any scenario previously described, Reclamation would minimize impacts on flows at the Dolores River Near Bedrock gage station by implementing the amended augmentation plan when the PVU water rights are out of priority. Flows past this gage would remain representative of the flows cited in the Affected Environment discussion. Flows past the Dolores River Near Bedrock gage station would increase by up to 240 gpm (0.53 cfs), compared with current conditions, due to the release of produced freshwater from the facility. Initial tests have indicated the produced freshwater stream may need additional treatment, such as mixing with river water or brine to meet CDPHE water quality requirements before it can be discharged to the Dolores River.

3.5 Wetlands and Other Waters

3.5.1 Affected Environment

Under Section 404 of the CWA, the USACE has the authority to regulate the discharge of dredged or fill material into Waters of the United States. The USACE can authorize such discharges through nationwide permits or individual permits. In addition, USACE can deny requests for permits to discharge dredged or fill material if there were a practicable alternative to the proposed discharge that would have fewer adverse impacts on the aquatic ecosystem, as long as the alternative does not present other significant environmental consequences. An alternative is practicable if it is available and capable of being done after taking into account cost, existing technology, and logistics in light of overall project purposes. All practicable alternatives that do not involve a discharge into a special aquatic site are presumed to have less adverse impact, unless clearly demonstrated otherwise (40 CFR 230 - 404(b)(1), Guidelines for Specification of Disposal Sites for Dredged or Fill Material).

Existing aquatic resources were identified and mapped using a combination approach of onsite and offsite delineation methods. The Dolores River is the only perennial stream in the study areas; adjacent vegetation includes reed canarygrass (*Phalaris arundinacea*), saltgrass (*Distichlis spicata*), coyote willow (*Salix exigua*), common reed (*Phragmites australis*), tamarisk (*Tamarix sp.*), eastern cottonwood (*Populus deltoides*), single-leaf ash (*Fraxinus anomala*), and Siberian elm (*Ulmus pumila*). The ephemeral stream channels in the study areas are typically devoid of vegetation, with upland species such as sagebrush (*Artemisia sp.*) and cheatgrass (*Bromus tectorum*) on adjacent terraces. A small area of tamarisk occurs next to East Paradox Creek, as discussed in **Section 3.7**, “Vegetation.” Palustrine and riverine wetlands in the study areas are adjacent to the Dolores River; hydrophytic vegetation in these wetland areas includes reed canarygrass, saltgrass, coyote willow, muhly grass (*Muhlenbergia sp.*), watercress (*Nasturtium officinale*), broadleaf cattail (*Typha latifolia*), eastern cottonwood, and Siberian elm. Aquatic resources are delineated, depicted, and described in more detail in the aquatic resources investigation report, which was submitted to the USACE (Wood Environment & Infrastructure Solutions, Inc. 2018) and is attached as **Appendix G**, “Preliminary Identification of Aquatic Resources Report.”

3.5.2 Impacts on Wetlands and Other Waters

Issues identified in relation to wetlands and other waters are the ability to avoid and minimize impacts on jurisdictional wetlands and other Waters of the United States. Project impacts on these issues are described in terms of acres and linear feet of disturbance to wetlands and other waters and compliance with the Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material (40 CFR 230). Aquatic resources delineation methods included an analysis of USGS quad maps, aerial photography, the USGS StreamStats website, and select ground truthing (Wood Environment & Infrastructure Solutions, Inc. 2018). Permanent and temporary impacts were estimated using GIS to overlay conceptual layouts and footprints of each alternative onto the aquatic resources mapping.

3.5.2.1 Alternative A—No Action Alternative

There would be no effect on wetlands or other Waters of the United States under Alternative A.

3.5.2.2 Alternatives B, C, and D

All facilities and associated infrastructure, such as pipelines, access roads, and bridges, would be sited to avoid and minimize impacts from the discharge of fill material to Waters of the United States, to the maximum extent practicable. Ephemeral streams (streams that flow only in response to precipitation) would be filled and realigned to maintain downstream flows in areas where the ephemeral streams cannot be avoided.

Table 3-7, “Summary of potential impacts on wetlands and other waters” summarizes the potential impacts on wetlands and other waters. Further delineation of wetlands and other waters would be completed, as necessary, after a preferred alternative is

Table 3-7. Summary of potential impacts on wetlands and other waters

Alternative	Stream Channel Disturbance Linear Feet (Acres)				Emergent Wetland Disturbance (Acres)	
	Permanent		Temporary			
	Perennial	Ephemeral	Perennial	Ephemeral	Permanent	Temporary
A	0	0	0	0	0	0
B–Area B1	60 (0.1)	32 (<0.1)	342 (0.6)	121 (0.1)	<0.1	0.1
B–Area B2	0	0	0	3,146 (0.2)	0	0
C	0	3,985 (0.3)	0	1,671 (0.1)	0	0
D	0	1,920 (0.1)	0	2,459 (0.2)	0	0

selected to determine impacts to Waters of the United States. Then a CWA Section 404 Permit would be obtained from the USACE prior to any activities in Waters of the United States. The Section 404 Permit would be either a Nationwide Permit or Individual Permit depending on the type of activity and the final impacts to Waters of the U.S. Permanent impacts to Waters of the U.S. may require compensatory mitigation as part of the Section 404 permitting process, and any compensatory mitigation would be determined in consultation with the USACE.

Based on conceptual design, Alternative B would likely qualify for a NWP. Neither Alternatives C nor D would qualify for a Nationwide Permit and would require an Individual Permit unless USACE, in coordination with EPA and FWS, waives evaluation under an Individual Permit and authorizes the activity under a Nationwide Permit.

3.6 Water Quality

3.6.1 Affected Environment

3.6.1.1 Salinity in the Dolores River

Title II of the Salinity Control Act of 1974 authorized the Secretary, acting through Reclamation, to construct, operate, and maintain the PVU facilities to control saline groundwater as a means of improving water quality in the Dolores River and, ultimately, in the Colorado River.

Salinity in the Dolores River in Paradox Valley is a nonpoint source pollutant, as it comes from many diffuse sources as groundwater moves across the collapsed salt dome and enters the Dolores River. The water quality of the Dolores River downstream of Paradox Valley has improved considerably since PVU operations began in 1996. Historical data from 1971 to 1976 indicate over 200,000 tons of salt entered the river annually at Paradox Valley during those years (Reclamation 1979). The USGS maintains two water quality monitoring stations: one at the upstream end of Paradox Valley (09169500-Dolores River at Bedrock) and one at the downstream end (09171100-Dolores River Near Bedrock) (**Figure 2-1**, **Appendix B**). Water quality has been continually monitored at these two stations. The change in average annual salt load in the Dolores River at Paradox Valley between the pre-PVU (1980 – 1993) and post-PVU (1997 – 2015) periods was 94,600 tons/year, which represents a nearly 70% reduction in salt loading to the river and compares closely to the annual average mass of salt (95,000 tons) currently disposed of at the PVU injection well (USGS 2017). The history of salt loading and the salinity control effectiveness of the PVU is described in **Section 2.1**, “Assumptions and Data Limitations.”

Salinity concentrations in the Dolores River vary considerably on a seasonal basis because of the large fluctuations in streamflow. Water quality is slightly degraded during spring, when salinity concentrations are normally low due to the dilution effect of high runoff. During the low flows of summer, fall, and winter, salt concentrations in the river dramatically increase, which substantially degrades water quality.

3.6.1.2 Salinity in the Colorado River

In 1974, the EPA promulgated a regulation that set forth a basin-wide salinity control policy for the Colorado River Basin. This regulation required the Colorado River Basin States to develop and submit for approval to the EPA water quality standards for salinity, including numeric criteria and a plan of implementation. In 1975, the basin states each developed water quality standards to control salinity increases in the Colorado River, which were subsequently approved by the EPA (Colorado River Basin Salinity Control Forum 1975). The numeric criteria were established to protect against increases in economic damages to infrastructure and crop production in the Lower Colorado River Basin (Colorado River Basin Salinity Control Forum 2017).

Salinity in the Colorado River is measured at three monitoring stations: below Hoover Dam, below Parker Dam, and at Imperial Dam. The salinity numeric criteria associated with the three monitoring stations are 723 mg/L downstream of Hoover Dam, 747 mg/L downstream of Parker Dam, and 879 mg/L at Imperial Dam (**Figure 3-1**, "Colorado River Basin Salinity Numeric Criteria Stations," **Appendix B**). Salinity controlled by the PVU currently represents about 7% of the total salinity control objective achieved to date in the Colorado River at Imperial Dam (Colorado River Basin Salinity Control Forum 2017). This makes the PVU the largest single contributor to the Colorado River Basin Salinity Control Program (Colorado River Basin Salinity Control Forum 2017).

The water operations staff at Reclamation's Yuma Area Office uses the RiverWare Salinity Projection Model to assist operators in remaining compliant with the IBWC Minute No. 242 salinity differential. The salinity differential is the difference in salinity concentration between two locations; it does not refer to a specific salinity concentration. IBWC Minute No. 242 states that the cumulative annual average salinity differential between waters arriving at the Northerly International Boundary (NIB) with the Republic of Mexico cannot be more than 115 parts per million (ppm) plus or minus ($\pm$) 30 ppm (U.S. count) than the water arriving at Imperial Dam.

The major controlled water sources between Imperial Dam and the NIB are the Pilot Knob Power Plant and Wasteway (PKPP), the Yuma Main Canal Wasteway, pumped groundwater from the Drainage Pump Outlet Channels (DPOCs), and the Yuma Mesa Conduit. Deliveries to the NIB through the PKPP and the Yuma Main Canal Wasteway do not affect the salinity differential. This is because this water has the same (or very similar) concentration as water arriving at Imperial Dam. Pumped groundwater delivered to the river from the DPOCs and the Yuma Mesa Conduit add to the salinity differential. That is because this water has a concentration in the range of 1400–1700 ppm (Hydros Consulting 2019a).

A major objective of operating the water system from Imperial Dam to the NIB is to blend as much groundwater as possible from the DPOCs and the Yuma Mesa Conduit with the Colorado River water from PKPP and Yuma Main Canal Wasteway (as well as the other uncontrolled sources), while remaining below the 145 ppm (115 ppm ± 30 ppm) cumulative annual salinity differential. Groundwater added to the river through the DPOCs and/or the Yuma Mesa Conduit, can be used to meet water delivery at the NIB in lieu of Colorado River water released from Lake Mead (Hydros Consulting 2019a).

Generally speaking, each acre-foot of groundwater directed to the river at Imperial Dam could represent a 1 acre-foot “savings” at Lake Mead. Essentially, the higher the salinity concentration of Colorado River water arriving at Imperial Dam, the more high-saline groundwater can be used to meet the water delivery to the NIB while still being within the differential. Conversely, the lower the salinity concentration of Colorado River water arriving at Imperial Dam, the less high-saline groundwater can be used to meet the water delivery to the NIB while remaining within the differential. In the case of the latter, this means that more water would need to be released from Lake Mead to meet the salinity differential requirement at the NIB. (Hydros Consulting 2019a).

As discussed in **Section 3.4**, “Surface Water and Water Rights,” long-term climate trends are predicted to result in increased variability in surface flows in the western US, with longer, more extreme dry and wet periods than previously observed (Georgakakos et al. 2014). As a result of surface flow variability, salinity concentrations in the Colorado River would also become more variable. This could also affect the downstream salinity numeric criteria.

3.6.1.3 Surface Water Quality

The CDPHE Water Quality Control Division, under the authority of Federal and Colorado statutes, administers State programs that implement the CWA. The CWA establishes the basic structure for protection of the quality of Colorado’s water bodies, including rivers, streams, lakes, reservoirs, and groundwater. Use classifications and numeric water quality standards have been adopted by the CDPHE for streams, lakes, and reservoirs throughout each of the State’s river basins. Site-specific water quality classifications are intended to protect all existing uses of State waters and any additional uses for which waters are suitable or are intended to become suitable.

Section 303(d) of the CWA, as amended, requires States to identify waters within their boundaries for which technology-based effluent limitations and other required controls are not adequate to attain water quality standards. These identified waters are included on the State’s 303(d) list of impaired waters, based on an evaluation of biological, chemical, or physical data demonstrating nonattainment of numeric or narrative standards, or use impairment. Once listed, the State prioritizes these water bodies or segments for analysis to determine the causes of the water quality problem and to allocate responsibility for controlling the pollution (CDPHE 2013). If water bodies are suspected to be impaired, but there is not enough data to address the uncertainties, the CDPHE places them on the M&E list while it collects further data (CDPHE 2018b).

The Dolores River through and downstream of the Paradox Valley is on Colorado’s 303(d) list for total recoverable iron and on the Colorado State M&E list for temperature and macroinvertebrates. Other streams in the action study areas are East Paradox Creek and small tributaries to East Paradox Creek. These streams are ephemeral and are not on the Colorado 303(d) list; however, they are on the State M&E list for selenium, total recoverable iron, nitrate, and sulfate. Classified uses for many of the streams or drainages in the study areas are agriculture, habitat for either warm- or cold-water aquatic species, primary contact recreation (those activities where there is a significant risk of ingesting water, such as swimming), and a potable water supply. A small stock pond is in the Alternative C study area, but no water quality data are available for the pond. Its classified uses are agriculture, habitat for warm-water aquatic species, and primary contact recreation (CDPHE 2018b).

The Dolores River Dialogue has developed the Dolores River Nonpoint Source Pollution Watershed Plan to protect and maintain watershed health, while ensuring the persistence of native fishes in the lower Dolores River (Kane and Oliver 2013).

3.6.1.4 Groundwater Quality

The SDWA was established to protect the quality of drinking water in the United States and focuses on all waters designated, or potentially designated, for drinking use (EPA 2017). Most of the residents of Paradox and the Highway 90 corridor are on the Paradox Pipeline, whose source water is a privately-owned spring at the northwest end of the valley. Private wells also supply drinking water in the Paradox Valley. Private well owners are responsible for monitoring the quality of their drinking water. Most of the privately-owned wells in the Paradox Valley are in the western half of the valley, and a few wells are along the southern mesa walls in the eastern portion of the valley. All privately owned wells, including those near the existing PVU project area along the Dolores River, may be active and may be providing drinking water. No private wells are in the study areas for the action alternatives.

Brine groundwater, which underlies Paradox Valley, surfaces in and near the Dolores River channel in two general areas, extending from the middle of the valley downstream to the river's exit from the valley. A significant layer of comparatively freshwater overlies the brine in western Paradox Valley and is pumped from wells for irrigation (Reclamation 1978). The brine and freshwater aquifers have a variety of potential recharge sources, including runoff from the La Sal Mountains, irrigation return flows from western Paradox Valley, seepage from West Paradox Creek, precipitation, and surface and subsurface runoff from the valley walls. Based on available information, brine circulates over the top of the salt core at depths of 650 feet or more before surfacing, it originates from the farthest recharge source, while the shallower freshwater originates from closer sources (Reclamation 1978).

Pumping brine from the ground to operate the PVU creates a cone of depression around each production well—a cone-shaped area surrounding each production well, where brine is drawn down toward the well for collection. The pumping rate for each production well needs to be sufficient to create a large enough cone of depression in the brine near the river to allow the freshwater to replace the brine, thus preventing its discharge into the river (Reclamation 1979). Pumping rates have ranged from 100 gpm to 400 gpm at the PVU brine production wells over the life of the PVU (See **Table 2-1**). There have been no reported effects on private wells or surface water while operating under any of these pumping rates.

3.6.2 Impacts on Water Quality

Issues identified in relation to water quality are salt prevented from entering the Dolores River and the Colorado River, salt reduction downstream at Imperial Dam, additional water released or saved from Lake Mead, changes in surface water or groundwater quality from construction and operations, and drinking water quality and the potential for contamination. Project impacts on these issues are described in terms of the amount of salt entering the Dolores River (nonpoint source pollution), the change in CWA 303(d) list status and in classified uses, and the potential for impacts on private drinking water wells.

As described in **Section 2.1**, according to Reclamation's method, every ton of salt injected results in an equal reduction in the amount of salt removed from the river; therefore, impacts on salinity in the Dolores River were analyzed according to this method. The salinity module of the Colorado River Support System (CRSS) RiverWare model was used to analyze changes in salinity concentration under each of the alternatives downstream to Imperial Dam (Colorado River Basin Salinity Control Forum 2017). Surface water quality was analyzed using publicly available data from the State of Colorado (CDPHE 2018b). Groundwater quality was analyzed considering known information on underground geology, groundwater elevation, and historical well use.

3.6.2.1 Impacts Associated with Salinity in the Dolores River (All Alternatives)

Under the No Action Alternative (Alternative A), 95,000 tons/year of salt would no longer be prevented from entering the Dolores River. Alternatives B, C, and D would reduce the amount of salt entering the Dolores River from Paradox Valley, with a resulting benefit to downstream water quality and a reduction in nonpoint source pollution entering the Dolores River. Alternative B would reduce up to 114,000 tons of salt per year, and Alternatives C and D would reduce up to 171,000 tons of salt per year from entering the Dolores River.

The United States will need to comply with Minute 242 and the US-Mexico Agreement as described in section ES.2; however Reclamation recognizes that the action alternatives would make compliance more difficult. The purpose of this action is to comply with the Salinity Control Act. However, compliance with the Treaty must occur in addition to compliance with the Act.

3.6.2.2 Impacts Associated with Salinity in the Colorado River (All Alternatives)

Effects of each alternative on salinity levels in the Lower Colorado River were modeled using the CRSS model. Data used in the CRSS salinity model are based on annual (Upper Basin) and monthly (Lower Basin) regressions of salinity data from 1971 through 2012. Another basis is the historical record of natural flow in the river system over the 107 years from 1906 through 2012 from 29 individual inflow points on the Colorado River System (Reclamation 2019a). The model simulates flow weighted annual average salinity concentrations for locations downstream of Hoover Dam and Parker Dam and at Imperial Dam.

A key assumption, which is different from typical CRSS modeling, is that certain Colorado River System conditions were kept at 2017 values throughout the simulation to conduct a steady state CRSS run. The Colorado River System conditions that were kept constant at 2017 values included: all salinity control projects, Upper and Lower Colorado River Basin water demands, and time varying Colorado River operational elements.

Table 3-8, "Projected Colorado River Salinity (mg/L) under each alternative" presents the flow-weighted annual projected salinity concentrations from 2051 to 2060 for each PVU alternative at the numeric criteria points (Reclamation 2019a) (**Appendix H**, "Hydrologic Modeling Report and Memoranda"). This period was chosen since both the hydrologic and salinity conditions achieve the desired steady state condition at this time.

Table 3-8. Projected Colorado River Salinity (mg/L) under each alternative

Alternative	Salt Reduction at PVU (tons/year)	Below Hoover Dam (Criterion 723 mg/L)	Below Parker Dam (Criterion of 747 mg/L)	At Imperial Dam (Criterion of 879 mg/L)	Salt Reduction at Imperial Dam due to PVU (mg/L)
A	0	632.3 mg/L	652.1 mg/L	786.1 mg/L	0
B	114,000	623.5 mg/L	642.9 mg/L	775.0 mg/L	11.1
C and D	171,000	619.0 mg/L	638.2 mg/L	769.4 mg/L	16.7
Current	95,000	624.9 mg/L	644.4 mg/L	776.8 mg/L	9.2

Table 3-9, "Water released or saved annually in Lake Mead to meet the salinity differential" shows estimates of the change in the amount of water that would be released or saved in Lake Mead annually as a result of implementing the alternatives (Hydros Consulting 2019b, appendix E). The numbers in the table were developed by modeling the salinity reduction anticipated at Imperial Dam (as determined by the CRSS model discussed above) with a modified version of the historical (2003 – 2017) salt concentration of water arriving at the NIB. This modeling effort was used to determine how operations at Yuma would potentially change to meet the salinity differential. It is important to note that the numbers in the table are meant to show relative differences between the alternatives and are not actual values.

Table 3-9. Water released or saved annually in Lake Mead to meet the salinity differential

Alternative	Water Released from Lake Mead Compared to Existing Conditions (Acre-Feet/Year)	Water Saved in Lake Mead Compared to Existing Conditions (Acre-Feet/Year)	Total Amount of Water Released from Lake Mead (Acre-Feet/Year)
A	—	4,090	0
B	438	—	4,528
C and D	2,927	—	7,017

To put this in perspective, 4,000 acre-feet is about equivalent to the following (Hydros Consulting 2019a):

0.3% of the annual delivery to the NIB

0.05% of the annual release from Lake Mead

7 hours of flow arriving at Imperial Dam (assuming a flow rate of 7,000 cfs at Imperial Dam)

A few days of evaporation from Lake Mead

While the values shown in **Table 3-9** indicate the potential for additional water saved in, or released from, Lake Mead for each of the alternatives, it is uncertain if these potential changes in releases from Lake Mead may be realized through actual operations. The RiverWare Salinity Projection Model is not accurate enough to forecast the salinity differential within the level of precision required to determine the annual volume of groundwater that could be directed to the river within a few thousand acre-feet. It is uncertain if Yuma Area Office Water Operations staff can forecast the year-end salinity differential to an accurate enough degree to adjust the annual volume of groundwater directed to the river or bypassed (Hydros Consulting 2019a). Therefore, it would be reasonable to assume there would be no change in bypass water due to the change in salt concentration at Imperial Dam; rather, the cumulative annual salinity differential would be different than what occurred historically (Hydros Consulting 2019b).

Should it be determined, after issuance of the ROD, that implementing the selected alternative would require additional water to be released from Lake Mead to comply with IBWC Minute No. 242, Reclamation would consider implementing mitigation measures to address the potential loss of water storage in Lake Mead.

3.6.2.3 Alternative A—No Action Alternative

Surface Water Quality

Alternative A would increase salinity in the Dolores River, however the change in concentration is unknown. Therefore, the increase in salinity may have an adverse effect on the segment's classified uses. The increase in salinity is not anticipated to affect the listing of the streams of Colorado's 303(d) list. There would be no effect on the segment’s primary contact recreation or potable water supply classified uses or to the listing of streams on Colorado’s 303(d) list. However, under Alternative A, any downstream segments of the Colorado River which are on state 303(d) lists for TDS or salinity would be further impacted due to salinity at Paradox no longer being controlled.

Groundwater Quality

The cone of depression created by the production wells would no longer occur, and groundwater would return to pre-salinity control conditions. Based on the functionality of private water wells prior to the initiation of PVU operations, there would be no effect to wells once operations cease. The existing PVU has been shutdown throughout the years for periods up to seven months and is not aware of any reported well impacts.

3.6.2.4 Alternative B—Injection Well

Surface Water Quality

There would be no change to the water quality of the Dolores River or ephemeral streams in Areas B1 or B2, compared with current conditions. Salinity levels in the Dolores River would be reduced, compared with Alternative A. Implementing Alternative B would have no effect on the listing status of the Dolores River or any ephemeral streams on Colorado’s M&E list or their classified uses.

Groundwater Quality

The injected brine would be disposed of in the Leadville Formation, below a confining layer of salt, which would eliminate any potential impacts on underground sources of drinking water. The pumping rate of 200 gpm would fall within the historical pumping rate of the PVU, and

Reclamation is not aware of any reported well impacts at historical pumping rates; therefore, there would be no impacts on water quality in private wells.

3.6.2.5 Alternative C—Evaporation Ponds

Surface Water Quality

There would be no change in water quality, compared with current conditions. Also, there would be no change to the M&E listing status or classified uses of ephemeral streams in the study area or to the Dolores River. Salinity levels in the Dolores River would be reduced, compared with Alternative A. The 2.7-acre stock pond would be destroyed, and that water would no longer be available for agriculture, habitat for warm-water aquatic species, or primary contact recreation.

Groundwater Quality

The ponds and landfill would be lined, and groundwater is estimated to be more than 600 feet below the ground surface (Golder Associates, Inc. 2008); therefore, groundwater and drinking water quality would not be affected. In addition, a groundwater monitoring system would be installed as required by the Solid Waste Disposal Sites and Facilities Regulations (6CCR 1007-2, Part1). The pumping rate of 300 gpm would fall within the historical pumping rate of the PVU, and Reclamation is not aware of any reported well impacts at historical pumping rates; therefore, there would be no impacts on water quality in private wells.

3.6.2.6 Alternative D—Zero-Liquid Discharge Technology

Surface Water Quality

There would be no change to the M&E listing status of the Dolores River or any ephemeral stream or their classified uses. Release of produced freshwater from the ZLD process would result in up to a 240 gpm produced freshwater stream. This would be discharged to the Dolores River and would dilute the naturally occurring constituents in the river, especially during low flows. Initial tests have indicated that the produced freshwater stream would be similar to distilled water, which is harmful to aquatic organisms. Therefore, the produced freshwater stream would need additional treatment, such as mixing with river water or brine, to meet CDPHE water quality requirements before it can be discharged to the Dolores River. Reclamation would work with CDPHE to ensure the composition and temperature of the produced freshwater stream meets CWA standards prior to its discharge to the Dolores River. Under this Alternative salinity levels of the Dolores River would be reduced, compared with Alternative A.

Groundwater Quality

All facilities associated with Alternative D would be fully contained. In addition, a groundwater monitoring system would be installed as required by the Solid Waste Disposal Sites and Facilities Regulations (6CCR 1007-2, Part1). As a result, implementing Alternative D would have no effect on groundwater quality or potential drinking water sources. The pumping rate of 300 gpm would fall within the historical pumping rate of the PVU, and Reclamation is not aware of any reported well impacts at historical pumping rates; therefore, there would be no impacts on water quality in private wells.

3.7 Vegetation

3.7.1 Affected Environment

Vegetation classifications and quality are discussed in the Biological Evaluation Report (**Appendix I**, "Biological Evaluation Report"). **Table 3-10**, "Vegetation communities in the study areas" summarizes the vegetation classifications, habitat correlation, and the acreage of each vegetation classification in the study areas (USGS 2011).

Table 3-10. Vegetation communities in the study areas

U.S. National Vegetation Classification	Habitat Correlation[1]	Approximate Acres in Study Areas[2]				
		A	B1[3]	B2[3]	C	D
Colorado Plateau Mixed Bedrock Canyon and Tableland	Cliff and rocky outcrops	—	—	5	16	—
Inter-Mountain Basins Shale Badland		—	—	1	—	—
Colorado Plateau Mixed Low Sagebrush Shrubland	Sagebrush	—	—	1	—	—
Inter-Mountain Basins: Big Sagebrush Shrubland		—	60	237	855	168
Colorado Plateau Pinyon-Juniper Shrubland	Pinyon-juniper woodlands	—	171	79	281	104
Colorado Plateau Pinyon-Juniper Woodland		—	114	369	2	20
Cultivated Cropland	Agricultural	—	—	7	—	4
Inter-Mountain Basins Greasewood Flat	Desert shrublands	—	27	10	22	25
Inter-Mountain Basins Mixed Salt Desert Scrub		—	—	41	105	92
Inter-Mountain Basins Semi-desert Shrub-Steppe		—	—	2	13	5
Introduced Riparian and Wetland Vegetation	Riparian	—	53	—**	6	—**
Inter-Mountain Basins Semi-desert Grassland	Arid grasslands	—	—	1	7	1
Introduced Upland Vegetation—Annual Grassland		—	2	51	224	63
Introduced Upland Vegetation—Perennial Grassland and Forbland		—	—	5	—	—
Open Water (fresh)	Aquatic	—	10	—	—	—
Quarries, Mines, Gravel Pits, and Oil Wells	—	—	—	4	2	3

Source: USGS 2011

[1] Habitat categorization is based on the description of features and plants predominantly in the vegetation communities (see Appendix I).

[2] Acres rounded to the nearest whole number.

[3] Acres for seismic survey area not included.

**Actual acreage is greater than zero but less than 0.5.

The BLM (1997) adopted standards for the health of public land in Colorado (also known as Colorado Land Health Standards or Standards for Public Land Health), resulting in an assessment of the condition of vegetation and overall land health on BLM-administered lands. The primary issues identified by BLM in the land health assessments on upland sites in or near the study areas were a lack of plant diversity, noxious plant species, low vigor, and lack of groundcover (i.e., bare soil). The primary issues identified by BLM in the land health assessments for riparian areas were a lack of wetland and riparian vegetation, lack of diverse age classes, and excessive stream width to depth ratios. Causes are attributed to climatic conditions, altered hydrologic functions, mineral extraction, and historical livestock grazing (BLM 2007, 2011a).

The BLM and CDOT have mapped several noxious plant species in the study areas; however, there are no noxious plant species designated by the Colorado Commissioner of Agriculture for eradication (CDOT 2018). The BLM has management programs for controlling weeds on BLM-administered lands (BLM 2015, BLM 2013a).

3.7.2 Impacts on Vegetation

Issues identified in relation to vegetation include the spread of noxious weeds and the loss of rare, but ecologically important, vegetation communities. Project impacts on these issues are described in terms of ground disturbance and acres of riparian vegetation communities affected. Multiple measures, such as, noxious weed control, dust suppression and revegetation would be implemented to reduce impacts to riparian species and other vegetation communities. The USGS Gap Analysis Program (USGS 2011) was used to determine the vegetation communities, and ArcGIS[3] was used to generate acres for each alternative.

3.7.2.1 Alternative A—No Action Alternative

Under Alternative A, any abandoned facilities on BLM-administered lands would be reclaimed. There would be no additional ground disturbance; therefore, the potential for noxious weed spread would not change from current conditions.

3.7.2.2 Impacts Common to Alternatives B, C, and D

Direct effects on vegetation would occur during construction in the areas physically modified by ground-disturbing activities, such as site grading and clearing and facility construction. Indirect effects on vegetation—fugitive dust, soil compaction and erosion, change in vegetation composition, and altered fire regime—may occur near ground-disturbing activities. Areas temporarily disturbed during construction, such as pipeline corridors, would be revegetated. This would be a gradual process, with grasses and broad leaf plants establishing within the first 3 years, shrubs establishing after 5 or more years, and trees in wooded areas taking a decade or more to establish.

Disturbed soils provide an opportunity for the introduction and spread of noxious weeds. The more ground disturbance, the greater the opportunity for the spread of noxious weeds. Noxious weeds, such as cheatgrass (*Bromus tectorum*), have the potential to decrease vegetation

[3] A geographic information system for working with maps and geographic information.

communities' diversity and productivity and increase opportunities for altered ecological processes, such as fire frequency or intensity (Getz and Baker 2008). Due to climatic irregularities and uncertainties the potential exists for vegetation communities to be degraded by project-related activities.

3.7.2.3 Alternative B—Injection Well

Area B1

New facilities in Area B1 would permanently remove 16 acres of vegetation. Ground disturbance due to construction activities would result in an additional 10 acres of temporary vegetation removal and indirect impacts described in **Section 3.7.2.2**, "Vegetation, Impacts Common to Alternatives B, C, and D" such as soil compaction and change in vegetation composition. Ground disturbance would increase the potential for noxious weed spread. Seismic surveys would cover a large area but would cause negligible ground disturbance, since vehicles would be restricted to existing routes.

Area B1 has 53 acres of mapped riparian vegetation along the Dolores River, with a riparian floodplain that supports coyote willow (*Salix exigua*), desert olive privet (*Forestiera pubescens*), and some isolated cottonwoods (*Populus deltoides*), but tamarisk (noxious weed) is a predominant species (**Appendix I**). The construction of two bridges and a pipeline across the Dolores River from the existing BIF to the southern portion of Reclamation land would result in 5 acres of temporary and <1 acre of permanent impacts on riparian vegetation.

Implementation of Alternative B in Area B1 would result in a total of 26 acres of temporary and permanent vegetation impacts, of which 6 acres would be riparian.

Area B2

New facilities in Area B2 would permanently remove 7 acres of vegetation. Ground disturbance due to construction activities would result in an additional 145 acres of temporary vegetation removal and indirect impacts described in **Section 3.7.2.2**, such as soil compaction and change in vegetation composition. Ground disturbance would increase the potential for noxious weed spread. Seismic surveys would cover a large area but would cause negligible ground disturbance, since vehicles would be restricted to existing routes.

Area B2 has 0.4 acre of mapped riparian vegetation along East Paradox Creek, which is an ephemeral channel, where a small area of isolated tamarisk trees occur (**Appendix I**). Tamarisk is a noxious weed that is an undesirable riparian species. There would be no permanent loss of riparian vegetation but there would be 0.25 acre of temporary impacts from the installation of the brine pipeline across East Paradox Creek. Implementation of Alternative B in Area B2 would result in a total of 152 acres of temporary and permanent vegetation impacts, of which 0.25 acre would be riparian.

3.7.2.4 Alternative C—Evaporation Ponds

Alternative C would permanently remove 600 acres of vegetation. Ground disturbance due to construction activities would result in an additional 231 acres of temporary vegetation removal and indirect impacts described in **Section 3.7.2.2**, such as soil compaction and change in vegetation composition. Ground disturbance would increase the potential for noxious weed spread.

Alternative C has 6 acres of mapped riparian vegetation along the Dolores River and East Paradox Creek. Tamarisk is the predominant species and East Paradox Creek is an ephemeral channel. There would be no permanent loss of riparian vegetation but there would be 0.25 acre of temporary impacts from the installation of pipelines.

Implementation of Alternative C would result in a total of 831 acres of temporary and permanent vegetation impacts, of which 0.25-acre would be riparian.

3.7.2.5 Alternative D—Zero-Liquid Discharge Technology

Alternative D would permanently remove 80 acres of vegetation. Ground disturbance due to construction activities would result in an additional 96 acres of temporary vegetation removal and indirect impacts described in **Section 3.7.2.2**, such as soil compaction and change in vegetation composition. Ground disturbance would increase the potential for noxious weed spread.

Alternative D has 0.4 acre of mapped riparian vegetation along the Dolores River where tamarisk is the predominant riparian species. There would be no permanent loss of riparian vegetation, but there would be 0.1 acre of temporary impacts from the installation of the pipeline outlet at the Dolores River.

Implementation of Alternative D would result in a total of 176 acres of temporary and permanent vegetation impacts, of which 0.1 acre would be riparian.

3.8 Special Status Plant Species

3.8.1 Affected Environment

No Federally listed plant species exist in the study areas (FWS 2019). The only special status plant species known and with the potential to occur are BLM-sensitive species (**Appendix I**). The paragraphs below describe the BLM-sensitive plant species that occur or have potential to occur in the study areas (NatureServe 2017; CNHP 1997, 2017).

Gypsum Valley cateye (*Oreocarya revealii*)—This is a Colorado endemic species. It is known to occur in Dolores, Montrose, and San Miguel Counties and is found on grayish, near-barren gypsum hills of the Paradox member of the Hermosa Formation. There have been no populations documented in the Paradox Valley, although suitable habitat is present and known populations occur in the Gypsum Valley area.

Naturita milkvetch (*Astragalus naturitenis*)—This species occurs in Delta, Dolores, Garfield, Mesa, Montezuma, Montrose, and San Miguel Counties, Colorado; McKinley and San Juan Counties, New Mexico; San Juan County, Utah; and the Navajo Nation. It has been documented on mesas above the Dolores River and its tributaries in pinyon-juniper woodland. There are no populations mapped in the study areas, although suitable habitat is present.

San Rafael milkvetch (*A. rafaelensis*)—This species occurs in Emery and Grand Counties, Utah, and Montrose and Mesa Counties, Colorado. There are documented occurrences along the Dolores River canyon, on side slopes and in tributary drainages near the towns of Uravan and Nucla, and along Roc Creek. It is associated with slopes where numerous channels have formed at the bases of mesas in sagebrush, desert shrubland, and arid grasslands. There are no populations mapped in the study areas, although suitable habitat is present.

Sandstone milkvetch (*A. sesquiflorus*)—Occurs in Montrose County, Colorado; Garfield, Kane, San Juan, Wayne, and disjointly in Sanpete Counties, Utah; and northern Navajo and Coconino Counties, Arizona. It has been documented in the Dolores River canyon near Uravan and in Paradox Valley on sandstone rock ledges, fissures, and talus in pinyon-juniper woodland and desert shrubland. There are no populations mapped in the study areas, although suitable habitat is present.

Paradox Valley (Payson's) lupine (*Lupinus crassus*)—Endemic to Colorado and documented in Paradox Valley, near the towns of Nucla and Naturita. Found in drainages, draws, and washes in pinyon-juniper woodland. There are no populations mapped in the study areas, although suitable habitat is present.

Paradox (aromatic Indian) breadroot (*Pediomelum aromaticum*)—Occurs in Mesa and Montrose Counties, Colorado; Mohave County, Arizona; and San Juan, Washington, Emery, and Grand Counties, Utah. It is documented in Paradox Valley and along the Dolores River and tributaries in pinyon-juniper woodland. This plant is often found alongside Paradox Valley lupine. Suitable habitat is present in the study areas. Based on BLM UFO GIS data, Alternative D contains 0.03 acre of a known population of this species.

3.8.2 Impacts on Special Status Plant Species

Issues identified in relation to special status plant species are the loss of or impacts on special status plant species. Project impacts on this issue are described in terms of known populations of special status plant species in project areas. The BLM and Colorado Natural Heritage Program (2017) mapped special status plant species, and these data were used to determine the potential presence of special status plant species.

3.8.2.1 Alternative A—No Action Alternative

There are no mapped special status plants at the existing facilities. Under Alternative A, there would be no impact on special status plant species because activities would be restricted to pre-disturbed areas.

3.8.2.2 Impacts Common to Alternatives B, C, and D

There are no mapped special status plants in the Alternative B or C study areas. Alternative D contains 0.03 acre of a larger mapped population of the Paradox (aromatic Indian) breadroot. There could be direct and indirect effects on this or other special status plant species, including the loss or damage of individual plants and permanent loss or degradation of suitable habitat. Since surveys would not be conducted until prior to construction, plant occurrence is unknown;

therefore, the extent of impacts is unknown. Destruction of suitable habitat would prevent the expansion of any nearby plant populations into disturbed areas.

3.9 Terrestrial and Aquatic Wildlife

3.9.1 Affected Environment

Wildlife species inhabit particular areas depending on the plant communities and habitats present (see **Table 3-10**). The Biological Evaluation Report (**Appendix I**) contains additional information on terrestrial and aquatic species, as well as the rationale for including and excluding species from analysis. Certain wildlife species receive more focus depending on their recreation and economic value, regulatory status, high public interest, or other qualities; these species (See **Table 3-11**, "Terrestrial and aquatic wildlife focal species") and their habitats in the vicinity of the study areas are the focus for analyzing the impacts of the alternatives. Because wildlife is mobile, it is presumed that they occur wherever their suitable habitat occurs; therefore, the analysis focuses on the occurrence of suitable habitat within the study areas. Only species that have suitable habitat in one or more of the study areas are included in the analysis.

Table 3-11. Terrestrial and aquatic wildlife focal species

Species or Groups	Rationale for Inclusion as Focal Species: Recreation and Economic Value	Rationale for Inclusion as Focal Species: High Public Interest	Rationale for Inclusion as Focal Species: BLM Sensitive and State Listed
Reptiles	—	—	X
Birds			
Waterfowl and shorebirds	X	—	X
Upland game birds	X	—	—
Raptors	—	X	X
Migratory birds	X	X	X
Mammals			
Bats	—	—	X
Bighorn sheep (*Ovis canadensis*)	—	—	X
Black bear (*Ursus americanus*)	X	X	—
Elk (*Cervus canadensis*)	X	X	—
Gunnison's prairie dog (*Cynomys gunnisoni*)	—	—	X
Kit fox (*Vulpes macrotis*)	—	—	X
Mountain lion (*Puma concolor*)	X	X	—
Mule deer (*Odocoileus hemionus*)	X	X	—

Species or Groups	Rationale for Inclusion as Focal Species		
	Recreation and Economic Value	High Public Interest	BLM Sensitive and State Listed
Pronghorn (*Antilocapra americana*)	X	X	—
River otter (*Lontra canadensis*)	—	—	X
Fishes			
Sport fishes	X	X	—
Native fishes	—	—	X
Amphibians	—	—	X

3.9.1.1 Terrestrial Wildlife

The focal terrestrial wildlife species in the area are reptiles, birds, and mammals. Although many terrestrial invertebrate species also occur, adequate populations are typically present when populations of the vertebrate groups that prey on invertebrates are healthy. Therefore, invertebrate species are not a focus of analysis.

Reptiles

Most reptiles occur at lower elevations in shrubby arid landscapes, such as sagebrush, desert shrubland, pinyon-juniper woodland, and arid grassland. Common species in the area are garter snakes (*Thamnophis*), sagebrush lizards (*Sceloporus graciosus*), fence lizards (*S. undulatus*), and collared lizards (*Crotaphytus collaris*). Longnose leopard lizards (*Gambelia wislizenii*) and midget faded rattlesnakes (*Crotalus oreganus concolor*), both BLM-sensitive species, have the potential to occur.

Birds

Several hundred species of birds occur in or around the study areas. Most birds have additional regulatory protections under the Migratory Bird Treaty Act or the Bald and Golden Eagle Protection Act.

Waterfowl and Shorebirds

Canada geese (*Branta canadensis*), mallards (*Anas platyrhynchos*), green-winged teal (*A. carolinensis = A. crecca carolinensis*), common mergansers (*Mergus merganser*), Clark's grebes (*Aechmophorus clarkii*), and American coots (*Fulica americana*) are some of the waterfowl species found in the area along waterways. Great blue herons (*Ardea herodias*), spotted sandpipers (*Actitis macularius*), sandhill cranes (*Grus canadensis*), willets (*Catoptrophorus semipalmatus*), lesser yellowlegs (*Tringa flavipes*), marbled godwits (*Limosa fedoa*), and other wading birds and shorebirds can be found along major rivers, valleys, and irrigated fields. Many are spring and fall migrants, most are ground-level nesters, and many forage in flocks on the ground or in water. Paradox Valley is not a major migratory corridor for waterfowl. The Dolores River, Wild Steer Canyon, La Sal Creek, West Paradox Creek, along with the associated riparian corridors and agricultural fields, offer the most suitable habitat for waterfowl and shorebirds in the area.

Upland Game Birds

Upland game birds include dusky grouse (*Dendragapus obscurus*), mourning doves (*Zenaida macroura*), wild turkeys (*Meleagris gallopavo*), Gambel's quail (*Callipepla gambelii*), ring-necked pheasants (*Phasianus colchicus*), and chukars (*Alectoris chukar*). The mourning dove is the most abundant upland game bird. Mourning doves are habitat generalists, preferring woodland and grassland, but are also commonly found in agricultural and urban settings. According to CPW, ring-necked pheasants use areas around agricultural fields northwest of the Dolores River. Wild turkeys occupy ponderosa pine (*Pinus ponderosa*) and Gambel oak (*Quercus gambelii*) woodland, mixed mountain shrub, pinyon-juniper woodland, and riparian areas. The La Sal Creek drainage, roughly 2 miles above the confluence with the Dolores River, is mapped as turkey winter and overall range. Chukar and Gambel's quail occur in rocky foothills, canyons, and valleys (NatureServe 2017).

Raptors

Raptors are eagles, falcons, hawks, and owls. Diurnal species that likely inhabit the area are golden eagles (*Aquila chrysaetos*), bald eagles (*Haliaeetus leucocephalus*), red-tailed hawks (*Buteo jamaicensis*), sharp-shinned hawks (*Accipiter striatus*), ferruginous hawks (*Buteo regalis*), Swainson's hawks (*B. swainsoni*), northern harriers (*Circus hudsonius* = *Circus cyaneus hudsonius*), American kestrels (*Falco sparverius*), Cooper's hawks (*Accipiter cooperii*), peregrine falcons (*Falco peregrinus*), and prairie falcons (*F. mexicanus*).

Great-horned owls (*Bubo virginianus*), long-eared owls (*Asio otus*), and several other owl species occupy mostly wooded habitats and are nocturnal, except for the burrowing owl (*Athene cunicularia*), which is diurnal and prefers arid grasslands and desert shrublands.

Cliffs, rocky outcrops, and large trees provide nesting habitat for most of these species, while a few species nest in tree cavities or on the ground. Some raptor species, such as ferruginous hawks, are winter migrants and do not nest in the area. CPW has mapped an active bald eagle nest north of the Dolores River, about 0.5 mile east of the town of Bedrock, and a roost site by the town of Paradox. There are several potential peregrine falcon nest sites along the northern cliffs of Paradox Valley and along the Dolores River. Peregrine falcons, ferruginous hawks, bald eagles, golden eagles, and burrowing owls are BLM sensitive species and, in the case of the burrowing owl, are also listed by the State of Colorado as threatened.

Migratory Birds

Migratory birds represent the most diverse and abundant category of birds in the Paradox Valley. Nesting can occur in vegetation from near ground level to the upper canopy of trees, on the ground, or on cliffs, depending on the species. Some species may forage in flight, such as swallows and swifts, in vegetation, or on the ground, such as warblers, finches, and thrushes. In addition to ESA protected species, the FWS identified two bird species for the study areas that warrant special attention: Brewer's sparrow (*Spizella breweri)* and Grace's warbler (*Setophaga graciae*). Grace's warbler is associated with montane pine and pine-oak forests, but there is no suitable habitat in the study areas. This species is primarily observed in higher elevations on national forests. The Brewer's sparrow has suitable habitat in the study areas. It breeds primarily in sagebrush shrublands but also in other shrublands, such as mountain mahogany or rabbitbrush. Migrants will use wooded, brushy, and weedy riparian, agricultural, and urban areas and occasionally pinyon-juniper.

Mammals

The study areas contain suitable habitat for numerous mammal species, both large and small. CPW has mapped important seasonal habitat for multiple mammal species, particularly game animals (those managed for hunting). Paradox Valley and surrounding areas provide habitat for mountain lions (*Puma concolor*), black bears (*Ursus americanus*), and Gunnison's prairie dogs (*Cynomys gunnisoni*, a BLM sensitive species).

A small resident population of pronghorn (*Antilocapra americana*) occurs on Monogram Mesa, but it resides primarily in the Dry Creek Basin. Elk (*Cervus canadensis*) and mule deer (*Odocoileus hemionus*) are the most abundant and widespread big game species in Paradox Valley. The entire Paradox Valley and surrounding areas are mapped as severe winter range for elk and mule deer, with the exception of the Dolores River canyon for elk. Elk and mule deer winter concentration areas are mapped along the Paradox Valley floor, and both species have resident populations mapped around the agricultural fields in the northwest portion of Paradox Valley (see **Appendix I**, Maps 3 and 5). The elk population is stable and CPW is managing for a reduced population level to maintain an adequate forage base. The mule deer population is experiencing declines due to habitat availability and condition. Deer winter range is limited and is affected by human disturbance from rural development and recreation, overgrazing, and drought.

The Dolores River canyon is mapped as a BLM-sensitive desert bighorn sheep (*Ovis canadensis*) production area, water source, and winter and summer range. A limiting factor affecting the local desert bighorn population is mountain lion predation. The Dolores River corridor is also mapped as overall and winter range for the river otter (*Lontra canadensis*), which is listed by the State as a threatened species.

Surveys suggest that kit fox are now extirpated, or nearly so, from Colorado (Reed-Eckert 2009). However, the species does occur in eastern Utah and suitable habitat exists in the Paradox Valley.

Paradox Valley is used by roughly 17 species of bats. The Townsend's big-eared bat (*Corynorhinus townsendii*) a BLM sensitive species and a State species of special concern, is the most common species to use mines. The Yuma myotis (*Myotis yumanensis*) is likely to be common close to rivers. Other common species include pallid bats (*Antrozous pallidus*), western small-footed myotis (*Myotis ciliolabrum*), canyon bats (*Parastrellus hesperus*), big free-tailed bats (*Nyctinomops macrotis*), Brazilian free-tailed bats (*Tadarida brasiliensis*), and spotted bats (*Euderma maculatum*) (D. Neubaum 2018 personal communication). Allen's big-eared bats (*Idionycteris phyllotis*), big free-tailed bats, fringed myotis (*Myotis thysanodes*), and spotted bats are BLM-sensitive species. Bat species forage in riparian areas, shrublands, and pinyon-juniper woodland. They roost in rock crevices, caves, mines, buildings, and trees. CPW has no records of maternity colonies in the study areas.

3.9.1.2 Aquatic Wildlife

The focal aquatic wildlife species in the area are fish and amphibians. Aquatic habitats in the study areas range in size and permanency from ephemeral ponds and streams to the Dolores River, a perennial stream. The quality of the aquatic habitat varies by season, location, and species requirements.

Fish

The 36-mile-long section of the Dolores River, from Disappointment Creek to the town of Bedrock (referred to as Slickrock Canyon), is actively managed for native fish rather than sport fish and contains one of the most intact native fisheries in the Colorado River Basin; however, the abundance of these native fishes is relatively low (CPW 2017a). Those conducting surveys in Slickrock Canyon in 2017 collected four native species—flannelmouth suckers (*Catostomus latipinnis*), bluehead suckers (*C. discobolus*), roundtail chub (*Gila robusta*), and speckled dace (*Rhinichthys osculus*)—and four nonnative species—white suckers (*C. commersonii*), black bullhead (*Ameiurus melas*), sand shiners (*Notropis stramineus*), and brown trout (*Salmo trutta*). Flannelmouth suckers, bluehead suckers, and roundtail chub are BLM-sensitive species. Flannelmouth suckers and roundtail chub comprised 85% of the total species detected during the 2017 survey (CPW 2017a).

The 12-mile section of the Dolores River, from the town of Bedrock to the San Miguel River confluence, is affected by low flow, temperature, and salinity (measured as TDS). This section of the river is not monitored, and the assumption is that it is a potential barrier to fish movement between the Dolores River below the San Miguel River confluence and Slickrock Canyon upstream of the town of Bedrock (Kane and Oliver 2013; Lower Dolores River Working Group 2014).

Amphibians

A variety of amphibian species inhabit moist or seasonally wet areas, such as stock ponds, grassy yards, irrigation ditches, and draws. Northern leopard frogs (*Lithobates pipiens* = *Rana pipiens*; BLM sensitive species), canyon tree frogs (*Hyla arenicolor*; BLM sensitive species), Great Basin spadefoot toads (*Spea intermontana*), Western tiger salamanders (*Ambystoma mavortium*), and Woodhouse’s toads (*Anaxyrus woodhousii*) are likely common species in the area.

3.9.2 Impacts on Terrestrial and Aquatic Wildlife

Issues identified in relation to terrestrial and aquatic wildlife are impacts to habitat, wildlife, and special status wildlife species. Project impacts on these issues are described in terms of the acres of overall habitat loss; the potential for wildlife disturbance, injury or mortality; the acres of big game critical winter range and production area disturbance; and the proximity to known raptor nests or roosts. Information regarding wildlife distribution is supported by GIS data maintained by CPW, the BLM, and the Colorado Natural Heritage Program. Reclamation used CPW species activity maps (CPW 2017b) to define wildlife habitat in the area; to determine game species’ sensitive habitat areas; and to identify active raptor nests and roosts.

ArcGIS was used to calculate acreages of habitat disturbance and loss.

3.9.2.1 Alternative A—No Action Alternative

Low flows, which in turn create higher temperatures, may be the primary contributor to decreased fish abundance in the Dolores River's 12-mile segment from the Town of Bedrock to the San Miguel River confluence. Based on fish surveys conducted prior to PVU operations, salinity does not appear to be the limiting factor that prohibits fish use in this segment (Anderson 2010). The increased salinity in combination with low flows would likely compound impacts to fishes in this segment. Given the current low abundance of fish in this segment, increased salinity concentrations would create a negligible potential for an increase in wildlife mortality. Furthermore, the intensity of effects would decrease downstream of the San Miguel River confluence, because salt concentrations are diluted from increased flows from the San Miguel River. Because of the relatively large flow of the Colorado River, the increased salt load from the Dolores River would not cause a noticeable change in fish habitat or populations in the Colorado River.

Human disturbance to terrestrial wildlife, due to operations at the existing salinity control facilities, would decrease. There would be temporary, minor disturbance to wildlife during closure of the PVU facilities. No nuisance habitat would be created.

3.9.2.2 Impacts Common to Alternatives B, C, and D

Impacts on wildlife would occur from habitat loss, wildlife disturbance, injury, or mortality, as further described below. Impacts would be localized and would not result in population-level declines that would warrant the need for special Federal protections. Compared to Alternative A, salinity control would improve water quality which would benefit aquatic habitat in the Dolores River, particularly in the 12-mile segment from the town of Bedrock to the San Miguel confluence.

Habitat Loss

The construction, operation, and maintenance of any of the action alternatives would adversely affect wildlife through habitat alteration, fragmentation, and loss. Habitat loss could result in a decrease in wildlife abundance and richness for populations in the vicinity of the proposed project. Although habitats next to the site would remain intact, some species might make less use of these areas; this is primarily because of disturbance (e.g., noise, human presence) that would occur in the study areas (Sawyer et al. 2006).

Winter range is recognized by state wildlife agencies as the limiting factor in maintaining sustainable big game populations (Austin 2010). Overcrowding of species, such as mule deer in winter ranges, could cause density-dependent effects, such as increased fawn mortality (Sawyer et al. 2006). Increased vehicle traffic would adversely affect wildlife by increasing the potential for mortality, modifying behavior, altering habitat, and helping spread noxious weeds (Anderson 2004).

Wildlife Disturbance, Injury or Mortality

Wildlife would be disturbed by construction, operation, and maintenance of any of the action alternatives. However, certain wildlife (e.g. bears) can habituate to increased human-caused disturbance (Thompson and Henderson 1998; Yarmoloy et al. 1988). A species' response to disturbance caused by noise and human presence is affected by the physiological or reproductive conditions of individuals, the distance from the disturbance, and the type, intensity, and duration of the disturbance. Some wildlife would cease foraging, mating, or nesting near areas of ongoing human activities.

Regular or periodic disturbance would reduce wildlife use, change species composition, and change wildlife behavior in areas exposed to a repeated variety of disturbances, such as noise and increases in traffic (see **Section 3.16**, "Noise," and **Section 3.18**, "Traffic and Transportation")

(Manci et al. 1988; AMEC Americas Limited 2005; Ortega 2012; Larkin 1996; Pater et al. 2009; Habib et al. 2007; Francis et al. 2009; Brown et al. 1999; Delaney et al. 1999; Gaines et al. 2003; Anderson 2004; Jones 2008). Artificial lighting could disrupt wildlife behaviors like migration, predation, and mating.

Construction may result in the direct injury or death of less-mobile wildlife species, such as reptiles and small mammals, or species that inhabit burrows. More mobile wildlife species, such as big game and adult birds, can avoid construction by moving to adjacent areas. Direct mortality to wildlife from vehicle collisions may occur along access routes (see **Section 3.18**). Overhead utility lines provide perch and nest sites for raptors and corvids, ravens (*Corvus corax*), crows (*C. brachyrhynchos*), and magpies (*Pica hudsonia*), thereby increasing the potential for predation on small mammals and birds (Steenhof et al. 1993). The risk of mortality and injury to birds from in-flight collisions with utility lines is likely to vary with species (Faanes 1987).

3.9.2.3 Alternative B—Injection Well

Area B1

Habitat within the Area B1 study area is primarily composed of pinyon-juniper woodland (65%; 285 acres) and, to a lesser degree, sagebrush (14%; 60 acres) and riparian (12%; 53 acres) areas (see **Section 3.7**, "Vegetation"). There would be a permanent loss of 16 acres of wildlife habitat from new facilities and an additional 10 acres of temporary disturbance from construction activities. Within Area B1, 285 acres of deer severe winter range, 90 acres of elk severe winter range, and 123 acres of desert bighorn sheep production area are mapped, which represent a small percentage of the severe winter range (<0.1%) and production areas (0.2%) mapped for these herds in CPW's data analysis units that overlap the study area (see **Appendix I**). No nuisance habitat would be created.

There are 10 acres of aquatic habitat mapped in Area B1, and construction of two bridges across the Dolores River would temporarily impact < 1 acre. Construction of bridges would cause minor, temporary impacts on aquatic habitat, such as increased suspended sediment concentrations and turbidity. Approximately 2 acres of potential peregrine falcon nesting habitat overlaps the westernmost portion of the Area B1 study area, out of 13,700 acres mapped as potential nesting habitat in the Dolores River canyon (CPW 2017b). Seismic surveys would cause wildlife disturbance; however, impacts would be minor since surveys would be temporary (3 months) and of short duration, due to the continuous progression along survey routes.

Implementation of Alternative B in Area B1 would cause negligible wildlife mortality and minor adverse effects on wildlife and habitat, as described in **Section 3.9.2.2** "Terrestrial and Aquatic Wildlife, Impacts Common to Alternatives B, C, and D," since impacts would cover a relatively small, localized portion of the overall species' range.

Area B2

Habitat within the Area B2 boundary is primarily composed of pinyon-juniper woodland (55%; 448 acres) and sagebrush (30%; 237 acres) (see **Section 3.7**). There would be a permanent loss of 7 acres of wildlife habitat from new facilities and an additional 145 acres of temporary disturbance from construction activities. Within Area B2, 464 acres of mule deer and 810 acres of elk severe winter range are mapped, which represent a small percentage (0.1%) of the severe winter ranges for these herds in CPW's data analysis units that overlap the study area (see **Appendix I**). The pipeline corridors would cross a resident population area of pronghorn and winter concentration areas for elk and mule deer. Pipeline installation would create temporary wildlife and habitat disturbance. The brine pipeline would be within one mile of an active bald eagle nest, but outside of the 0.5-mile buffer recommended by CPW. No nuisance habitat would be created, and aquatic habitat is absent.

Seismic surveys would cause wildlife disturbance; however, impacts would be minor since surveys would be temporary (3 months) and of short duration, due to the continuous progression along survey routes. Implementation of Alternative B in Area B2 would cause negligible wildlife mortality and minor adverse effects to wildlife and habitat, as described in **Section 3.9.2.2**, "Terrestrial and Aquatic Wildlife, Impacts Common to Alternatives B, C, and D," since impacts would cover a relatively small, localized portion of the overall species' range and the majority of impacts are temporary.

3.9.2.4 Alternative C—Evaporation Ponds

Habitat within the Alternative C study area is primarily composed of sagebrush (55%; 855 acres), pinyon-juniper woodland (18%; 283 acres), and arid grassland (15%; 231 acres). There would be a permanent loss of 600 acres of wildlife habitat from new facilities and an additional 231 acres of temporary disturbance from construction activities. The entire Alternative C study area is mapped as severe winter range for mule deer and elk (1,530 acres), and 535 acres and 70 acres are mapped as winter concentration areas for deer and elk, respectively, which represents a small percentage (≤0.4%) of severe winter range and winter concentration areas for these herds in CPW's data analysis units that overlap the study area (see **Appendix I**). The freshwater and brine pipelines would be within one mile of an active bald eagle nest but outside of the 0.5-mile buffer recommended by CPW. There would be a minor impact on aquatic habitat with the removal of the stock pond.

Alternative C has the potential to cause major wildlife mortality. The evaporation ponds would create 380 acres of nuisance habitat. A predictive ecological risk assessment was completed, which evaluates and describes the potential physical and chemical exposure hazards of implementing Alternative C (**Appendix J**, Amec 2017e). The high salinity concentrations and mineral content of the waters in the evaporation pond system would present the greatest hazard to wildlife of all classes, but particularly to waterfowl and bats. Physical and toxicological effects would occur on organisms that come in contact with or consume the water and to those that repeatedly prey on or scavenge animals that succumb to exposure.

The freshwater pond constructed within the fenced evaporation pond complex would provide alternative habitat. The evaporation ponds would present a significant hazard to wildlife, particularly waterfowl and bats, due to these species' mobility and attraction to water (**Appendix J**).

3.9.2.5 Alternative D—Zero-Liquid Discharge Technology

Habitat within the Alternative D boundary is primarily composed of sagebrush (35%; 167 acres), pinyon-juniper woodland (25%; 124 acres), and desert scrubland (25%; 120 acres). There would be a permanent loss of 80 acres of wildlife habitat from new facilities and an additional 96 acres of temporary disturbance from construction activities. The entire Alternative D study area is mapped as severe winter range for mule deer and elk (480 acres), and 220 acres and 165 acres are mapped as winter concentration areas for deer and elk, respectively, which represents a small percentage (≤0.1%) of severe winter range and winter concentration areas for these herds in CPW's data analysis units that overlap the study area (see **Appendix I**). The gas and brine pipelines would be within one mile of an active bald eagle nest, but outside of the 0.5-mile buffer recommended by CPW. No nuisance habitat would be created.

Implementation of Alternative D would cause negligible wildlife mortality and minor adverse effects to wildlife and habitat, as described in **Section 3.9.2.2**, since impacts would cover a relatively small, localized portion of the overall species' range. There would be benefits to aquatic wildlife from the produced freshwater that would be returned to the Dolores River.

3.10 Federally Listed Species

3.10.1 Affected Environment

Through coordination with the FWS and the BLM, and site investigations, the Gunnison sage-grouse (*Centrocercus minimus*) has been determined to be the only Federally listed species with the potential to occur in any of the study areas or to be affected downstream by any of the alternatives (**Appendix I**, "Biological Evaluation Report"). Designated critical habitat for the Gunnison sage-grouse is in the Alternative B study area.

The San Miguel Basin population (mainly near Miramonte Reservoir, Colorado) is the closest Gunnison sage-grouse population to the study areas. In 2014, CPW estimated 206 sage-grouse in this population. Within the San Miguel Basin population, there are six small subpopulations (see **Appendix I**). The subpopulation closest to the study areas is referred to as Dry Creek Basin, which has the fewest sage-grouse numbers in the San Miguel Basin population (FWS 2014a). Global positioning system (GPS) satellite data have been collected for Gunnison sage-grouse in the Dry Creek Basin since March 2014 (BLM 2017a). No sage-grouse have been detected on Monogram Mesa (N. West 2019 personal communication).

Gunnison sage-grouse show site fidelity to breeding grounds (also known as leks). Studies of radio-collared females suggest that Gunnison sage-grouse hens typically nest within 4 miles of their leks (GSRSC 2005). The nearest known active lek is in the Dry Creek Basin area (N. West 2017 personal communication; Reclamation 2017d; E. Phillips 2016 personal communication).

Human-generated noise from residential developments, roads, and natural gas drilling can cause a decrease in Gunnison sage-grouse use of an area; the FWS (2014a) recommends not allowing an increase in noise levels greater than 10 dBA above ambient levels at the perimeter of a lek during the breeding season, March 1 to May 31.

The Dry Creek Basin subpopulation critical habitat makes up 62% of the San Miguel Basin population area (62,100 acres) and includes Monogram Mesa, but contains some of the poorest quality habitat within the San Miguel Basin population area (FWS 2014a). Habitat loss and fragmentation are attributed as the primary causes for Gunnison sage-grouse decline in abundance and distribution (FWS 2014a). The primary factors affecting habitat quality are invasive species and mineral development, which contribute to habitat decline through loss, degradation, or fragmentation (FWS 2014b).

Gunnison sage-grouse require plant communities composed primarily of sagebrush (at least 25% of the primarily sagebrush land cover within a 0.9-mile radius of any given location). It must be of sufficient size and configuration to encompass all seasonal habitats for a given population and to facilitate movements in and among populations (FWS 2014b).

Small isolated patches of sagebrush do not support sage-grouse.

Data suggest that Gunnison sage-grouse avoid stands of sagebrush with conifer encroachment by 1,000 feet (BLM 2017a). Due to the amount of conifer encroachment on Monogram Mesa, there is a limited amount of preferred sagebrush habitat available, which makes it unlikely for sage-grouse to use the area for any extended period (N. West 2019 personal communication).

Most critical habitat in the San Miguel Basin population is on BLM-administered lands (FWS 2014a). The BLM has conducted several habitat improvement projects to benefit Gunnison sage-grouse on Monogram Mesa. It is currently improving habitat in the Dry Creek Basin and plans to have ongoing efforts to conserve this species and its habitat.

3.10.2 Impacts on Federally Listed Species

Issues identified in relation to Federally listed species are adverse modification to designated critical habitat and adverse impacts on Federally listed species. Project impacts on these issues are described in terms of preliminary effects determinations. A Reclamation biologist, with technical assistance from FWS staff, performed preliminary assessments of the effects of each of the alternatives on Federally listed species. Final effects determinations would be made through consultation with the FWS after a preferred alternative is identified and prior to issuance of the ROD.

3.10.2.1 Alternative A—No Action Alternative

Gunnison sage-grouse do not occur and there is no critical habitat or suitable habitat in or near existing facilities. Therefore, there would be no effect on Gunnison sage-grouse or critical habitat under Alternative A.

3.10.2.2 Alternative B—Injection Well

Area B1

Area B1 would be outside of critical habitat and in unsuitable Gunnison sage-grouse habitat. Area B1 is a sufficient distance away from known lek sites (15 miles) that construction activities, which would create the greatest amount of noise, would not impact breeding or nesting behavior. Construction noise would attenuate to background levels 10 miles from the project site, which would be outside of the 4-mile lek buffer where sage-grouse typically carry out nesting activity (see **Section 3.16**). Noise generated from ongoing project operations would attenuate to background levels within 0.1 mile of the project site. Therefore, it would be highly unlikely that noise would have any measurable effect on Gunnison sage-grouse.

Since data suggest Monogram Mesa is unoccupied or at least not actively used by sage-grouse, traffic using the existing county roads through critical habitat for access to the injection well on Skein Mesa would not affect sage-grouse. If over the life of the project, sage-grouse are translocated or expand into the area, project-related traffic would be unlikely to result in mortality of sage-grouse due to the lower traffic speeds on county roads.

The seismic survey area would overlap critical habitat within potentially occupied areas; survey activities would have the potential to temporarily disrupt sage-grouse behavior. Seismic surveys would occur outside the breeding and nesting season, to avoid disrupting sage-grouse breeding or nesting behavior. There would be minimal impacts to critical habitat since seismic survey vehicles would be restricted to existing routes.

For these reasons, implementation of Alternative B in Area B1 may affect, but is not likely to adversely affect, Gunnison sage-grouse and its critical habitat.

Area B2

Area B2 would overlap parts of Gunnison sage-grouse critical habitat. The injection well location in Area B2 would be outside of critical habitat and in unsuitable Gunnison sage-grouse habitat. Area B2 is a sufficient distance away from known lek sites (7 miles) that construction activities, which would create the greatest amount of noise, would not impact breeding or nesting behavior. Construction noise would attenuate to background levels 2 miles from the project site, which would be outside of the 4-mile lek buffer where sage-grouse typically carry out nesting activity (see **Section 3.16**). Noise generated from ongoing project operations would attenuate to background levels within 0.1 mile of the project site. Therefore, it would be highly unlikely that noise would have any measurable effect on Gunnison sage-grouse.

Since data suggest Monogram Mesa is unoccupied or at least not actively used by sage-grouse, traffic using the existing county roads for access to the injection well would not affect sage-grouse. If over the life of the project, sage-grouse are translocated or expand into the area, project-related traffic is unlikely to result in mortality of sage-grouse due to the lower traffic speeds on county roads.

The installation of the brine pipeline parallel to County Roads EE21 and DD19 would temporarily remove vegetation in critical habitat on Monogram Mesa along the road corridor. Since the pipeline and utility corridor would be revegetated and would be within an area already affected by the county roads and overhead powerlines, impacts would be temporary and there would be no additional habitat decline due to habitat loss or fragmentation.

The seismic survey area would overlap critical habitat, and survey activities would have the potential to temporarily disrupt sage-grouse behavior. To minimize impacts on sage-grouse and avoid disrupting breeding or nesting behavior, seismic surveys would occur outside the breeding and nesting season (see **Section 2.9**). There would be minimal impacts to critical habitat since seismic survey vehicles would be restricted to existing routes.

For these reasons, implementation of Alternative B in Area B2 may affect, but is not likely to adversely affect, Gunnison sage-grouse and its critical habitat.

3.10.2.3 Alternatives C and D

There is no critical habitat in or near the Alternative C or D study areas, and these areas are not occupied by Gunnison sage-grouse. Alternatives C and D are a sufficient distance away from known lek sites (11 and 16 miles, respectively) that noise produced would not impact sage-grouse. Noise created under these alternatives would attenuate to background levels in 2.2 miles or less from project sites (see **Section 3.16**). Therefore, these alternatives would have no effect on Gunnison sage-grouse or critical habitat.

3.11 Land Acquisition and Land Use

3.11.1 Affected Environment

The study areas include both Federal and non-Federal lands, as described in **Table 3-12**, "Federal and Non-Federal land located within each study area." As discussed in **Section 2.2**, the combined total of permanent and temporary disturbance acres is less than the acreage of the study areas to provide Reclamation with siting flexibility once an alternative is selected and designs are finalized.

Table 3-12. Federal and Non-Federal land located within each study area

Alternative	Acres of Federal Land - BLM	Acres of Federal Land - Reclamation	Acres of Non-Federal Land
A	106	458	195
B - Area B1	80	360	None
B - Area B2	616	9	185
C	1,300	5	225
D	267	2	211

3.11.1.1 Federal Land

Reclamation Land Use and Management

Reclamation lands and ROWs within the study area were acquired for purposes associated with the PVU. These lands and ROWs currently include 458 acres of Reclamation land, 106 acres of ROWs on BLM-administered lands, and 195 acres of ROWs on private lands. Reclamation's lands were acquired subject to ROWs for roads, railroads, telephone lines, transmission lines, ditches, conduits, or pipelines, on, over, or across said lands in existence on such date.

Reclamation lands in the study area are managed primarily for operation and maintenance of the PVU. Reclamation may allow other uses on its lands pursuant to 43 CFR 429 *Use of Bureau of Reclamation Facilities, Lands, and Waterbodies* and Directives and Standards LND 08-01 *Land Use Authorizations*, if such uses do not interfere with the PVU's primary purpose. Any use authorizations issued by Reclamation would include appropriate terms and conditions to protect its facilities, resources, and project operations.

Table 3-13, "Uses Authorized by Reclamation or Reserved Rights on Reclamation Lands within the study areas" lists uses authorized by Reclamation or reserved rights on Reclamation lands within the study areas.

Table 3-13. Uses Authorized by Reclamation or Reserved Rights on Reclamation Lands within the study areas.

Agreement Number	Authorization Mechanism	Use and User
14-LM-4A-00150	Temporary Use Permit, set to expire the date the Final PVU EIS is released to the public.	Colorado State University AgMet weather station
1-LM-48-00008	License Agreement	San Miguel Power Association power line to the existing injection well and private lands.
None	Existing Right	Domestic water pipeline serving a portion of Bedrock is located within a Reclamation easement from Ayers Ranch. Owner and location unknown.
None	Grantor reserved minerals and right of development	Parcel BWF-7; Rudy Groom and M.L. Schehin. Subordinated to Reclamation.
None	Grantor reserved minerals and right of development	Parcel BWF-3A and BWF-3B; Union Carbide Corp. Subordinated to Reclamation.

Mining and Mineral Development on Reclamation Land

There is potential for mineral development on Reclamation lands in the study areas. Reclamation lands are subject to mineral rights and associated development rights as reserved by or outstanding in third parties at the time of Reclamation's acquisition. Within the 458 acres of Reclamation land in the study area, Reclamation acquired all the grantor's mineral rights on 320 acres and may authorize third-party development of those minerals. On the remaining 138 acres, the grantors reserved their mineral and development rights subject to non-interference with Reclamation's construction, operation, and maintenance of any project works, and approval by Reclamation of any exploration or exploitation of such minerals. Reclamation cannot unreasonably deny such approval. Reclamation has not conducted a mineral chain-of-title search on its land associated with the PVU, so it is unknown who owns or holds mineral rights.

Recreation on Reclamation Land

Public use of Reclamation lands, including recreation, is governed by 43 CFR 420 *Off-Road Vehicle Use* and 43 CFR 423 *Public Conduct on Bureau of Reclamation Facilities, Lands, and Waterbodies*. There are no developed recreation facilities on Reclamation's acquired lands. However, dispersed recreation does occur, including hunting, fishing, and boating.

Grazing on Reclamation Land

There currently are no livestock grazing permits authorized on Reclamation acquired lands in the study area. Cattle trespass occurs on Reclamation lands because the property boundaries are not fenced.

BLM Land Use and Management

Title V of the FLPMA and its implementing regulations at 43 CFR Part 2800 guide BLM's authorization and management of ROWs on BLM-administered lands. The general terms and conditions for all public land ROWs are described in FLPMA Section 505 and include measures to minimize damage and otherwise protect the environment, require compliance with air and water quality standards, and require compliance with more stringent State standards for public health and safety, environmental protection, siting, construction, operation, and ROW maintenance. The Secretary may prescribe additional terms and conditions deemed necessary to protect Federal property, to provide for efficient management, and, among other things, to generally protect the public interest in the public lands or lands next to them.

The BLM manages public lands for multiple uses, although the ROW and withdrawal processes may modify the allowable uses of BLM-administered lands.

The BLM processes withdrawal applications in accordance with 43 CFR 2300. The BLM's withdrawal processing includes preparing a case file and submitting a recommendation to the Secretary of the Interior. The Secretary may order the withdrawal or deny it.

Table 3-14, "ROWs authorized by the BLM in the study areas" lists the ROWs that are authorized by the BLM in the study areas.

Table 3-14. ROWs authorized by the BLM in the study areas

ROW Serial Number	ROW Holder	Study Areas				
		Alt. A	Alt. B Area B1	Alt. B Area B2	Alt. C	Alt. D
COC-0-13661	Northwest Pipeline	—	—	—	—	X
COC-0-22294	San Miguel Power Association	—	—	X	X	X
COC-0-22295	San Miguel Power Association	—	—	X	—	—
COC-0-46765 (COC-75179)	San Miguel Power Association	—	—	X	—	—
COC-12348	Nucla-Naturita Telephone	—	—	X	X	X
COC-27756	Reclamation	X	X	X	X	X
COC-29789	San Miguel Power Association	—	—	X	—	—
COC-38376	San Miguel Power Association/DOE	—	—	X	—	—
COC-38386	San Miguel Power Association	X	X	X	X	X
COC-42672	Montrose County	X	X	X	X	X
COC-44582	San Miguel Power Association	X	X	X	—	—
COC-68253	San Miguel Power Association	—	—	X	—	—
COC-72184	San Miguel Power Association	—	—	X	X	X
COC-74913	San Miguel Power Association	X	X	X	X	X

There are two uncommon land statuses in the study areas. First, a portion of BLM-administered land in the Alternative C study area was previously private land, and all but the mineral estate has been conveyed back to Federal ownership. This means the mineral estate below the BLM-administered land is privately held. Second, portions of BLM-administered land in all the study areas are classified as power sites with the FERC. This means the land was previously determined to have potential power resource value.

BLM RMP Conformance

The BLM's RMPs provide direction for managing BLM-administered lands and Federal mineral estate under its jurisdiction. RMPs are prepared using BLM planning regulations and guidance issued under the authority of the FLPMA (43 U.S.C. §1701 et seq.). Portions of the study areas are located on BLM land and are covered by two BLM RMPs: the TRFO RMP (BLM 2015) and the UFO RMP (BLM 1985). The UFO is currently revising the 1985 RMP. FLPMA requires that the BLM determine lands available for ROWs in RMPs and that ROW decisions conform to those plans. In instances where actions are not in conformance with RMPs, the BLM may either deny the action or amend the RMP.

Uses of public land in the study areas currently include grazing, mining, mineral development, and recreation.

Mining and Mineral Development on BLM-Administered Lands

Mining may occur on public lands that have not been withdrawn from operation of the mining laws. A mining claim is a parcel of land for which the claimant has asserted a right of possession and the right to develop and extract a mineral deposit. **Table 3-15**, "Number of existing mining claims in each action study area," and **Table 3-16**, "Claimants with claims in each action study area," list the number of active mining claims and the claimants under each action study area (Hoard 2019).

Table 3-15. Number of existing mining claims in each action study area

Action Alternative	Number of Existing Claims
B1	1
B2	96
C	5
D	0

Table 3-16. Claimants with claims in each action study area

Action Alternative	Claimant
B1	Hallock, George
B2	Pinon Ridge Mining LLC
	Shupe Nugget
	Highlands Natural Resources Corp
	Burgess Crystal
	Premium Uranium LLC
C	Premium Uranium LLC
	Energy Fuels Resources Corp
D	n/a

Mineral development is an important land use on BLM-administered land. Mineral resources with a high potential to occur in the Alternative A, B (Area B1), C, and D study areas are uranium, vanadium, placer gold, gypsum, sodium, and potassium (BLM 2011b). In the

Alternative B (Area B2) study area there is a high potential for sodium, potassium, uranium, and vanadium (BLM 2015a).

Recreation on BLM-Administered Lands
Recreation is a major use of BLM-administered lands. The primary recreational activities on BLM-administered lands in the vicinity of the Paradox Valley are hunting, river-related uses, such as fishing, rafting, and canoeing, off-highway vehicle use, hiking, rock climbing, mountain biking, backpacking, and camping.

There is low visitation in the study areas due to the rural nature of the area. Use is dispersed and, other than hiking on Y9 Road within the WSA and the BLM boat ramp, there are no established recreational trails or major access routes to developed recreation sites in or near the study areas. Recreation activities are common year-round, but the fall hunting and spring boating and fishing seasons are the busiest times. Dolores River boating opportunities are restricted to times when there is sufficient flow during spring runoff. While fishing occurs, the Dolores River in the study areas is not managed by CPW as a sports fishery.

Grazing on BLM-Administered Lands
Domestic livestock grazing is a major and widespread use of BLM-administered lands. Grazing on BLM-administered lands is authorized either through a grazing permit or a lease issued by the BLM to local ranchers. **Table 3-17**, "Grazing permits and AUMs in the action study areas" lists grazing permits and AUMs in each of the action study areas. Once the preferred alternative is identified and more detailed design is completed, supplemental NEPA would be conducted to further analyze the effects of loss of AUMs, such as changes in locations of grazing and effects of the loss of grazing on the land.

Table 3-17. Grazing permits and AUMs in the action study areas[1]

Alternative	AUMs in Each Study Area	Permitted AUMs Associated with Allotments that Overlap Study Areas[2]	Authorization Numbers Associated with Allotments in Each Study Area
A	None	None	None
B—Area B1	23	498	0504560
B—Area B2	136	498	0504560
C	361	1,255	0500270, 0503503, 0503528, 0503572, 0505738
D	30	123	0502942

[1] Grazing permits authorize a specific number of animals in each allotment, based on the amount of AUMs the allotment is capable of providing. One AUM is the amount of forage required by one animal for one month.

[2]Allotments are large, so they extend substantial distances beyond the study area boundaries under each alternative. FLPMA Section 4100.0-5 defines an AUM as "the amount of forage necessary for the sustenance of one cow or its equivalent for a period of 1 month." FLPMA Section 4230.8-1(c) states that "For purposes of calculating the fee, an animal unit month is defined as a month's use and occupancy of range by 1 cow, bull, steer, heifer, horse, burro, mule, 5 sheep, or 5 goats over…6 months at the time of entering…lands administered by the BLM. This column identifies the total AUMs associated with all allotments that may partially fall within a given study area. It is important to look at impacts on the AUMs within the allotments rather than just the AUMs in each study area; this is because grazing permits are authorized based on allotments rather than on specific on-the-ground locations, such as the alternatives study areas.

3.11.1.2 Non-Federal Lands

Non-Federal lands in portions of the action study areas are lands managed or owned by the CDOT, Montrose County, and private landowners needed to implement the Federal action. Non-Federal lands may be acquired by the Federal government if required to implement Federal actions if the non-Federal lands are not already in public ownership and available for full use for the specific project purposes. Acquisition would follow a standard process required by the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (42 USC 61) and in accordance with current Reclamation land acquisition policies. The purpose of this act is to comply with the Federal regulations to acquire non-Federal property and water rights.

The Montrose County Master Plan (Montrose County 2010) does not contain plans for specific projects in the vicinity of the study areas. Private lands in the study areas are primarily agricultural.

3.11.2 Impacts on Land Acquisition and Land Use

Issues identified in relation to land acquisition and use are conformance with existing BLM RMPs and designated land uses, impacts on potential mineral development, recreation, and grazing and grazing allotments, and changes in land ownership or management. Project impacts on these issues are described in terms of RMP conformance, acres of Federal land withdrawn and/or ROW acquired, acres of non-Federal land acquired, changes in potential mineral development, changes in recreational opportunities, and the amount of AUMs lost or grazing permits affected.

Reclamation consulted with the BLM staff regarding plan conformance and identification of impacts. To determine plan conformance, the BLM reviewed the alternatives to identify whether the actions are specifically provided for in the plans and, if not, whether the actions would be clearly consistent with the terms, conditions, and decisions of the approved plan or amendment. The BLM provided information on RMP conformance, mining or mineral potential, recreational use, and AUMs and grazing permits in the study areas. For the purposes of this analysis, Reclamation has analyzed withdrawal in 40-acre increments; however, per Part 603, **Chapter 1** of the BLM Departmental Manual on Public Lands, the minimum acreage consistent with demonstrated need would actually be withdrawn. ROWs would be obtained only on areas required for constructing, operating, maintaining, and terminating the authorized facilities. In addition, lands proposed for withdrawal have been analyzed as if the land would transfer from multi-use to single-use in order to capture the greatest level of impact which could occur under each of the action alternatives; however, the actual change in land use would be determined once areas to be withdrawn are identified in final design and the site-specific existing land uses are considered.

Reclamation has analyzed non-Federal land acquisitions as if the acreage of non-Federal lands to experience temporary and permanent land disturbance would be acquired (see **Section 2.2**). However, the full range of available land acquisition allowed under law would be explored with landowners to ensure, to the extent reasonable, that project goals could be achieved by means of land acquisitions that are mutually agreeable. If properties needed cannot be acquired on a willing-seller basis, then property would be acquired through exercise of eminent domain.

3.11.2.1 Alternative A—No Action Alternative

Federal Land

Reclamation Land Use and Management

Reclamation would retain its land associated with the PVU until a future date, when it would reevaluate the land for other uses. Reclamation land that is determined no longer needed for current or identifiable future Reclamation project or program purposes would be administered in accordance with applicable Federal law and Reclamation Manual Directives and Standards LND 08-02 and LND 08-03. In the event Reclamation land is sold, it would be sold subject to prior existing rights. Therefore, there would be no change in existing land uses on Reclamation lands (**Table 3-13**).

BLM-Administered Land Use and Management

Under Alternative A, there would be no change in land management or status. After the injection well ceases to operate, currently authorized BLM ROWs would be reviewed to determine if they could be put to other uses. There would be no effect on the classification of the land with potential power resource value for FERC (K. Olagbegi 2019a personal communication).

BLM RMP Conformance

Alternative A would be in conformance with both the TRFO RMP and the UFO RMP (BLM 2015a; BLM 1985).

Mining and Mineral Development on BLM-Administered Lands

There would be no change to mining or mineral development on BLM-administered lands.

Recreation on BLM-Administered Lands

There would be no change to recreational opportunities. The cessation of salinity control operations would degrade water quality (see **Section 3.6**, "Water Quality") and may adversely affect aquatic wildlife, though mortality would be negligible (see **Section 3.9**, "Terrestrial and Aquatic Wildlife"). Therefore, recreational fishing would not be affected. Once the well becomes inoperable, noise levels associated with operation of the PVU would cease, which would improve nearby recreational experiences (see **Section 3.16**).

Grazing on BLM-Administered Lands

There would be no change to grazing on BLM-administered lands.

Non-Federal Lands

No change would occur in non-Federal landownership or uses under Alternative A. There would be no relocation or involuntary displacement of any residences or businesses. Currently authorized PVU easements on non-Federal lands would be reviewed to determine if they could be put to other uses.

3.11.2.2 Alternative B—Injection Well

Federal Land

Reclamation Land Use and Management

Area B1. The study area for Area B1 includes 360 acres of Reclamation lands. There would be no change to Reclamation land use, including mining and mineral development, recreation, and grazing. License Agreement 1-LM-48-00008 with San Miguel Power Association may be amended to extend the power line across Reclamation lands to serve the new BIF. There would be no change to other existing uses identified in **Table 3-13**.

Area B2. Nine acres of Reclamation lands occur within the study area boundary. There would be no change to Reclamation land use, including mining and mineral development, recreation, and grazing. There would be no change to other existing uses identified in **Table 3-13**.

BLM-Administered Land Use and Management

Area B1. Under Alternative B in Area B1, Reclamation would continue to manage lands associated with the existing PVU. Alternative B in Area B1 would require a ROW and/or withdrawal of 80 acres of BLM-administered lands to build and operate an injection well and associated ancillary facilities. This 80 acres is a larger area than what is required for the facilities to provide flexibility in final facility siting and to protect facilities from incompatible land uses.

Area B2. Under Alternative B in Area B2, Reclamation would require a ROW and/or withdrawal from the BLM for 616 acres of BLM-administered lands to build and operate an injection well and associated ancillary facilities. This 616 acres is a larger area than what is required for the facilities to provide flexibility in final facility siting and to protect facilities from incompatible land uses.

Impacts Common to Both Area B1 and Area B2. The BLM would need to process Reclamation's request for withdrawal of public land and/or grant or deny Reclamation's request for a ROW on BLM-administered lands. In locations that cross BLM-administered lands, the BLM would approve or deny an application for ROW for new Reclamation facilities. Any ROWs for new Reclamation facilities in existing utility ROWs on BLM-administered lands would be granted as amendments to Reclamation's existing ROWs.

All BLM-administered land withdrawn by Reclamation would transition from multi-use to a single use, thereby removing the potential for other uses. Other uses include the future issuance of ROWs, grazing permits, mining and mineral development, and recreational use. All BLM-administered land within the proposed ROW area would remain multi-use, Reclamation ROWs and/or withdrawals would have no effect on the classification of the land with potential power resource value for FERC (K. Olagbegi 2019a personal communication).

<u>BLM RMP Conformance</u>

Impacts Common to Both Area B1 and Area B2. Alternative B in Area B1 and Area B2 would conform with both the TRFO RMP and the UFO RMP (BLM 2015a; BLM 1985).

<u>Mining and Mineral Development on BLM-Administered Lands</u>

Impacts Common to Both Area B1 and Area B2. Any active mining claims near access roads would not be affected because work would be temporary and within ROWs next to the road. New mining claims could not be located in withdrawn areas. Reclamation would coordinate with existing mining claimants to minimize impacts as described in **Section 2.9**.

<u>Recreation on BLM-Administered Lands</u>

Area B1. Impacts on recreational use would be minimal. While Y9 Road and the Dolores River are within the study area, boating opportunities and access to hiking on Y9 Road would not be affected. Dispersed recreation, such as hunting, would be prohibited in the withdrawn areas; however, access routes leading to recreation areas outside the study area would not be affected. Visual impacts on river recreationists in the study areas are described in **Section 3.13**, “Areas of Special Designation.” Recreational opportunities based on solitude and natural setting would be affected by noise, most intensely during construction (see **Section 3.16**).

Area B2. Impacts on recreational use would be minimal because there are no designated recreational trails in the study area. Dispersed recreation, such as hunting, would be prohibited in the withdrawn areas; however, access routes leading to recreation areas outside the study area would not be affected. Recreational opportunities based on solitude and natural setting would be adversely affected by noise, most intensely during construction (see **Section 3.16**).

Grazing on BLM-Administered Lands

Area B1. Implementing Alternative B in Area B1 could remove up to 23 AUMs in the BLM-administered portion of the study area, which is a 5% reduction of currently permitted AUMs. The AUMs were calculated based on the entire 80-acre study area on BLM-administered land; however, the actual permanent disturbance would cover 7 acres of BLM-administered land. Moreover, the remainder of the study area would not be fenced to exclude grazing, reducing the anticipated number of AUMs lost. One BLM grazing permit could require modification to reflect this loss of AUMs.

Area B2. Implementing Alternative B in Area B2 could remove up to 136 AUMs in the study area, which is a 27% reduction of currently permitted AUMs. The AUMs were calculated based on the entire 616-acre portion of the Alternative B2 study area on BLM-administered land; however, the actual permanent disturbance would cover 7 acres of BLM-administered land. Moreover, the remainder of the study area would not be fenced to exclude grazing, limiting the anticipated number of AUMs lost. One BLM grazing permit could require modification to reflect this loss of AUMs.

Non-Federal Lands

Area B1

There would be no new pipelines in the ROW held by the CDOT and Montrose County along Hwy 90 and county roads. There would be no change in non-Federal land ownership or uses. Implementing Alternative B in Area B1 would not require the relocation or involuntary displacement of any residences or businesses.

Area B2

Under Alternative B, Area B2, Reclamation would acquire approximately 49 acres of non-Federal land. Implementation of Alternative B in Area B2 would not require the relocation or involuntary displacement of any residences or businesses.

3.11.2.3 Alternative C—Evaporation Ponds

Federal Land

Reclamation Land Use and Management

Five acres of Reclamation lands fall within the study area boundary. There would be no change to Reclamation land use, including mining and mineral development, recreation, and grazing. There would be no change to other existing uses identified in **Table 3-13**.

BLM Land Use and Management

Under Alternative C, Reclamation would require ROWs and/or withdrawal of 1,300 acres of BLM-administered land to build and operate the evaporation pond complex and associated ancillary facilities. This 1,300 acres is a larger area than what is required for the facilities to provide flexibility in final facility siting and to protect facilities from incompatible land uses. The BLM would need to process Reclamation's request for withdrawal of public land and/or grant or deny Reclamation's request for a ROW on BLM-administered lands. The BLM would approve and/or deny an application for ROW for new Reclamation facilities in the existing utility ROW. Any ROWs for new Reclamation facilities on BLM-administered lands would be granted as amendments to Reclamation's existing ROWs. New facilities would be constructed so as to not affect any currently authorized ROW uses. All BLM-administered land in the study area would transition from multi-purpose use to a single use, thereby removing the potential for other uses in the study area. Other uses include the issuance of future ROWs, grazing permits, mining and mineral development, and recreational use. There would be no effect on the classification of the land with potential power resource value for FERC (K. Olagbegi 2019b personal communication).

<u>BLM RMP Conformance</u>

Alternative C would not conform to the interim visual resource management (VRM) objectives identified by the UFO (see **Section 3.12**, "Visual Resources;" BLM 1985); therefore, the UFO RMP would need to be amended to implement Alternative C. The RMP amendment process is described in **Section 1.5**, "Federal Decisions to be Made."

<u>Mining and Mineral Development on BLM-Administered Lands</u>

New mining claims could not be located in withdrawn areas. The privately held mineral estate located below a portion of the BLM-administered land in the study area would be acquired. Reclamation would coordinate with existing mining claimants to minimize impacts as described in **Section 2.9**.

<u>Recreation on BLM-Administered Lands</u>

Impacts on recreational use would be minimal because there are no designated recreational trails in the study area. Recreation, including dispersed recreation such as hunting, would be prohibited in the withdrawn areas; however, access routes leading to recreation areas outside the study area would not be affected. Recreational opportunities based on solitude and natural setting near the study area would be affected by noise and visual impacts (see **Section 3.16** and **Section 3.12**).

<u>Grazing on BLM-Administered Lands</u>

Implementing Alternative C would permanently remove up to 361 AUMs in the study area, which is a 29% reduction of currently permitted AUMs. The AUMs were calculated based on the entire 1,300-acre portion of the Alternative C study area on BLM-administered land; however, the actual permanent disturbance would cover 527 acres of BLM-administered land, and the remainder of the study area would not be fenced to exclude grazing, thereby limiting the anticipated number of AUMs lost. Up to five BLM grazing permits could require modification to reflect this loss of AUMs.

A small dam captures runoff from storms to create a stock pond in the Alternative C area, and this stock pond would be removed. Reclamation would coordinate with the BLM on appropriate mitigation for the stock pond, such as reconstructing the stock pond in an alternate location that could utilize the same water right.

Non-Federal Lands

Under Alternative C, Reclamation would acquire approximately 281 acres of non-Federal land. Implementing Alternative C would not require the relocation or involuntary displacement of any residences or businesses.

3.11.2.4 Alternative D—Zero-Liquid Discharge Technology

Federal Land

Reclamation Land Use and Management

Two acres of Reclamation lands fall within the study area boundary. There would be no change to Reclamation land use, including mining and mineral development, recreation, and grazing. There would be no change to other existing uses identified in **Table 3-13.**

BLM Land Use and Management

Under Alternative D, Reclamation would require ROWs and/or withdrawal of 267 acres of BLM-administered land to build and operate the ZLD facilities and associated ancillary facilities. This 267 acres is a larger area than what is required for the facilities to provide flexibility in final facility siting and to protect facilities from incompatible land uses. The BLM would need to process Reclamation's request for withdrawal of public land and/or grant or deny Reclamation's request for a ROW on BLM-administered lands. In locations that cross BLM-administered lands, the BLM would approve or deny an application for ROW for new Reclamation facilities in the existing utility ROW. Any ROWs for new Reclamation facilities on BLM-administered lands would be granted as amendments to Reclamation's existing ROWs.

New facilities would be constructed so as not to affect any currently authorized ROW uses. All BLM-administered land in the study area would transition from multi-purpose use to a single use, thereby removing the potential for other uses there. Other uses include the issuance of future ROWs, grazing permits, mining and mineral development, and recreational use. There would be no effect on the classification of the land with potential power resource value for FERC (K. Olagbegi 2019a personal communication).

BLM RMP Conformance

Alternative D would conform to the UFO RMP (BLM 1985).

Mining and Mineral Development on BLM-Administered Lands
New mining claims could not be located in withdrawn areas. Reclamation would coordinate with existing mining claimants to minimize impacts as described in **Section 2.9**.

Recreation on BLM-Administered Lands
Impacts on recreational use would be minimal because there are no designated recreational trails in the study area. Recreation, including dispersed recreation such as hunting, would be prohibited in the withdrawn areas; however, access routes leading to recreation areas outside the study area would not be affected. Recreational opportunities based on solitude and natural setting would be affected near the study area by noise (see **Section 3.16**).

Grazing on BLM-Administered Lands
Implementing Alternative D would permanently remove up to 30 AUMs in the study area, which is a 24% reduction in permitted AUMs. The AUMs were calculated based on the entire 267-acre portion of the Alternative D study area on BLM-administered land; however, the actual permanent disturbance would cover 80 acres of BLM-administered land, and the remainder of the study area would remain open to grazing, thereby limiting the anticipated number of AUMs lost. One BLM grazing permit could require modification to reflect this loss of AUMs.

Non-Federal Lands

Under Alternative D, Reclamation would acquire approximately 56 acres of non-Federal land. Implementing Alternative D would not require the relocation or involuntary displacement of any residences or businesses.

3.12 Visual Resources

3.12.1 Affected Environment

The BLM's VRM program provides a framework for managing public land in a manner that protects the quality of scenic values as required by FLPMA. There are three key parts that make up the VRM program: 1) maintaining records on the quality of scenic values related to BLM-administered lands; 2) establishing direction for managing those qualities and values in RMPs as VRM classes; and 3) and assessing all proposed actions to identify how the quality of scenic values would be affected and if the proposed changes to the landscape would be allowable by the RMP VRM classes. Actions that result in a change in the landscape that are not allowable by the RMP VRM classes do not conform with the RMP and may require an RMP amendment. Conformance with RMPs is discussed in **Section 3.11**.

The VRM system categorizes BLM-administered land into VRM classes, which is how the BLM manages visual resources in a given area. Class I and II areas are the most valued, Class III areas represent a moderate value, and Class IV areas represent the least value. **Table 3-18**, "VRM classes in each study area," lists the VRM classes in each study area.

Table 3-18. VRM classes in each study area

VRM Classes	Alternative				
	A	B—Area B1	B—Area B2	C	D
VRM Classes	n/a	III	II, III, and IV	II and III	II and III

Reclamation prepared a visual resources analysis report of the effects of each alternative on visual resources to determine whether each alternative would be in conformance with BLM's VRM program (**Appendix K**). The degree to which an alternative affects the visual quality of the landscape depends on the visual contrast created between the proposed alternative and the existing landscape.

3.12.2 Impacts on Visual Resources

The issue identified in relation to visual resources includes a change in the visual landscape. Project impacts on this issue are described in terms of the degree of contrasts between features of the landscape from KOPs. These were selected after various mapping exercises were completed, including analyses to determine areas that could be viewed within a 5-mile radius of the study areas, with a concentration on potential observers in residences, transportation corridors, and recreation areas. Reclamation used a viewshed analysis tool to determine the visibility of the study areas. The degree of contrast was determined by conducting field visits to the KOPs and using the BLM's Visual Contrast Rating Worksheet (Form 8400-4).

3.12.2.1 Alternative A—No Action Alternative

Under Alternative A, no noticeable changes would occur to the visual qualities of the landscape compared with current conditions.

3.12.2.2 Alternative B—Injection Well

Area B1

Alternative B, Area B1 is located on Reclamation land south of Bedrock, Colorado and on BLM land on Skein Mesa. The main development located within the Dolores River Canyon consists of existing Reclamation facilities, the Y9 recreation trail, and the BLM Bedrock recreation campground site.

Only the portion of the study area on Skein Mesa is on BLM-administered land, which is designated as VRM Class III. The proposed facilities would not be seen from the KOPs because they would be obstructed by landscape conditions, or they would conform with the VRM Class objective for this area (**Appendix K**). However, bridges and facilities would be visible from Reclamation land to rafters and hikers, even if they are not visible from the KOPs (see "Recreation," in Section 3.11). Design features and mitigation measures would not change the conformance determination; however, the design features and mitigation would minimize the impacts on visual resources. From the KOPs, the level of change to the characteristic landscape would generally be low, and the degree of contrast created by the pipeline scar would be weak.

Area B2

The proposed facilities would either not be seen from the KOPs because they would be obstructed by the landscape, or they would conform with VRM class objectives (**Appendix K**).

Pipeline scars would be visible and would alter the character of the landscape. The level of change to the characteristic landscape during construction would be moderate to high, mostly because of the presence of construction equipment and supplies. Construction equipment would be visible and would attract the attention of the casual observer, primarily because of the proximity of the pipelines to travel routes. With the implementation of mitigation measures after construction (see **Section 2.9**), such as revegetating the pipeline scar, the degree of contrast would be minimized or eliminated. Although the color of the revegetated area would be lighter than the surrounding vegetation, the short, sparse, new vegetation would eventually mirror the surrounding vegetation. The topography would not change. The level of change to the characteristic landscape would eventually be low, and the degree of contrast created by the pipeline scar would be weak.

3.12.2.3 Alternative C—Evaporation Ponds

The size and scale of the proposed project facilities in a nearly undeveloped area would not conform with VRM class objectives (**Appendix K**). Due to construction and operation of the evaporation pond facilities, the character of the landscape would not be retained or even partially retained. The level of change to the characteristic landscape would be high and the degree of contrast would be strong, mostly because of both the relatively large area of disturbance and the presence of artificial features on land that was previously undeveloped. Construction and operation would be visible and would attract the attention of the casual observer, mostly because of the proximity to travel routes and because the facilities would break up large tracts of previously undeveloped land. Visible pipeline scars would alter the character of the landscape, as described above in Alternative B.

3.12.2.4 Alternative D—Zero-Liquid Discharge Technology

The proposed facilities would either not be seen from the KOPs, because they would be obstructed by the existing landscape conditions, or they would conform with VRM class objectives (**Appendix K**). Visible pipeline scars would alter the character of the landscape, as described above in Alternative B.

3.13 Areas of Special Designation

3.13.1 Affected Environment

3.13.1.1 Wild and Scenic Rivers

There are no designated WSRs in the study areas. Through the BLM's RMP revision process, segments of the Dolores River in or near the study areas have been determined to be eligible for inclusion in the National Wild and Scenic Rivers System because they are free flowing and have been determined to possess certain ORVs: scenic, recreational, geological, fish, wildlife, archaeological, and/or vegetation. The eligible river segments include the river and its immediate environment, as well as a boundary that extends up to 0.25 miles on either side of the Dolores River channel. The Dolores River upstream of Reclamation land, in the Dolores River Canyon WSA, was assigned a preliminary classification as wild. The Dolores River, from the WSA/Reclamation land boundary downstream to the San Miguel River confluence, was assigned a preliminary classification of recreational (**Figure 3-2**, "Areas of Special Designation,"

Appendix B). Segments classified as recreational allow the greatest level of development, while segments classified as wild must remain relatively undeveloped. The BLM is responsible for managing eligible WSR segments in a manner that preserves the integrity of the preliminary classification, until a Record of Decision is issued for a (revised) RMP (BLM 2010, 2013b).

3.13.1.2 Wilderness and Wilderness Study Areas

Wilderness areas are designated by Congress and are protected under the Wilderness Act. There are no congressionally designated wilderness areas near the study areas.

In contrast, WSAs are areas that were identified by BLM as suitable for designation as wilderness areas and recommended for such designation pursuant to section 603 of the FLPMA. WSAs have been determined to possess certain wilderness characteristics: minimum roadless size, apparent naturalness, outstanding opportunities for solitude or primitive and unconfined recreation, and supplemental values. The BLM manages WSAs to preserve these characteristics in an unimpaired condition until such time as Congress either designates them as wilderness or releases them for other uses.

Reclamation land is next to the Dolores River Canyon WSA (**Figure 3-2**, **Appendix B**). The WSA encompasses 30,119 acres of BLM-administered land and is situated around the Dolores River. The WSA is closed to motorized and mechanized travel and is managed for wilderness values. It offers outstanding natural scenery, ecological diversity, and opportunities for solitude and primitive, unconfined recreation. The area is relatively low in elevation and can be reached by maintained roads on both the north and south boundaries, making it accessible for year-round primitive recreation. The BLM is responsible for managing the WSA in a manner that maintains its suitability for preservation as wilderness (BLM 2012a).

3.13.2 Impacts on Areas of Special Designation

The issues identified in relation to eligible WSR segments and WSAs include adverse impacts on the WSR values or tentative classification that might lead to ineligibility and impairment to the area's suitability for preservation as wilderness. Project impacts on WSR issues are described in terms of effects on values (free-flowing condition, water quality, tentative classification, and ORVs). Project impacts on WSA issues are described in terms of effects on wilderness characteristics (sufficient size, naturalness, outstanding opportunities, and supplemental values). The procedures in BLM Manuals 6400 (2012b) and 6330 (2012a) were followed to evaluate the impacts on WSR values and WSA wilderness characteristics. The BLM policy does not specifically address brine injection facilities. Therefore, Reclamation consulted with BLM on interpretation of BLM policy. Reclamation used the viewshed tool in Google Earth Pro as a supplemental analysis method for assessing visibility of infrastructure and impacts on scenery.

3.13.2.1 Alternative A—No Action Alternative

Wild and Scenic Rivers

The cessation of salinity control operations would degrade water quality compared with current conditions (see **Section 3.6**), and may adversely affect aquatic wildlife, though mortality would be negligible (see **Section 3.9**). This would not affect the values in stream segments with a preliminary classification of recreational. The free-flowing condition, scenic, recreational, geological, archaeological, or vegetation ORVs would remain unchanged, making it unlikely to change the tentative classification or lead to ineligibility.

Wilderness and Wilderness Study Areas

The cessation of salinity control would have no direct impacts but would have beneficial indirect impacts on the WSA. The current human imprints observable from within the WSA would remain. There would be a reduction in noise compared with current conditions (see **Section 3.16**), which would increase opportunities for solitude.

3.13.2.2 Alternative B—Injection Well

Wild and Scenic Rivers

Area B1

Under Alternative B in Area B1, the scenic and recreational ORVs for eligible river segments, with a preliminary classification of recreational and wild, would be negatively affected. There would be direct effects to the recreational segment and indirect effects to the wild segment.

For river segments with a preliminary classification of wild, the scenery would be altered due to the new injection well facilities, which include two new bridges over the Dolores River, overhead power lines, a new access road, and associated infrastructure constructed on Reclamation land (see **Section 3.12**). Impacts on scenic ORVs would be minor since the topographic features—the canyon walls and hills—and dense riparian vegetation along the banks screen views from the river. Noise generated during construction and ongoing O&M activities would be audible to recreationists (see **Section 3.11** and **Section 3.16**), but vegetation would provide a buffering effect. Construction noise would be louder than noise from ongoing O&M activities, but it would be short-term and therefore have a temporary and minor adverse effect on the recreational ORV.

For river segments with a preliminary classification of recreational, the vegetation ORV and free-flowing condition would be adversely affected. The construction of bridges across the river on Reclamation land would have a minor impact on riparian vegetation since it is limited to a narrow margin adjacent to the river channel and tamarisk is a predominant species (see **Section 3.7**). Additionally, the bridges would have a minor adverse effect on the free-flowing condition of the Dolores River on Reclamation land due to bank riprapping at the bridge abutments. However, no bridge supports or abutments would be constructed below the ordinary high water mark of the river, nor would any rip rap be placed below the ordinary high water mark. In segments classified as "recreational," BLM policy states "Bridge crossings and river access are allowed" (BLM 2012b). Since adverse impacts on the ORVs would be minor and bridge crossings are allowed, Alternative B Area B1 is unlikely to affect the river segments' tentative classification or eligibility. Environmental commitments described in **Section 2.9** would further mitigate impacts. The additional salinity control in the river, compared with Alternative A, would be beneficial to water quality (see **Section 3.6**). The recreational, geological, fish, wildlife, and archaeological ORVs would remain unchanged, making it unlikely to affect the tentative classification or lead to ineligibility.

Area B2

There would be temporary, minor impacts on the scenic ORV for eligible river segments with a preliminary classification of recreational, during construction of pipelines. The free-flowing condition, remaining ORVs, and tentative classification would not change. The additional salinity control in the river, compared with Alternative A, would be beneficial to water quality (see **Section 3.6**).

Wilderness and Wilderness Study Areas

Area B1

Under Alternative B in Area B1, there would be a minor indirect impact from an increase in noise from construction and field investigations, such as 3D seismic surveys, which would temporarily affect opportunities for solitude in areas of the WSA near Reclamation land (see **Section 3.16**). There would be a permanent indirect impact due to human imprints observable from the WSA from new infrastructure constructed on Reclamation land.

The directional injection well and high-pressure transmission pipeline connecting the BIF to the well head on Skein Mesa would result in permanent placement of subsurface facilities in the WSA. This would not meet the BLM non-impairment standard that the use must be both temporary and not create surface disturbance. The facilities proposed in this alternative would not create new surface disturbance, but they would be permanent below the surface and would likely require a ROW from BLM.

BLM policy has exceptions to the non-impairment standard to allow for other obligations created by Congress. The PVU is authorized by Congress under Title II, Section 202(a)(1), of the Colorado River Basin Salinity Control Act (PL 93-320, as amended). The permanent subsurface facilities would not affect the wilderness characteristics; therefore, they would not impair the area's suitability for preservation as wilderness.

Area B2

There would be no impact on the Dolores River Canyon WSA.

3.13.2.3 Alternative C—Evaporation Ponds

Wild and Scenic Rivers

There would be temporary, minor impacts on the scenic ORV for eligible river segments with a preliminary classification of recreational during pipeline construction. The free-flowing condition, remaining ORVs, and tentative classification would not change. The additional salinity control in the river, compared with Alternative A, would be beneficial to water quality (see **Section 3.6**).

Wilderness and Wilderness Study Areas

Under Alternative C, there would be a minor direct impact from an increase in noise during construction of the freshwater pipeline on Reclamation land. This would temporarily affect opportunities for solitude in areas of the WSA near Reclamation land.

3.13.2.4 Alternative D—Zero-Liquid Discharge Technology

Wild and Scenic Rivers

There would be temporary, minor impacts on the scenic ORV for eligible river segments with a preliminary classification of recreational during pipeline construction. The free-flowing condition, remaining ORVs, and tentative classification would not change. The additional salinity control in the river, compared with Alternative A, would be beneficial to water quality (see **Section 3.6**, “Water Quality”).

Wilderness and Wilderness Study Areas

There would be no impact on the Dolores River Canyon WSA.

3.14 Solid Waste, Hazardous Substances, and Environmental Media

3.14.1 Affected Environment

Reclamation conducted a review of Federal, State, and tribal environmental regulatory databases to identify and locate properties with known hazardous substance contamination in the study area of each action alternative. A search of available environmental records of documented hazardous material sites located within the study areas or within 1.0 mile of their boundaries did not reveal any documented hazardous material sites (Kahler 2018).

The existing PVU facilities are regulated by the EPA under a Class V UIC permit, and also by CDPHE and OSHA. Once collected, the brine is an environmental media (i.e. component of the natural environment), not a solid or hazardous waste, despite the presence of H_2S in the brine (Reclamation 2017e). **Section 3.1** provides information on H_2S air quality concerns.

3.14.2 Impacts on Solid Waste, Hazardous Substances, and Environmental Media

Issues identified in relation to solid waste, hazardous substances, and environmental media are as follows:

- The generation of solid or hazardous waste
- The creation of a landfill to dispose of the generated solid waste
- The storage, use, or release of hazardous materials
- Any recorded past, ongoing, or potential threat of releases of hazardous waste onto the study areas

Project impacts on these issues are described in terms of the quantity and type of waste generated by an alternative and the occurrence or potential for release of hazardous substances. Reclamation reviewed databases to determine the likelihood of recognized environmental conditions. Reclamation also consulted with the EPA and CDPHE to determine the generation of any solid waste, hazardous substances, or environmental media.

3.14.2.1 Alternative A—No Action Alternative

Once the brine is no longer collected, it would no longer be considered an environmental media. The naturally occurring H_2S entrained in the brine would be released to the atmosphere.

3.14.2.2 Impacts Common to Alternatives B, C, and D

The potential for an accidental brine release exists, which would pose a risk to human health due to the presence of H_2S. Prior to site acquisition and construction, Reclamation and its contractors would implement hazardous substance, waste management, and health and safety BMPs, as applicable (see **Section 2.9**). Reclamation would comply with OSHA, CDPHE, and EPA regulations to ensure worker health and safety.

3.14.2.3 Alternative B—Injection Well

Reclamation would obtain a new UIC permit from the EPA. The brine would continue to be classified as environmental media, and the well would continue to be classified as a Class V well. No solid waste would be generated, but there would continue to be an occasional release of H_2S to the atmosphere of less than 2 tons/year (see **Section 3.1**). The new injection well would be designed and constructed with features similar to the existing PVU facilities, including safety and SCADA monitoring equipment.

3.14.2.4 Impacts Common to Alternatives C and D

During the evaporation process, the CDPHE would regulate brine in the evaporation pond and ZLD facilities as environmental media. After the water is evaporated from the brine, the salt would be harvested and regulated as a solid waste (CDPHE 2016). The facilities would generate an estimated volume of 98 acre-feet per year of solid waste (salt). The solid waste would be disposed of in a permanent salt landfill next to either the evaporation pond complex (Alternative C) or the ZLD facilities building (Alternative D).

Based on testing to date, no hazardous waste would be generated or developed under either Alternative C or Alternative D (Amec 2017d; SaltWorks 2019). Reclamation would conduct a toxicity characteristic leaching procedure analysis before disposing of the salt, to characterize the solid waste and ensure it is appropriate for disposal in the onsite, solid waste landfill (40 CFR Section 261.24; test Method 1311 in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," EPA Publication SW-846). Permitting for the salt disposal landfill would require submittal of an application to the commissioners of Montrose County and the CDPHE to acquire a certificate of designation as a solid waste disposal site.

3.15 Socioeconomics

3.15.1 Affected Environment

3.15.1.1 Economic Damages

The numeric criteria for salinity in the Colorado River were established to protect against salinity-related increases in economic damages to infrastructure and crop production in the Colorado River Basin (Colorado River Basin Salinity Control Forum 2017). The current average, annual economic damages associated with salinity levels in the Colorado River are described in **Table 3-19**, "Average annual economic damages associated with salinity levels in the Colorado River" (Reclamation 2019a). Current salinity levels are disclosed in **Table 3-8** in **Section 3.6.2.2**.

Table 3-19. Average annual economic damages associated with salinity levels in the Colorado River

Levels	Average Annual Economic Damages ($ Millions)
Below Hoover damages	$53.647
Below Parker damages	$190.173
Below Imperial damages	$251.681
Total damages	$495.501

3.15.1.2 Economy and Employment

The geographic area or region for the socioeconomics analysis is defined as the three-county region of Montrose and Mesa Counties in Colorado and Grand County in Utah. While the Paradox Valley is in Montrose County, Mesa County is included in the region because a significant portion of the construction material and workforce is expected to stem from the Grand Junction area. Grand County, Utah, is included in the region because it is likely to be the temporary residence of much of the workforce during construction. Despite the expectation that a significant portion of the construction workforce would come from the Grand Junction area, one way driving time from Grand Junction to Paradox, Colorado, is over two and a half hours. The city of Moab in Grand County, Utah, has ample lodging and rental opportunities and is just over an hour from Paradox. O&M jobs at the existing PVU are currently held by local residents, so it is anticipated that O&M jobs under the action alternatives would also be held by local residents.

The annual O&M in-region estimated expenditures for the existing PVU are $2,370,000. These expenditures result in 30 jobs with a total economic labor income of $1.2 million and a total economic impact of $4 million in the three-county region (Reclamation 2019b).

The construction industry is the focus for this socioeconomic analysis. In the three-county region, the number of annual construction jobs is 7,437. The total output for construction is $1,280.5 million, and the total labor income for construction is $384.4 million; see **Appendix L**, "Socioeconomic Analysis Report," for the complete text of the socioeconomics report (Reclamation 2019b). The alternatives also involve replacement costs, which could include construction, services or supplies that have a life of less than 50 years.

3.15.1.3 Local Property Values and Property Taxes

Property values in Paradox Valley average $1,500 per acre, though some land tracts are valued as high as $6,000 per acre. Near the Town of Paradox, land values range from $17,000 to $30,500 per acre (R. Levine 2017 personal communication). The land values in the Paradox area are among the lowest in Montrose County and tend to have a base value—a point at which the value is unlikely to decrease, regardless of condition or outside influence. According to Montrose County's assessment of property values, land values in Paradox Valley are currently at the low base value (Reclamation 2017c).

According to the Montrose County Assessor, land in Paradox Valley is classified as residential or agricultural. Residential value is determined by demand in the area, and demand in Paradox Valley is low. Agricultural land value is based on the income capacity or productivity of the land. In Paradox Valley, agricultural land value is generally based on grazing. Montrose County considers much of Paradox Valley as badlands with low grazing value; therefore, the agricultural land value is low (Reclamation 2017f). Montrose County collects property taxes on private lands. The amount a property is taxed depends on whether it is residential or agricultural. The Federal government is required to make payments in lieu of taxes to offset the annual loss of property tax revenue due to Federal ownership.

3.15.2 Impacts on Socioeconomics

The three issues related to socioeconomics are economic damages due to salinity in the Lower Colorado River, issues related to economics and employment, and issues related to property values and property taxes. Issues identified in relation to economic damages are the change in annual average economic damages due to salinity in the Colorado River. Reclamation used the salinity module of the CRSS RiverWare model to analyze changes in economic damages under each of the alternatives downstream to Imperial Dam (Reclamation 2019a). Issues identified in relation to economics and employment include how the alternatives would change economic employment in the three-county region and total average economic benefit. Economic effects or impacts of the alternatives were calculated for construction, O&M, and replacement using the IMPLAN model (Reclamation 2019b). Issues identified in relation to property values and property taxes are changes in property tax and assessment values.

Effects of each alternative on economic damages resulting from salinity levels in the Lower Colorado River were determined using the CRSS model (Reclamation 2019a). The IMPLAN model was used to determine impacts to economy and employment. IMPLAN is a static regional input-output economic model that estimates changes in economic activity, including employment, total output, and total labor income, in the specified regional economy. Employment is measured in terms of the number of jobs[4], as opposed to full-time equivalent positions. Jobs created include jobs in multiple sectors; therefore, jobs created during construction are not necessarily construction jobs, but rather jobs created due to construction activities such as construction, hotel, or restaurant jobs. Total output represents the value of goods and services produced by businesses in a given industry of the regional economy and is measured in terms of sales dollars. Total labor income is comprised of employee compensation

[4] A job in IMPLAN equals the annual average of monthly jobs in that industry. Thus, 1 job lasting 12 months = 2 jobs lasting 6 month = 3 jobs lasting 4 months, etc.)

and proprietor income. Employment and total labor income are often of particular interest to local government officials, whereas total output is the most comprehensive measure of regional economic activity (Reclamation 2019b). The property values and property taxes analysis was based on personal communication with the Montrose County Assessor (Reclamation 2017f).

3.15.2.1 Impacts on Economic Damages (All Alternatives)

The average annual economic benefit of controlling salt at the PVU under the alternatives is described in **Table 3-20**, "Average annual economic benefit (in $ millions) by alternative."

Table 3-20. Average annual economic benefit (in $ millions) by alternative

Benefit	Alternative A	Alternative B	Alternatives C and D
Economic benefit below Hoover	$0	$3.787	$5.726
Economic benefit below Parker	$0	$13.118	$19.634
Economic benefit below Imperial	$0	$10.833	$16.298
Total economic benefit	$0	$27.738	$41.658

Changes in average annual economic damages under the alternatives, as compared with the current salt control at the PVU, are described in **Table 3-21**, "Change in average annual economic damages (in $ millions) under the action alternatives, as compared with the current salt control at the PVU" (Reclamation 2019a). The positive economic damages values indicate an increase in damages; the negative economic damages values indicate a decrease in damages. Alternative A shows the increase in damages associated with the current injection well becoming inoperable. Construction and replacement jobs would be temporary, and O&M jobs would be permanent.

Table 3-21. Change in average annual economic damages (in $ millions) under the action alternatives, as compared with the current salt control at the PVU

Damages	Alternative A	Alternative B	Alternatives C and D
Change in damages below Hoover	$3.185	-$0.602	-$2.541
Change in damages below Parker	$10.975	-$2.143	-$8.659
Change in damages below Imperial	$9.076	-$1.757	-$7.222
Total change in damages	$23.236	-$4.502	-$18.422

3.15.2.2 Alternative A—No Action Alternative

Economy and Employment

Under Alternative A, O&M expenditures associated with the existing PVU would cease, and the employment, labor income, and economic impact in the three-county region associated with the O&M of the existing PVU would no longer occur. Impacts from deconstruction of the PVU would generate 34 jobs over 2-3 years, with a total economic labor income of $1.2 million and a total economic impact of $3 million in the three-county region (Reclamation 2019b).

Property Values and Property Taxes

Under Alternative A, there would be no effect on private property values compared with current values because they are already at the low base property value (Reclamation 2017f). As a result, there would be no change in private property taxes. There would also be no change to Federal payments in lieu of taxes.

3.15.2.3 Alternative B—Injection Well

Economy and Employment

Area B1

Impacts from construction would be the generation of 253 jobs over 2-3 years, with a total economic labor income of $11.5 million and a total economic impact of nearly $28.6 million in the three-county region. The annual economic effects of O&M under Alternative B Area B1 would be the generation of approximately 21 jobs, with an estimated total economic labor income of $879,536 and a total economic output of nearly $2.9 million in the three-county region (Reclamation 2019b).

Area B2

Impacts of construction would be the generation of a total of an estimated 351 jobs over 2-3 years, with a total economic labor income of $15.8 million and a total economic impact of nearly $44.1 million in the three-county region. The annual economic effects of O&M of Alternative B Area B2 would be the generation of about 23 jobs with a total economic labor income of $973,852 and a total economic output of nearly $3.2 million within the three-county region (Reclamation 2019b).

Property Values and Property Taxes

Area B1

Property values, property taxes, and payments in lieu of taxes are not expected to change compared with Alternative A.

Area B2

Reclamation may acquire up to 49 acres of non-Federal lands in Montrose County (**Section 3.11**). No residences or buildings would be relocated. Because property values are already at the low base level, there would be no change to property values or taxes. Montrose County considers this to be badlands, with low grazing value, a land classification that generates $7 in county taxes per 100 acres annually. Once acquired, Reclamation would be required to pay a sum of less than $5 annually in lieu of taxes to Montrose County (B. Hughes 2019 personal communication).

3.15.2.4 Alternative C—Evaporation Ponds

Economy and Employment

Impacts of construction would be the generation of an estimated 766 jobs over 2-5 years, with a total economic labor income of about $31.8 million and a total economic impact of nearly $124.4 million in the three-county region. The annual economic effects of O&M of Alternative C would be the generation of around 20 jobs, with a total economic labor income of about $843,138 and a total economic output of almost $2.8 million in the three-county region. Replacement costs would occur roughly every 8 years over the life of the project. The economic effects of replacement would be the generation of about 140 jobs, with a total economic labor income of roughly $6.2 million and a total economic output of an estimated $23.5 million in the three-county region (Reclamation 2019b).

Property Values and Property Taxes

Reclamation may acquire up to 281 acres of non-Federal lands in Montrose County (**Section 3.11**). No residences or buildings would be relocated. Because property values are already at the low base level, there would be no change to property values or taxes. Montrose County considers this to be badlands, with low grazing value. Once acquired, Reclamation would be required to pay a sum of less than $20 annually in lieu of taxes to Montrose County (B. Hughes 2019 personal communication).

3.15.2.5 Alternative D—Zero-Liquid Discharge Technology

Economy and Employment

Impacts of construction would be the generation of 442 jobs over 2-3 years, with a total economic labor income of nearly $20.9 million and a total economic impact of nearly $62.4 million in the three-county region. The annual economic effects of O&M of Alternative D would be the generation of 157 jobs, with a total economic labor income of almost $6.5 million and an estimated total economic output of $21.1 million in the three-county region. Replacement costs would occur roughly every 8 years over the life of the project. The economic effects of replacement would be the generation of about 27 jobs, with a total economic labor income of about $1.1 million and a total economic output of roughly $4.9 million in the three-county region (Reclamation 2019b).

Property Values and Property Taxes

Reclamation may acquire up to 56 acres of non-Federal lands in Montrose County (**Section 3.11**). No residences or buildings would be relocated. Because property values are already at the low base level, there would be no change to property values or taxes. Montrose County considers this to be badlands, with low grazing value. Once acquired, Reclamation would be required to pay a sum of less than $5 annually in lieu of taxes to Montrose County (B. Hughes 2019 personal communication).

3.16 Noise

3.16.1 Affected Environment

Noise is characterized as unwanted sound; however, background sounds are not considered adverse and are not classified as noise. They are a composite of sound from all sources, including humans, which represent existing site conditions. In rural areas with a population density of 1 to 100 people per square mile, such as in or near the study areas, environmental background sounds are estimated at 35 dBA (Washington State Department of Transportation 2017), which is similar to a quiet office or a library.

Several noise measurements were taken at various locations around the existing BIF, using the National Institute for Occupational Safety and Health Sound Level Meter version 1.0.6 iOS application. This resulted in a calculated level of 57 dBA at a reference measurement distance of 50 feet from the BIF, and a calculated level of 45 dBA at Reclamation's nearest property boundary, due east of the injection facility (A. Nicholas 2018 personal communication). Colorado Hwy 90 is estimated to produce a noise level of 64 dBA at the highway, based on the daily traffic volume and speed limit (Washington State Department of Transportation 2017).

The State of Colorado outlines noise abatement regulations in Article 12 of the Colorado Revised Statutes. There it stipulates activities shall be conducted in a manner so that any noise produced is not objectionable due to intermittence, beat frequency, or shrillness. The measurements for this determination are made at a distance of twenty-five feet from the property line. Industrial noise is considered a public nuisance when in excess of 80 dBA from 7:00 a.m. to 7:00 p.m. or exceeds 75 dBA from 7:00 p.m. to 7:00 a.m. During the day, the noise level may be exceeded by 10 dBA for a period that does not exceed fifteen minutes in any one-hour period (Colorado Legal Services 2018).

Montrose County's noise guidance defines excessive noise at the property or subdivision boundary as noise that inherently or recurrently exceeds 60 dBA from 7:00 a.m. to 7:00 p.m. or that exceeds 55 dBA from 7:00 p.m. to 7:00 a.m. (Montrose County 2016).

3.16.2 Impacts on Noise

The issue identified in relation to noise includes noise disturbance to noise-sensitive receptors in the surrounding communities, such as residences and public buildings. Project impacts on this issue are described in terms of compliance with the State of Colorado's noise standards and guidance in Montrose County's zoning resolution. Empirical formulas from Chapter 7 of the Washington State Department of Transportation Biological Assessment Preparation Manual (Washington State Department of Transportation 2017) were used to evaluate the anticipated area of noise impacts before reaching State and County thresholds, as well as background noise levels. The distances were identified from the study area boundaries, and the equipment noise measurements were estimated at 50 feet from the source.

Noise levels for each alternative are identified below, and the distance of attenuation to Montrose County standards and background levels has been calculated (Busch 2019c).

3.16.2.1 Alternative A—No Action Alternative

During closure of the PVU, numerous pieces of heavy equipment would be used simultaneously. The loudest combination of equipment would likely be a drill rig (84 dBA), a dozer (82 dBA), and an excavator (81 dBA). The combined noise level from this equipment is 88 dBA, which would attenuate to Colorado's threshold 0.02 mile and Montrose County's threshold 0.12 mile from the project sites. There are no residences within these ranges of the existing facilities. Noise would attenuate to the 35-dBA background level at 1.25 miles from the project site, and there are numerous residences within this range. The noise produced during construction would exceed the standards as identified and be considered a public nuisance within those ranges.

After closure, noise levels associated with operation of the PVU would cease and would therefore comply with all thresholds.

3.16.2.2 Alternative B—Injection Well

Area B1

During construction of the injection well, numerous pieces of heavy equipment would be used simultaneously; however, the loudest piece of equipment potentially used would be an impact pile driver for bridge construction, and the noise produced from it alone would be the greatest noise produced from any combination of equipment: 110 dBA. It would attenuate to Colorado's threshold 0.3 mile from the project site and there are no residences within this range of the study area boundary. The noise would attenuate to Montrose County's threshold ~3 miles from the project site. There are numerous residences in this range of the study area boundary, as well as a BLM boat launch day use area. The noise at these locations would combine with the highway noise and would increase by 4 dBA to 68 dBA during construction. The noise would attenuate to the 35 dBA background level at 10 miles from the project site; there are numerous houses in this range of the study area boundary. The proposed Dolores River Canyon WSA is within 0.15 mile of the project site. The noise produced during construction would exceed the standards as identified and be considered a public nuisance within those ranges.

During regular O&M, the injection pump facility would produce the greatest noise. The measured noise from the existing pump facility is 57 dBA, which is below the Colorado and Montrose County thresholds and therefore would be in compliance with both standards. The noise from this activity would attenuate to background noise levels 0.12 mile from the project site. There are no residences within 0.12 mile of the study area boundary.

Area B2

During construction of the injection well, numerous pieces of heavy equipment would be used simultaneously. The loudest combination of equipment would likely be a grader (89 dBA), a compactor (83 dBA), and a dozer (82 dBA). The combined noise level from this equipment is 91 dBA, which would attenuate to Colorado's threshold 0.03 mile from the project site and there are no residences within this range of the study area boundary. The noise would attenuate to the Montrose County threshold 0.16 mile from the project site. Noise would attenuate to the 35-dBA background level at 1.65 miles from the project site, and there are no residences within 1.65 miles of the study area boundary. The noise produced during construction would exceed the standards as identified and be considered a public nuisance within those ranges.

During regular O&M, the injection pump facility would produce the greatest noise. The measured noise from the existing pumping facility is 57 dBA, which is below the Colorado and Montrose County thresholds and therefore would be in compliance with both standards. The noise from this activity would attenuate to background noise levels 0.12 mile from the project site. There are no residences within 0.12 mile of the study area boundary. The pumping stations would contain a brine pump with electric motors producing a noise level of 48 dBA, which is below Colorado and Montrose County thresholds and therefore would be in compliance with both standards. This noise would attenuate to background levels within 0.04 mile of the pump station. The pump and motor would also be located in a building which would greatly reduce these potential noise levels.

3.16.2.3 Alternative C—Evaporation Ponds

During construction of the evaporation ponds, numerous pieces of heavy equipment would be used simultaneously. The loudest combination of equipment would likely be three graders, each with an individual noise level of 89 dBA, which would produce a combined noise level of 94 dBA. It would attenuate to Colorado's threshold 0.03 mile from the project site, Montrose County's threshold 0.2 mile from the project site, and background level 2.2 miles from the project site. There are no residences within any of these ranges of the study area boundary. The noise produced during construction would exceed the standards as identified and be considered a public nuisance within those ranges.

During regular O&M, harvesting the produced salt would create the most noise because it would require a grader (89 dBA), a loader (79 dBA), and a dump truck (76 dBA). The combined noise level for this equipment would be 90 dBA. It would attenuate to Colorado's threshold 0.02 mile from the project site, Montrose County's threshold 0.15 mile from the project site, and are no residences in this range of the study area boundary. The noise produced during harvesting of the salt would exceed the standards as identified and be considered a public nuisance within those ranges. The noise from this activity would attenuate to background noise levels 1.5 miles from the project site. There is one residence 1.4 miles from the project site boundary, but hills between the house and the project site may further diminish noise levels. The project site is also next to Colorado Hwy 90, which produces noise levels of 64 dBA.

3.16.2.4 Alternative D—Zero-Liquid Discharge Technology

During construction of the ZLD facilities, numerous pieces of heavy equipment would be used simultaneously. The loudest combination of equipment would likely be a grader (89 dBA), a compactor (83 dBA), and a dozer (82 dBA). The combined noise from this equipment is 91 dBA. It would attenuate to Colorado's threshold 0.03 mile from the project site and Montrose County's threshold 0.16 mile from the project site. There are no residences within these ranges of the study area boundary. The noise produced during construction would exceed the standards as identified and be considered a public nuisance within those ranges. The noise from the construction would attenuate to the 35-dBA background levels at 1.65 miles from the project site. Several residences are in this range of the study area boundary and they would experience increased noise over background levels.

During regular O&M, the most noise would result from hauling and disposing of the produced salt, which would require a dozer, a loader, and dump trucks. The combined noise level for this equipment would be 85 dBA. It would attenuate to Colorado's threshold 0.02 mile from the project site and Montrose County's threshold ~0.09 mile from the project site, but there are no residences within these ranges of the study area boundary. The noise produced during O&M activities would exceed the standards as identified and be considered a public nuisance within those ranges. The noise from this activity would attenuate to background levels 0.95 mile from the project site, and there are several houses in this range of the study area boundary; however, they are close to Hwy 90, which generates a noise level of 64 dBA. Any noise produced by the project at these residences would be less than the current highway noise.

3.17 Artificial Light

3.17.1 Affected Environment

Light pollution is characterized as the excessive use of artificial light resulting in adverse effects to the natural or desired condition. The use of artificial outdoor lighting can result in the intrusion of artificial light into the night sky with direct and indirect effects on nearby communities and wildlife.

Due to the rural nature of the area, existing light pollution in the Paradox Valley is minimal. The area is served by a network of Federal and State highways, and county and local roads. There are no streetlights along the roadways, although intermittent light occurs from vehicle headlights. Industrial development has had direct impacts on night sky resources in the area through the proliferation of artificial lighting related to mineral production activities and various other land uses.

The existing PVU BIF is located within the narrow Dolores River canyon and near the small towns of Paradox and Bedrock. Some amount of light pollution currently exists from the facility through artificial nighttime lighting. However, the narrow river canyon walls provide a natural visual barrier, screening direct views of light associated with the facility from the town of Paradox. Light produced by the facility is visible from the community of Bedrock.

3.17.2 Impacts from Artificial Light

The primary issue identified with regard to artificial light is impacts in the surrounding communities to light-sensitive resources such as natural habitat, residential areas, and night sky quality. Project impacts are described in terms of short-term and long-term changes in the intensity and duration of artificial light. While Montrose County does not regulate the intensity of artificial light through the use of specific thresholds, the 2010 Montrose County Master Plan addresses light pollution with the stated goal of "preserv[ing] the dark sky resource of Montrose County" and the accompanying objective of "minimiz[ing] the light pollution created by new development" (Montrose County 2010). Impacts on light pollution were analyzed by comparing a qualitative description of existing light pollution in the Paradox Valley with the new light sources anticipated in each of the alternatives.

3.17.2.1 Alternative A—No Action Alternative

Lighting levels associated with operation of the PVU would diminish compared with current conditions, but security lighting would remain around the facilities.

3.17.2.2 Alternative B—Injection Well

Area B1

During the 2- to 3-year construction period, the use of artificial nighttime lighting could interfere with light-sensitive resources. Residences within the Town of Bedrock are located within approximately 3 miles of the study area boundary, and the Dolores River Canyon WSA is within 0.15 mile of the study area (see **Figure 3-2**, **Appendix B**). Direct effects would be limited somewhat by the area topography, which provides a natural screen between the light source and the Town of Bedrock. Indirect effects of artificial lighting would be present at these locations, however, from increases in overall sky glow which would result in short-term impacts on night skies. The intensity of impacts would vary depending on the design and installation of lighting, and the amount of activity and type of equipment used during the night.

During regular O&M, the injection pump facility would produce sources of artificial light. While one residence is located 1.4 miles from the study area boundary, hills between the house and the study area would impede direct sources of lighting. The study area is also located adjacent to Colorado Hwy 90, which produces intermittent sources of artificial light from vehicle headlights. While the facility would introduce a new source of artificial light on the landscape, the amount of light required for regular operations would be minimal.

Reclamation does not have standard lighting requirements for its facilities. Light features are included in the existing PVU design and would be included in the design of the proposed action based on the need to ensure employee safety and site security. The short-term and long-term impacts of artificial lighting would be minor.

Area B2

Impacts from construction and regular O&M in Area B2 would be the same as those described above for Area B1. However, the WSA is more than 3 miles from this study area, and residences in the Town of Bedrock are approximately 9 miles from the study area. Direct effects would be limited somewhat by the area topography which provides a natural screen between the light source and the Town of Bedrock. Indirect effects of artificial lighting would be present at these locations, however, from increases in overall sky glow which would result in short-term impacts on night skies. The intensity of impacts would vary depending on the design and installation of lighting, and the amount of activity and type of equipment used during the night.

3.17.2.3 Alternative C—Evaporation Ponds

During the 2- to 5-year construction period of the evaporation ponds, the use of artificial nighttime lighting could interfere with light-sensitive resources such as the WSA (see **Figure 3-2**, **Appendix B**) and residences within the Town of Bedrock. Effects of artificial lighting would be present at these locations, with increases in overall sky glow. The intensity of impacts would vary depending on the design and installation of lighting and the amount of activity and type of equipment used during the night.

During regular O&M, the facility would introduce a new source of artificial light on the landscape, but the amount of light required for regular operations would not be substantial or continuous. The short-term and long-term impacts of artificial lighting would be moderate.

3.17.2.4 Alternative D—Zero-Liquid Discharge Technology

During the 2- to 3-year construction period, the use of artificial nighttime lighting could interfere with light-sensitive resources such as the WSA (see **Figure 3-2**, **Appendix B**) and residences within the nearby Town of Bedrock. Effects of artificial lighting would be present at these locations, with increases in overall sky glow. The intensity of impacts would be minimal, however, due to the proposed location of the ZLD facilities being largely hidden from view of a large portion of the valley. Effects of artificial lighting would also vary depending on the design and installation of lighting, and the amount of activity and type of equipment used during the night.

During regular O&M, the facility would introduce a new source of artificial light on the landscape. The long-term impacts of artificial lighting would be minimal because, although the ZLD building would be large, it would be hidden from view of a large portion of the valley.

3.18 Traffic and Transportation

3.18.1 Affected Environment

The major rural collector road in Paradox Valley is Colorado Hwy 90, which extends from the Utah border to just west of Naturita, where it intersects with Colorado Hwy 141. Traffic data are available at three short-duration traffic data stations along Colorado Hwy 90, from the Colorado/Utah state line (mile marker 0) to the Colorado Hwy 90 intersection with Colorado Hwy 141 (mile marker 33.874).

Station ID 103885 is at mile marker 9.493, where the annual average daily traffic[5] (AADT) is 190 vehicles. Station ID 103886 is at mile marker 14.797 (at Bedrock, Colorado), where the AADT is 360 vehicles. Station ID 103887 is at mile marker 33.874, where the AADT is 430 vehicles. The recorded AADT counts show traffic is the lightest at the Utah border and increases with proximity to Colorado Hwy 141 and the towns of Naturita and Nucla (CDOT 2017).

A network of minor collectors and local roads provide access to Colorado Hwy 90 and are primarily maintained by Montrose County. Montrose County traffic counts indicate these roads have low use. The PVU currently employs 16 full-time employees, and about half of them regularly travel between the office building, BIF, and STF locations. The roads providing service between these facilities are Colorado Hwy 90 and County Road Y11. Available traffic counts on County Road Y11 are highly variable.

3.18.2 Impacts on Traffic and Transportation

Issues identified in relation to traffic and transportation are the changes in traffic patterns, volume, and vehicle types. Project impacts on these issues are described in terms of changes in AADT on Colorado Hwy 90 and other access roads (heavy truck traffic, delivery, and workforce traffic during construction or operation). Reclamation consulted the CDOT Online Transportation Information System for historical traffic counts on Colorado Hwy 90 (CDOT 2017). Montrose County provided traffic counts on the identified county roads (K. Laube 2017 personal communication). The design reports were used to predict future traffic volumes for each alternative.

[5] AADT is the total vehicles counted in a year, divided by 365 days. The most recent available data are from 2016.

3.18.2.1 Alternative A—No Action Alternative

After operations are discontinued, traffic around the study area would decrease compared with current conditions. The greatest relative decrease in traffic volume would occur on County Road Y11. Changes in traffic volumes on Colorado Hwy 90 would be negligible.

3.18.2.2 Alternative B—Injection Well

Area B1

Construction of the new injection well would temporarily increase traffic on Colorado Hwy 90 and possibly County Roads EE21, DD19, DD15, DD16 and DD9, due to heavy truck traffic, delivery, and workforce traffic. Trucks carrying approximately 1,200 loads, averaging less than 110,000 pounds, would require ingress and egress over 100 days during injection well drilling. The maximum load would have a semi-trailer length of 120 feet and a width of 16 feet; it would have 12 axles and weigh up to 170,000 pounds. Additionally, daily construction operations would require approximately 30 personnel. During peak construction, Reclamation anticipates 20 to 25 additional vehicle trips per day on Colorado Hwy 90. Compared with the Station ID 103886 AADT, this volume represents a temporary 7% daily increase in traffic compared with current conditions, and a larger relative increase in comparison with Alternative A.

Access to the new BIF would require 1.3 miles of new road to be constructed on Reclamation land. Operating the new well would require fewer employees than are currently required, due to automation of the facilities. The traffic generated by these employees would not change the traffic volume on area roadways from current conditions.

Accessing the top of Skein Mesa would require widening sections of County Roads DD15 and DD9 to a total width of 30 feet and installing road base along a 10-mile segment. A new 0.5-mile access road would be constructed from the county road to the well head location. During construction, all the trucks carrying loads cited above would use the identified County roads. During operation, traffic on these County roads would be minimal and occasional, based on OM&R needs, because the facilities would be automated.

Area B2

Construction of the new injection well would temporarily increase traffic on Colorado Hwy 90 and County Roads EE21, DD19, FF16 and GG15 due to heavy truck traffic, delivery, and workforce traffic. Semi-trailers, carrying 1,200 loads averaging less than 110,000 pounds, would require ingress and egress over 100 days during drilling of the injection well. The maximum load would have a semi-trailer length of 120 feet and a width of 16 feet; it would have 12 axles and weigh up to 170,000 pounds. During peak construction, Reclamation anticipates 20 to 25 additional vehicle trips per day on Colorado Hwy 90. Compared with the Station ID 103886 AADT, this volume represents a temporary 7% daily increase in traffic compared with current conditions, and a larger relative increase in comparison with Alternative A. There would be a substantial temporary increase in traffic on the County roads due to the currently low volume of traffic.

For O&M activities, traffic on County Road Y11 would remain consistent with existing conditions. The increase in traffic on Colorado Hwy 90 would be minimal, compared with the AADT. The traffic increase on County Roads EE21, DD19, FF16, and GG15 would depend on

OM&R needs and is expected to be occasional and minimal; however, the traffic impacts on the County roads would still be noticeable, as existing use on these roads is very low.

3.18.2.3 Alternative C—Evaporation Ponds

Alternative C would temporarily increase traffic on Colorado Hwy 90, due to heavy truck, delivery, and workforce traffic. Semi-trailer trucks carrying approximately 80 loads, averaging less than 110,000 pounds, would require ingress and egress over the course of the construction project. These would be concentrated primarily during mobilization and demobilization of construction. During peak construction, Reclamation anticipates 20 to 25 additional vehicle trips per day on Colorado Hwy 90. Compared with the Station ID 103886 AADT, this volume represents a temporary 7% daily increase in traffic compared with current conditions, and a larger relative increase in comparison with Alternative A. Also, County Road BB16 is in the project site and would need to be rerouted around the perimeter of the site.

All operations of the evaporation pond system, including harvesting and disposing of the salt in a landfill, would occur within the study area boundary. The amount of increased traffic on Colorado Hwy 90 would be approximately 6 vehicle trips per day. Compared with the Station ID 103886 AADT, this volume represents a 2% daily increase in traffic.

3.18.2.4 Alternative D—Zero-Liquid Discharge Technology

Construction of Alternative D would temporarily increase traffic on Colorado Hwy 90 and County Road Y11, due to heavy truck, delivery, and workforce traffic. Over the course of construction, Reclamation anticipates 15 to 20 additional vehicle trips per day on Colorado Hwy 90. Semi-trailer trucks carrying approximately 90 loads, averaging less than 110,000 pounds, would require ingress and egress over the course of the construction project, primarily for delivering the crystallizer units. Compared with the Station ID 103886 AADT, this volume represents a temporary 6% daily increase in traffic.

For O&M activities, traffic on Hwy 90 and County Road Y11 would increase slightly over existing conditions. There would be an increase of approximately 4 vehicle trips per day over existing conditions. Compared with the Station ID 103886 AADT, this volume represents a 1% daily increase in traffic compared with current conditions, and a larger relative increase in comparison with Alternative A. Most operations, including collection and disposal of the salt in a landfill, would be within the study area boundary.

3.19 Cultural Resources

3.19.1 Affected Environment

Two types of cultural resources are analyzed in this EIS: historic properties and Indian sacred sites.

3.19.1.1 Historic Properties

A Class I cultural resource overview, describing, in general, the types of known resources in the study area, has been prepared for this EIS; it is summarized below (Reed 2019). The literature search to identify known historic properties was conducted using the National Register of

Historic Places (NRHP), the Colorado SHPO online COMPASS database, GIS files of the BLM TRFO, an in-office file search at the BLM UFO, the Class I Overview of the BLM UFO (Greubel et al. 2010), and GLO plat maps. The NRHP and COMPASS database show that one site in the study area, the Dolores River Bridge, is listed on the NRHP; however, the CDOT has removed the bridge due to safety issues, and it no longer exists at its former location. The literature search indicates that there is a medium to high site density in Paradox Valley, and site density is typically higher in pinyon-juniper communities than on the valley floor.

Documented sites range from Paleo-Indian to protohistoric Ute sites and historic Euro-American and Native American sites. Previously documented prehistoric sites in Paradox Valley are open lithic scatters, open camps, open architectural, sheltered camps, sheltered lithic scatters, sheltered architectural, quarries, burials, rock shelters, rock art, and culturally scarred trees. These sites commonly contain projectile points and other lithic tools, groundstones, such as manos and metates, and less commonly, pottery. Prehistoric sites are more likely to be found in the pinyon-juniper community, on ridgetops and mesas, along cliff faces, and near water sources.

In the Class I overview of the Paradox Valley, 22 sites were listed as having rock art components:10 rock art sites have been documented, and rock art is recorded at an open architectural site, three open camps, six sheltered camps, and two sheltered lithic sites. Additionally, the BLM has draft files that it is documenting for a proposed Paradox Valley National Historic District.

Previously documented historic sites are a store, a hotel, a school, cabins, homesteads, habitations, bridges, structures, corrals, ranches, wells, campsites, trash scatters, sheep camps, graves, a transmission line, a highway, a culvert, and mines and mining-related sites. These historic sites commonly contain tin cans, glass, ceramics, wood, wire, nails, and other metal artifacts. Historic Native American sites documented in the Paradox Valley are Navajo sweat lodges and a hogan, and a traditional cultural property. In addition to the documented sites, GLO plats indicate the presence of other historic houses, wagon roads, trails, highways, and an “Old Indian Camp.” The highest probability areas for historic sites in the area are on private land, along Colorado Hwy 90 (the historic Paradox Wagon Road), and along the Dolores River. Additionally, exposures of the Morrison Formation, such as in Bull Canyon, Skein Mesa, and Fawn Spring Bench, are coded as high probability of containing historic mining sites.

3.19.1.2 Indian Sacred Sites

In conformance with Executive Order 13007, potentially affected Indian tribes were notified of the proposed project and asked to identify any known sacred sites they would like Reclamation to consider in the planning process. The Ute Mountain Ute Tribe, the Southern Ute Indian Tribe, the Ute Indian Tribe of the Uintah and Ouray Reservation, the Hopi Tribe, Navajo Nation, and the Zuni Pueblo were all contacted, and no tribe identified any sacred sites. Lack of identification early in the planning process does not guarantee that such sites do not exist, as tribes can be reluctant to share this information. Reclamation will continue to conduct tribal consultation throughout the identification and evaluation phase after a preferred alternative is chosen. Consultation is an ongoing process. If sacred sites are identified by tribes, project effects on those sites will be considered and avoided, if possible.

3.19.2 Impacts on Cultural Resources

The issue identified in terms of historic properties are adverse effects on historic properties. Project impacts on this issue are described in terms of the likelihood of historic properties being present. A Class I overview was conducted to determine the likelihood of historic properties in the study areas for the alternatives (Reed 2019).

Issues identified in terms of Indian sacred sites include changes in access or physical impacts on Indian sacred sites. Project impacts on these issues are described in terms of the presence of Indian sacred sites or access to sites. Each alternative was assessed as to whether it would block currently open roads or make previously inaccessible areas accessible. Native American Indian tribes were consulted to determine if there was sharable knowledge of sacred sites.

The potential for direct impacts on cultural resources from development, including ancillary facilities, such as access roads, transmission lines, and pipelines, is directly related to the amount of land disturbance and the location of the project.

Also considered are the indirect effects, such as impacts on the cultural landscape from induced seismicity, erosion of disturbed land surfaces, and increased human accessibility to possible site locations. Increases in human access can result in looting, vandalism, and trampling of cultural resources, and they could result from the establishment of corridors or facilities in otherwise intact and inaccessible areas.

Visual degradation of the setting associated with significant cultural resources, including rock art sites, could result from development. This could affect significant cultural resources for which visual integrity is a component of their significance, such as sacred sites and landscapes and historic trails and landscapes. Noise degradation of settings associated with significant cultural resources and sacred landscapes also could result from the presence of development; this could affect the pristine nature and peacefulness of a culturally significant location.

3.19.2.1 Alternative A—No Action Alternative

Under Alternative A, there would be no new impacts on historic properties or Indian sacred sites.

3.19.2.2 Alternative B—Injection Well

Siting and design would include measures to minimize adverse effects on cultural resources (see **Section 2.9**, “Environmental Commitments”).

Historic Properties

The land to be acquired under Alternative B is in pinyon-juniper vegetation and would have a higher density of historic properties than the open valley floor. This alternative would have the smallest footprint and would enable the easiest adjustment of facilities to avoid impacts on historic properties if they are found during Class III surveys. Induced seismicity has the potential to impact standing structures in the indirect APE. Induced seismicity from a new well would cause less potential degradation to historic properties outside of the actual construction footprint than the existing well, as induced seismicity is expected to be less with the new well. Temporary ground disturbance could occur within a 175 square mile area for a 3D seismic survey if this alternative is chosen. The seismic survey would be designed to avoid all historic properties identified during Class III surveys. The potential for adverse effects from the 3D seismic survey on cultural resources would be addressed after the Class III surveys have been completed.

Area B1
Area B1 has a medium-to-high site density, making it a concern to the BLM TRFO for the possibility of the induced seismicity to impact standing structures likely related to those sites. The smaller project footprint would make it easier to avoid impacts on historic properties.

Area B2
Area B2 has a medium-to-high site density. There is a high density of documented historic mining sites in the surrounding sections, making it a concern to the BLM TRFO for the possibility of the induced seismicity to impact standing structures likely related to those sites. The smaller project footprint would make it easier to avoid impacts on historic properties.

Indian Sacred Sites
Alternative B would not restrict access to Indian sacred sites by traditional practitioners, nor would it open new areas for access. This alternative would have the smallest footprint and would enable the easiest relocation of facilities to avoid impacts on sacred sites.

3.19.2.3 Alternative C—Evaporation Ponds
Siting and design would include measures to minimize adverse effects on cultural resources (see **Section 2.9**, “Environmental Commitments”).

Historic Properties
The location for Alternative C is in the low elevations of the valley floor, which, compared with pinyon-juniper woodland, would have the lowest density of historic properties. While the probability of historic properties in the direct effects APE is low, the large footprint of the project area would make it the most difficult to adjust if historic properties were found there. This alternative would have the largest potential visual impact on historic properties.

Alternative C would cover the largest area and includes a salt disposal landfill of 100-foot-high mounds of salt. Visual degradation of the integrity of setting and feeling associated with significant cultural sites and landscapes outside of the actual project footprint, in the indirect effects APE, could result from the presence of this proposed facility and associated land disturbances. This could affect important resources in the vicinity of this alternative, for which visual integrity is a component of their significance, such as the proposed Paradox Valley National Historic District that the BLM UFO is recommending to be listed on the NRHP.

Indian Sacred Sites
Alternative C would not restrict access to Indian sacred sites by traditional practitioners, nor would it open new areas for access. Visual degradation of settings associated with sacred sites and landscapes could result from the presence of this proposed facility and associated land disturbances. This could affect important resources for which visual integrity is a component of the sites’ significance to the affected tribes.

3.19.2.4 Alternative D—Zero-Liquid Discharge Technology

Siting and design would include measures to minimize adverse effects on cultural resources (see **Section 2.9**).

Historic Properties

The location for Alternative D is in the valley floor, and it would have a lower density of historic properties than the surrounding pinyon-juniper woodland. While the probability of historic properties in the direct effects APE is low, the footprint of the facilities would be more difficult to adjust than under Alternative B, if historic properties were found due to size of the proposed facilities. Alternative D would cover a large area and would include a salt disposal landfill of 100-foot-high mounds of salt. Visual degradation of the integrity of setting and feeling associated with historic properties in the indirect effects APE could result from the presence of this proposed facility and associated land disturbances.

Indian Sacred Sites

Alternative D would not restrict access to Indian sacred sites by traditional practitioners, but, like Alternative C, it could cause potential visual impacts on sacred sites. Visual degradation of settings associated with sacred sites and landscapes in the indirect effects APE could result from the presence of this proposed facility and associated land disturbances.

3.20 Resources Not Analyzed

Resources that are either not present within any of the study areas or those that may be present but would not be affected by any of the proposed alternatives are not analyzed in this EIS (see **Table 3-22**, "Resources not analyzed in this EIS and the exclusion justification").

Table 3-22. Resources not analyzed in this EIS and the exclusion justification

Resource	Exclusion Justification
Floodplains	No Federal Emergency Management Agency mapping or other mapping of the 100-year flood plain has been completed in the study areas.
Lands with wilderness characteristics	No lands possessing wilderness characteristics other than those within the WSA are in the study areas.
Soils	No highly sensitive soils, including erodible soils or biological soil crusts of concern, are in the study area (BLM 1985).
Population, households, and community services	There would be no change to population, households, or community services because any private property that would be acquired is uninhabited; however, other socioeconomic effects were analyzed.
Farmland and agriculture	No prime, unique, State, or locally important farmlands are in the study areas. Some study areas include prime farmland, if irrigated; however, this is located on Federal land and would not be irrigated. As a result, the Farmland Protection Act does not apply.
Indian Trust Assets	There are no Indian Trust Assets in the study areas.
Environmental Justice	No environmental justice communities are in the study areas.

This page intentionally left blank.

Chapter 4 – Cumulative Impacts and Other NEPA Considerations

4.1 Cumulative Impacts

Cumulative impacts result from the incremental impact of the alternatives when added to other past, present, or reasonably foreseeable future actions. Effects of past and present actions are reflected in the current condition of the affected environment described for each resource introduced in **Chapter 3**; these effects are incorporated into the analysis provided in that chapter. The effects of ongoing and reasonably foreseeable future actions are summarized below.

4.1.1 Methods

For the cumulative impacts assessment process, Reclamation considered the following:

- Scoping and project issues
- Cumulative impact time frames and the resources (or receptors) that could be affected by the alternatives
- The geographical area within which the impacts would occur
- Other past, present, and reasonably foreseeable future actions that have caused, or could be expected to cause, impacts on these resources, when considered with development of the alternatives

The cumulative impacts analysis does not include cumulative impacts associated with the 3D seismic survey under Alternative B. Additional site-specific NEPA analysis would be completed if Alternative B is selected in the ROD. The cumulative impacts analysis for the 3D seismic survey would be included in the future NEPA analysis. Details regarding the seismic survey area and methods are not developed enough at this point to conduct an impact analysis on the 3D seismic survey beyond those impacts disclosed in **Chapter 3**.

4.1.1.1 Geographic and Temporal Scope

The geographic scope is assessed, and is often different, for each cumulative resource topic. It is generally based on the natural boundaries of the resource affected. In several cases, the geographic scope of analysis for a resource is substantially larger than the corresponding study area for an alternative. This is so Reclamation can consider an area large enough to encompass likely effects from other nearby projects on the same resource. The geographic scope of analysis for each resource is described in **Section 4.1.1.2**, "Cumulative Impacts," below. Unless otherwise noted, the geographic scope of analysis lies in the West Paradox Creek-Dolores River and the Gypsum Valley-Dolores River hydrologic units. The hydrologic unit codes (HUCs) for these areas are HUC 1403000211 and HUC 1403000210, respectively (see **Figure 4-1**, "General Cumulative Impacts Analysis Area," **Appendix B**).

The temporal scope of analysis is the life of the project, which is 50 years.

4.1.1.2 Cumulative Actions

In general, a cumulative action is one that is past, present, or a reasonably foreseeable future action that could have a cumulatively significant impact, when combined with the actions under each alternative. For purposes of this analysis, reasonably foreseeable future actions are proposed projects or actions that have specific proposals in existence or that have begun NEPA documentation or plan review. The documents listed in **Table 4-1**, "Cumulative actions," were reviewed for occurrences of past, present, and reasonably foreseeable future actions that would be relevant to the cumulative impact analysis for the alternatives. However, only those documents that include actions that would take place within the same temporal scope and geographical area of a resource are analyzed for cumulative impacts in **Table 4-2**, "Potential for cumulative impacts on resources analyzed in this EIS." For example, the BLM's Grand Junction Field Office RMP falls within the geographical area of analysis identified for air quality, and therefore is considered in the air quality cumulative impacts analysis; however, it falls outside the geographical area of analysis for Federally listed species, and therefore is not considered in the Federally listed species cumulative impacts analysis.

Table 4-1. Cumulative actions

Action	Jurisdiction	Description	Status
Salinity Control Program	Reclamation	Aids in the implementation of salinity control measures on private agricultural lands	Ongoing program
County Master Plan	Montrose County	Master plan for county	Plan is finalized (Montrose County 2010)
Energy Fuels Piñon Ridge Uranium Mill*	CDPHE	Uranium mill	CDPHE (2011) prepared an environment impact analysis and has approved a radioactive minerals license. Montrose County has approved a special use permit, but the State of Colorado revoked the permit in 2018; however, the company has indicated it will continue to pursue the mill.
Environmental Quality Incentives Program (EQIP)	Natural Resources Conservation Service	Aids in the implementation of salinity control measures on private agricultural lands.	Ongoing program.

Action	Jurisdiction	Description	Status
Land use authorizations, including energy and minerals development, livestock grazing, off-highway vehicle use, prescribed burning, and vegetation management	BLM, National Forest Service	Existing BLM land use authorizations	Approved and in place
Moab Master Leasing Plan and RMP Amendments*	BLM Moab and Monticello Field Offices	Planning and analysis for 785,000 acres of new oil, gas, and potash leasing	Final EIS (FEIS; BLM 2016) and ROD completed
RMP	BLM Grand Junction Field Office	Management plan for field office	FEIS (BLM 2015b) and ROD completed
RMP	BLM Colorado River Valley Field Office	Management plan for field office	FEIS (BLM 2015c) and ROD completed
RMP	BLM Moab Field Office	Management plan for field office	FEIS (BLM 2008a) and ROD completed
RMP	BLM TRFO and San Juan National Forest	Management plan for field office and national forest	USFS ROD completed in 2013 (USFS 2013); BLM ROD completed in 2015 (BLM 2015a)
ACEC RMP Amendment	BLM TRFO	RMP amendment for ACEC designation in the field office	Preliminary environmental assessment completed in February 2019 (BLM 2019a)
Travel Management in BLM TRFO	BLM TRFO	Travel management planning in the field office	Preliminary environmental assessment completed in September 2019 (BLM 2019b)
Abandoned mine land closures on Bull Canyon	BLM TRFO	Closures of abandoned mine lands in the field office	Categorical Exclusion completed in July 2019 (BLM 2019c)
Habitat treatments in Dry Creek Basin	BLM TRFO	Vegetation treatments to improve wildlife habitat in Dry Creek Basin	Ongoing
ROW applications	BLM TRFO	Applications for ROWs by the Bureau of Reclamation and San Miguel Power Association	5 applications pending as of August 2019
RMP	BLM UFO	Management plan revision for field office	FEIS released June 2019 (BLM 2019d) and ROD to be completed

Action	Jurisdiction	Description	Status
RMP	BLM UFO	San Juan/San Miguel Planning Area RMP (currently governs the portion of the UFO within the PVU study areas)	ROD completed 1985 (BLM 1985)
RMP	BLM Monticello Field Office	Management plan for field office	FEIS (BLM 2008b) and ROD completed
RMP	BLM Dominguez-Escalante National Conservation Area and Dominguez Canyon Wilderness	Management plan for national conservation area and wilderness	FEIS (BLM 2017b) and ROD completed
RMP	Grand Mesa, Uncompahgre, and Gunnison National Forests	Management plan for national forests	FEIS (USFS 1991) and ROD completed
RMP	Manti-La Sal National Forest	Management plan for national forest	FEIS (USFS 1986) and ROD completed
Uranium Leasing Program*	DOE	Tracts of land approved for uranium development.	Programmatic EIS (DOE 2014) and ROD completed 2012

* Indicates this action is a reasonably foreseeable future action involving the construction of facilities.

4.2 Cumulative Impacts Analysis

This cumulative impacts analysis addresses effects that could occur from implementing a PVU alternative, combined with other reasonably foreseeable future actions. The analysis is commensurate with the best available information and data used in this EIS and on the cumulative actions documentation (**Table 4-1**). This assessment is primarily qualitative for most resources because of a lack of detailed information that would result from project-level decisions and other activities or projects. Impacts are quantified as appropriate and when supported by existing data. Where quantitative data are not available, impacts are described qualitatively.

The analysis assesses the magnitude of cumulative impacts by comparing the environment in its baseline condition with the expected impacts of the alternatives combined with other reasonably foreseeable future actions within a resource's geographical and temporal scope. The magnitude of an impact is determined through a comparison of anticipated conditions against the naturally occurring baseline, as described in the affected environment (see **Chapter 3**).

The following factors were considered in this cumulative impact assessment:

- Federal, non-Federal, and private actions
- Potential for additional, offsetting, or combining interactions between effects
- Potential for effects to cross political and administrative boundaries
- Other spatial and temporal characteristics of each affected resource

Table 4-2. Potential for cumulative impacts on resources analyzed in this EIS

Resource	Potential for Cumulative Impacts
Air quality, odors, and meteorology and climate	A 30-mile buffer around each of the study areas comprises the geographic scope of analysis for this resource (see **Figure 4-2**, "Air Quality, Odors, and Meteorology and Climate Cumulative Impacts Analysis Area," **Appendix B**). All counties within this geographic scope—Grand and San Juan Counties, Utah, and Mesa, Montrose, Ouray, San Miguel, and Dolores Counties, Colorado—are in attainment for all criteria pollutants (EPA 2019). Ongoing activities related to recreation, lands and realty actions, prescribed burning, vegetation management, transportation, and wildlife management are minor sources of air emissions, not well-defined concerning emissions factors and activity levels, or, in the case of prescribed burning, regulated by states through state smoke management programs to minimize impacts; therefore, these activities would not contribute to cumulative emissions beyond what is identified in the affected environment description in **Section 3.1**). Reasonably foreseeable future projects, such as oil and gas and uranium development (i.e., Energy Fuels Piñon Ridge Uranium Mill, Moab Master Leasing Plan and RMP Amendments, and the Uranium Leasing Program), would emit criteria pollutants, GHGs, and fugitive dust; however, none of these projects would be likely to exceed air quality standards in the cumulative effects analysis area. Most impacts would be temporary, during construction, or regulated through state air permits. If construction for multiple projects, including the PVU, were to occur at the same time, there would be a cumulative impact from fugitive dust emissions; however, this cumulative impact would be limited to the duration of construction, and the use of dust control BMPs would reduce these emissions. O&M would also result in criteria air pollutant emissions across all PVU alternatives. Other projects in Table 4-1 such as oil and gas and uranium development and agricultural use, would also contribute to these pollutants; however, the counties in the cumulative effects analysis area are expected to remain in attainment for all criteria pollutants. The primary air pollutants produced on an ongoing basis under the action alternatives for the PVU would be NOx, CO, PM10, PM2.5, fugitive dust, and GHGs. Alternative D would result in the highest criteria pollutant and GHG emissions of all the PVU alternatives, however, these emission levels would still be small enough that they would not contribute to violation of any air quality standards (Appendix E). GHG emissions would represent 0.02% of Colorado projected statewide emissions in 2020 (Arnold et al. 2014).

Resource	Potential for Cumulative Impacts
Energy demand and utility systems	The San Miguel Power Association's service area comprises the geographic scope of analysis for this resource (see **Section 3.2**, "Energy Demand and Utility Systems," and **Figure 4-3**, "Energy Demand and Utility Systems Cumulative Impacts Analysis Area," **Appendix B**). Construction and operation of the selected PVU alternative would increase energy demand and would upgrade existing utility infrastructure in the San Miguel Power Association and Xcel Energy service areas. This added demand from the selected PVU alternative, in combination with added demand from activities in **Table 4-1** that have energy or utility demands, such as uranium development (i.e., Energy Fuels Piñon Ridge Uranium Mill and the Uranium Leasing Program), would have a cumulative increased impact on energy demands in the cumulative effects area of analysis.
Geology and geologic hazards	The geographic scope of analysis for this resource is the Colorado River Basin (see **Figure 4-4**, "Geology and Geologic Hazards Cumulative Impacts Analysis Area," **Appendix B**). Induced seismicity from current PVU operations is expected to continue under any of the PVU alternatives (see **Section 3.3**, "Geology and Geologic Hazards"). Other projects, such as disposal of wastewater into deep wells following hydraulic fracturing on BLM lands, could also trigger seismicity in those areas. Determining the seismicity impacts of those other projects would be speculative, but seismic events could occur in combination with induced seismicity from Alternative B.
Surface water and water rights	The geographic scope for this resource encompasses the Dolores River and extends from the Paradox Valley to its confluence with the Colorado River and on downstream to Imperial Dam (see **Figure 4-5**, "Surface Water and Water Rights and Water Quality Cumulative Impacts Analysis Area," **Appendix B**). Actions listed in **Table 4-1,** such as oil and gas development (i.e., Energy Fuels Piñon Ridge Uranium Mill and the Uranium Leasing Program), would disrupt surface water flows in this area. Additionally, long-term climate trends are projected to increase variability in surface water flows in the Colorado River Basin, including the cumulative effects analysis area (Reclamation 2016d). While the PVU alternatives would also affect surface water flows, Reclamation has an augmentation plan to make releases from McPhee Reservoir to augment water depletions made by the PVU when the water depletions are out of priority (see **Section 3.4**). This augmentation plan would remain in place under Alternatives A, B1, and B2 and would be modified to accommodate an additional 100 gpm depletion under Alternatives C and D. In addition, Alternative D would release up to 240 gpm of freshwater back into the Dolores River. Further downstream, as described in **Section 3.6.2.2**, "Impacts Associated with Salinity in the Colorado River (All Alternatives)," additional water may be released from Lake Mead under the action alternatives to meet the salinity differential. However, because the additional amount would be so small that it may not be accounted for in the RiverWare Salinity Projection Model, it is uncertain whether these additional releases would actually occur. Due to the minimal change in flows below Lake Mead, the augmentation plans, and the potential to release additional water back into the Dolores River, implementation of any of the PVU alternatives would not contribute to a cumulative adverse impact on surface water and water rights. The return of freshwater to the Dolores River produced under Alternative D could partially offset depletions, to a minor extent, from other activities and long-term climate trends in the cumulative effects analysis area.

Resource	Potential for Cumulative Impacts
Wetlands and other waters	Implementation of the PVU alternative would have minimal impacts on streams or wetlands (see **Section 3.5**, "Wetlands and Other Waters"). Impacts on wetlands could occur from future uranium development described in **Table 4-1** (i.e., Energy Fuels Piñon Ridge Uranium Mill and the Uranium Leasing Program); however, proponents of all future actions would be required to avoid or mitigate impacts on Waters of the United States, including wetlands. Because of this, any incremental cumulative impact on wetlands and other waters as a result of future uranium development and implementing the PVU alternative would be minor.
Water quality	The geographic scope for this resource encompasses the Dolores River and extends from the Paradox Valley to its confluence with the Colorado River and on downstream to Imperial Dam (see **Figure 4-5**, **Appendix B**). The water quality parameter with the potential to be affected by the proposed project is salinity. When added to any of the PVU action alternatives, the ongoing Salinity Control Program and EQIP would be expected to cumulatively result in the decrease in salinity in the lower Colorado River. Under Alternative A, salinity would initially increase in the Lower Colorado River and would then be expected to incrementally decrease as the Salinity Control Program and EQIP continue to help implement the salinity control projects. Other influences, such as water conservation measures, could decrease the amount of salt entering the system by decreasing the amount of water that may pick up salts and transport them to the river. Conservation measures could increase the amount of water in the river, which could dilute salinity concentrations; however, conserving water in reservoirs could increase salinity concentrations. This is because water stored in reservoirs would not contribute to the in-stream dilution of salinity levels. In general, Reclamation anticipates that salinity concentrations observed at Imperial Dam would increase in drier years. In such years, there is less water to dilute the amount of salt in the system; salinity concentrations would decrease in wetter years due to increased dilution. Long-term climate trends are projected to increase year-to-year variability in precipitation and stream flow (Reclamation 2007). Under Alternative A, salinity would initially increase in the Lower Colorado River and would then be expected to incrementally decrease as the Salinity Control Program and EQIP implement new salinity control projects.

Resource	Potential for Cumulative Impacts
Vegetation	A 5-mile buffer around all study areas comprises the geographic scope of analysis for this resource (190,510 acres; see **Figure 4-6**, "Vegetation and Terrestrial and Aquatic Wildlife Cumulative Impacts Analysis Area," **Appendix B**). Within this geographic scope, the least abundant vegetation community is riparian and wetlands, which represents 0.8% of the 5-mile wide buffer area (1,668 acres). Due to its scarcity and importance to other resources, riparian and wetland vegetation is identified as the priority vegetation community. The BLM RMPs include management actions and stipulations to protect and restore riparian vegetation. Proposed uranium development areas lack riparian and wetland vegetation; therefore, there would be no incremental loss of riparian and wetland vegetation from the actions, when added to the riparian vegetation loss associated with implementation of the PVU alternatives. Ground disturbance is a known contributing factor to spreading noxious weeds; therefore, disturbance is used to determine effects on vegetation communities. The total acres of vegetation potentially disturbed by the Energy Fuels Piñon Ridge Uranium Mill site and the Uranium Leasing Program is 7,344 acres (3.9% of the 5-mile-wide buffer area). The following additive disturbances would occur under each PVU alternatives: • Alternative A—No additional acreage would be disturbed. • Alternative B (Area B1)—26 additional acres would be disturbed, resulting in 0.01% increase in cumulative disturbed surface area. • Alternative B (Area B2)— 152 additional acres would be disturbed, resulting in 0.07% increase in cumulative disturbed surface area. • Alternative C— 831 additional acres would be disturbed, resulting in 0.4% increase in cumulative disturbed surface area. • Alternative D— 183 additional acres would be disturbed, resulting in 0.1% increase in cumulative disturbed surface area. Design features, mitigation measures, and BMPs are included in all PVU alternatives (see **Section 2.9**), Energy Fuels Piñon Ridge Uranium Mill site, and Uranium Leasing Program areas to limit and prevent the spread of noxious weeds. The BLM RMPs include management actions and stipulations for integrated noxious weed control. Individual projects approved under RMPs might have short- or long-term impacts on vegetation but would be within the range of impacts considered in the plans. The incremental impacts of acres cumulatively disturbed from the future actions, when added to the acres disturbed with implementation of a PVU alternative, would result in a minor cumulative impact on vegetation.
Special status plant species	The Paradox breadroot is the only special status plant species that has known occurrences mapped within a PVU study area (Alternative D); however, there is suitable habitat for special status plant species in the PVU study areas for the alternatives (see **Section 3.5**). There are no mapped populations of the Paradox breadroot in the Energy Fuels Piñon Ridge Uranium Mill site or the Uranium Leasing Program tracts; however, the same potentially suitable habitats for special status plant species are present in these areas. Implementing a PVU alternative, the Energy Fuels Piñon Ridge Uranium Mill site and the Uranium Leasing Program would result in minor incremental degradation of potentially suitable habitat for special status plant species.

Resource	Potential for Cumulative Impacts
Terrestrial and aquatic wildlife	For big game species, the geographic scope of analysis for each species is the CPW's data analysis units for elk, mule deer, and desert bighorn sheep (see **Figure 4-7**, "Big Game Cumulative Impacts Analysis Areas," **Appendix B**). For all other terrestrial and aquatic wildlife species, the geographic scope is a 5-mile wide buffer around all study areas and proposed facilities, since beyond that point it becomes difficult to discern the effects of the alternatives (see **Figure 4-6, Appendix B**). The uranium leasing actions (i.e., Energy Fuels Piñon Ridge Uranium Mill and the Uranium Leasing Program) would affect wildlife in a similar manner as the PVU alternatives (see **Section 3.9**). These projects could potentially result in the additional loss of 163 acres (0.3%) of desert bighorn production area; 7,187 acres (1%) of elk severe winter range; and 3,658 acres (0.8%) of mule deer severe winter range. In addition, they could result in the loss of 820 acres of elk winter concentration and 12 acres of mule deer winter concentration areas. Cumulative impacts on scarce habitats such as riparian and wetland habitats are disclosed under the vegetation cumulative impacts analysis. The Energy Fuels Piñon Ridge Uranium Mill would include the creation of 130 acres of nuisance habitat from tailing and evaporation ponds. While these ponds would be netted and/or designed with other mitigation measures to prevent access by migratory birds and other wildlife, the risk of injury or mortality exists, and these impacts would be additive to the impacts disclosed in **Section 3.9**. The land use authorization plans and RMPs include standards and guidelines to protect wildlife species and habitat across their range. Individual projects approved under these plans may have short- or long-term impacts on wildlife but would be within the range of impacts considered in the plans, particularly BLM RMPs. Therefore, the incremental impacts on wildlife resulting from the projects listed in **Table 4-1**, and the other existing activities, when added to the wildlife impacts associated with implementation of a PVU alternative, would result in a minor cumulative impact on migratory birds, big game, and other wildlife in the cumulative impacts analysis area.
Federally listed species	The geographic scope for this resource encompasses the mapped critical habitat for the Gunnison Sage-Grouse San Miguel Basin population (see **Figure 4-8**, "Federally Listed Species Cumulative Impacts Analysis Area," **Appendix B**). Past actions have led to the status of the Gunnison sage-grouse as threatened throughout its range (see **Section 3.10**, "Federally Listed Species"). Up to 100 acres of critical habitat would be temporarily affected (Alternative B). Restoring and revegetating critical habitat would avoid fragmentation and loss. The Uranium Leasing Program tracts and the Energy Fuels Piñon Ridge Uranium Mill site are outside of critical habitat. The BLM TRFO has a 5-year project that started in 2017 to improve 763 acres of critical habitat by removing pinyon and juniper trees. The PVU alternatives, when considered in combination with the actions listed above, would not change the status of the Gunnison sage-grouse or have cumulative effects on habitat for these birds.

Resource	Potential for Cumulative Impacts
Land acquisition and land use	The HUC boundary geographic area contains 64,011 acres of BLM-administered lands designated for multiple uses (see **Section 3.11** and **Figure 4-1**, **Appendix B**). With implementation of the PVU alternative, up to 1,530 acres of BLM-administered land (approximately 2.4% of the acreage of BLM-administered land within the HUC boundary) would be withdrawn to Reclamation and would no longer be available for multiple uses. The Energy Fuels Piñon Ridge Uranium Mill project area is on private lands. The Uranium Leasing Program tracts are expected to have minor impacts on public land use; this is because the areas would remain open for limited multiple use, such as ROW authorizations and oil and gas leasing. Due to the small percentage of BLM-administered land (up to 2.4% of geographic area of analysis) that would experience a loss in public use, cumulative impacts from the actions on BLM-administered land would result in a negligible change in Federal land management. No other actions involve the transfer of non-Federal lands to Federal ownership. All actions would fall within the desired future land use, as outlined in the Montrose County Master Plan; therefore, there would be no cumulative impacts on non-Federal lands.
Visual resources	Impacts would result from surface disturbance caused by the cumulative projects listed in **Table 4-1**. If aboveground facilities associated with projects in **Table 4-1** are visible from the project area, they would contribute to changes in the visual landscape, in combination with any of the PVU action alternatives. Projects in **Table 4-1** with aboveground facilities would include the uranium leasing actions (i.e., Energy Fuels Piñon Ridge Uranium Mill and the Uranium Leasing Program), oil and gas developments, or surface disturbance caused by travel and transportation. Of the PVU alternatives, Alternative C would have the greatest incremental contribution to cumulative impacts on the visual character of the landscape in combination with the projects in **Table 4-1**. Where visual resource management classes are retained, cumulative impacts on visual resources are expected to remain within the range of impacts described by the BLM RMPs. However, if an RMP amendment modifies the management class to allow for increased impacts to visual resources, a larger cumulative impact could occur.
Areas of Special Designation – Wild and Scenic Rivers	The Dolores River, from the BLM UFO boundary to the confluence with the San Miguel River, comprises the geographic scope of analysis for this resource (see **Figure 4-9**, “Areas of Special Designation – WSRs Cumulative Impacts Analysis Area,” **Appendix B**). Implementation of any the PVU action alternatives would have minor negative impacts on the scenic ORVs and would improve water quality. These impacts would not result in changes to the eligible river segments’ tentative classification (see **Section 3.13.1.1**, “Affected Environment, WSRs”). The BLM manages these segments to retain their wild and scenic suitability; therefore, implementing the PVU alternatives, when considered in combination with other actions, would not have an additive effect on the suitability of the WSR segments.

Resource	Potential for Cumulative Impacts
Areas of Special Designation – Wilderness Study Areas	The Dolores River Canyon WSA comprises the geographic scope of analysis for this resource (see **Figure 4-10**, “Areas of Special Designation – WSAs Cumulative Impacts Analysis Area,” **Appendix B**,). Implementing the PVU alternatives would not affect the wilderness characteristics or cause undue degradation that would impair the area’s suitability for preservation as wilderness (see **Section 3.13.1.2**, “Affected Environment, Wilderness and WSAs”). The BLM manages this area to retain its wilderness characteristics until Congress determines otherwise; therefore, implementing the PVU alternatives, when considered in combination with other actions, would not have an additive effect that would prevent the area from being preserved as wilderness.
Solid waste, hazardous substances, and environmental media	Under the PVU alternatives, there would be no generation or release of solid wastes or hazardous substances (see **Section 3.14**, “Solid Waste, Hazardous Substances, and Environmental Media”); therefore, there would be no incremental cumulative impacts from the generation of solid wastes or hazardous substances under the PVU alternatives. Salt is considered an environmental media; because none of the projects listed in **Table 4-1**, would generate an environmental media, no other effects would contribute to the direct and indirect effects of salt generation from Alternatives C and D discussed in **Chapter 3**.
Socioeconomics	Impacts would occur from changes to local economic conditions caused by the cumulative projects listed in **Table 4-1**. With regard to economy and employment, reasonably foreseeable future activities such as the construction of facilities under the Uranium Leasing Program and the Energy Fuels Piñon Ridge Uranium Mill would generate workforce employment that would be cumulatively considerable. These impacts would be beneficial as a result of contributions to local employment from future uranium development. The PVU action alternatives would add to these beneficial impacts by creating additional employment and economic activity. The implementation of salinity control measures on private agricultural lands through the Reclamation Salinity Control Program and the NRCS Environmental Quality Incentives Program would result in cumulative decreases in economic damages associated with salinity levels through protection of infrastructure and crop production in the Colorado River Basin. When combined with these salinity control measures, cumulative beneficial impacts would accrue from controlling salt at the PVU under the action alternatives, resulting in reductions of economic damages associated with salinity levels. The PVU would not add to these benefits under Alternative A. The anticipated closure of abandoned mine lands in Bull Canyon, as well as the implementation of salinity control measures on private agricultural lands, could also result in increases to local property values. While the incremental cumulative contribution to local property values and property taxes would be minor, beneficial cumulative impacts would occur when these effects are considered in combination with changes to property values, property taxes, and payments in lieu of taxes resulting from the PVU action alternatives.

Resource	Potential for Cumulative Impacts
Noise	The noise attenuation distances to background levels of 35 dBA are described in **Section 3.16**. These distances range from 1.65 to 10 miles, depending on the alternative, and comprise the geographic scope of analysis for this resource (see **Figure 4-11**, “Noise Cumulative Impacts Analysis Area,” **Appendix B**). Construction noise may incrementally add to the noise produced by the Energy Fuels Piñon Ridge Uranium Mill and Uranium Leasing Program. After construction, noise produced during operation and maintenance of the PVU alternatives would attenuate to below Montrose County noise thresholds in less than 0.15 mile from the Alternatives B and C study areas and in approximately 1.65 miles from the Alternative D study area. There are no reasonably foreseeable future actions within the O&M attenuation distances that would contribute to the noise produced by the PVU alternatives; therefore, there would be no cumulative impacts on noise due to operation and maintenance of a PVU alternative.
Artificial light	Incremental cumulative contributions to impacts from artificial lighting would result from surface disturbance caused by the projects listed in **Table 4-1**. These include reasonably foreseeable oil and gas development and projected increases in light produced by travel and transportation corridors such as minor increase in traffic on Colorado Hwy 90 and a potential for major increases in traffic on EE21, DD19, and GG15 Roads. All PVU action alternatives would include changes to the existing character of the landscape with respect to sources of artificial light that would contribute to cumulative impacts on artificial light in combination with the projects in **Table 4-1.**
Traffic and transportation	The segments of Colorado Hwy 90, and Montrose County Roads Y11, EE21, DD19, and GG15 within the HUC boundaries comprise the geographic scope of analysis for this resource (see **Figure 4-1**, **Appendix B**). Implementation of the PVU alternatives would result in a minor increase in traffic on Colorado Hwy 90 under all action alternatives. There would be a minor increase in traffic on County Road Y11 under Alternatives C and D and moderate increases in traffic on EE21, DD19, GG15 Roads under Alternative B, Area B2 (see **Section 3.17**, “Traffic and Transportation”). Implementation of the uranium leasing actions would result in minor increases in traffic on Colorado Hwy 90. There is a potential for major increases in traffic on EE21, DD19, and GG15 Roads if those roads were used to enter the Monogram Mesa Uranium Leasing Program tracts. It is unknown to what extent the uranium leasing actions (i.e., Energy Fuels Piñon Ridge Uranium Mill and the Uranium Leasing Program) would change use of County Road Y11. Cumulatively, there would be a minor increase in traffic on Colorado Hwy 90 and a potential for major increases in in traffic on EE21, DD19, and GG15 Roads.
Cultural resources	A 2-mile buffer around the PVU alternatives study areas comprises the geographic scope of analysis for this resource (see **Figure 4-12**, “Cultural Resources Cumulative Impacts Analysis Area,” **Appendix B**). Past and present land uses, such as uranium development, and existing BLM land use authorizations, such as mineral development and livestock grazing, are expected to continue. The potential PVU impacts described above, including the visual impacts on sites, would add to the adverse impacts caused by all other reasonably foreseeable future cumulative impacts on cultural resources. These impacts cannot be quantified using available information.

4.3 Adverse Environmental Effects that Cannot be Avoided

Unavoidable adverse effects would result from implementing the action alternatives and Alternative A.

Under all alternatives, seismicity resulting from operation of the existing injection would continue to expand geographically until several years after injection is halted, when the number of events per year is expected to gradually decline. Under Alternative B, induced seismic events are possible in the area surrounding the new well, as further described in **Section 3.3.2.2**.

Unavoidable adverse impacts occurring during construction of the action alternatives would vary with the footprint of the disturbed area; there would be impacts on visual resources, some loss of recreational opportunities, increased traffic, increased air emissions and noise, wildlife habitat and vegetation loss, small mammal and reptile mortality, and localized impacts on land.

O&M could generate unavoidable adverse impacts similar to those occurring during construction. Unavoidable long-term impacts would include some visual contrast effects due to proposed facilities, with the visual contrast of the evaporation ponds and associated landfill rated as strong. Unavoidable long-term impacts also would include seismicity, wildlife injury and mortality, loss of grazing lands, minimal loss of recreational opportunities, increased energy demands, impacts on areas of special designation, increases in noise, and changes to socioeconomics. BLM-administered lands would be transferred from multi-use to single use. Adverse impacts would be minimized to the extent practicable by implementing avoidance measures and BMPs that are applicable to all action alternatives. Impacts on resources not specifically mentioned in **Table 2-9** could be mitigated by environmental commitments for other resources.

4.4 Irreversible and Irretrievable Commitment of Resources

An irreversible and irretrievable resource commitment refers to impacts on or losses of resources that cannot be recovered or reversed. Implementing an action alternative would involve a commitment of natural, physical, and socioeconomic resources. Land used in construction and operation of an alternative is considered an irreversible commitment while the land is being used for salinity control. If, however, the land is no longer needed for project purposes, it could be converted to another use. Induced seismicity would be an irreversible effect lasting beyond the life of the current PVU project under all alternatives. This effect may be exacerbated by additional induced seismicity under Alternative B. The salt landfills proposed under Alternatives C and D would be an irreversible commitment of the land that would change the topography and landscape and extend beyond the life of the project.

Fossil fuels, labor, Federal funds, State resources, and construction materials, such as steel and cement, would be used to build facilities. Labor and fossil fuels also would be used on an ongoing basis for O&M of the facilities. Labor, materials, and fossil fuels are irretrievable resources; however, they are in abundant supply, and their use would not have an adverse impact on future availability of these resources.

The irreversible and irretrievable commitment of these resources is offset by the benefits associated with the proposed Colorado River Basin Salinity Control Project. These benefits include the collection and disposal of saline groundwater in Paradox Valley that would otherwise enter the Dolores and Colorado Rivers. This would enhance and protect the quality of water available in the Colorado River for use in the United States and the Republic of Mexico. The benefits also include continued compliance with Title II, Section 202(a)(1) of the Colorado River Basin Salinity Control Act.

4.5 Short-Term Uses of the Human Environment and the Maintenance and Enhancement of Long-Term Uses

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 1502.16). Short-term refers to the temporary phase of construction of the PVU, while long-term refers to the operational life of the PVU and beyond. Short-term uses related to implementation of the action alternatives would include construction that would result in short-term impacts, such as increased noise, traffic delays, or detours. Air quality would be worse during construction. These temporary environmental impacts would be balanced through avoidance and minimization measures as much as possible.

Short-term impacts would result from the short-term surface disturbance, use of construction equipment and materials, generation of noise, increase in traffic, and increase in fugitive dust.

Short-term benefits would result from increased employment (construction jobs) and revenue generated during construction.

Long-term impacts would result from permanent loss of wildlife habitat, displacement of wildlife, loss of grazing AUMs, visual impacts, and land going from multi-use to single-use.

Long-term benefits would result from continued contribution toward maintaining acceptable levels of salinity concentrations in the Colorado River and continued employment for O&M jobs.

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, Indian tribes, and the public in preparing this DEIS. The NOI to prepare this EIS was published in the *Federal Register* on September 10, 2012 (77 FR 175). Since then, Reclamation has solicited input from a broad range of constituencies as part of the ongoing public involvement process.

Reclamation sought comments and involvement during the planning and preparation of this DEIS through the following actions, inviting input from the general public:

- Communication and consultation with a variety of Federal, State, and local agencies, Native American Indian tribes, and interest groups, including cooperating agencies
- The formal EIS scoping process
- PVU EIS project website

5.2 Public Outreach and Involvement

The public has specific opportunities to comment during three phases:

- Public scoping began with publication of an NOI to prepare the EIS in the *Federal Register* on September 10, 2012 and ended on November 26, 2012
- Public review of and comment on this DEIS
- Public review of the FEIS

Reclamation held three public meetings during the scoping period. The purpose of the meetings was to provide the public with opportunities to become involved, to learn about the PVU project and planning process, and to offer comments. Public input received during the scoping period is summarized in two scoping reports (Reclamation 2013, 2016a) available on the PVU EIS website (https://www.usbr.gov/uc/progact/paradox/index.html). These scoping reports provide additional details on the outcomes of public scoping, project development, and analysis of alternatives (Reclamation 2013, 2016a).

5.3 Cooperating Agency Involvement

The following 18 agencies are cooperating agencies for this EIS:

Federal:

- BLM
- USACE
- EPA
- USFWS
- USGS

State:

- Arizona Department of Water Resources
- Colorado Department of Natural Resources
- CDPHE
- Colorado River Board of California
- Colorado River Commission of Nevada
- New Mexico Interstate Stream Commission
- Utah Department of Environmental Quality
- Wyoming Department of Environmental Quality
- Wyoming State Engineer's Office

Quasi-State and Local:

- Montrose County, Colorado
- Colorado River Water Conservation District
- Southern Nevada Water Authority
- Southwestern Water Conservation District

Cooperating agencies provide information, expertise, and review of working documents. Reclamation hosted periodic cooperating agency meetings throughout the preparation of this DEIS to ensure that all the agencies were informed of and involved in the issues and analyses. Reclamation also held site visits in Paradox Valley with the cooperating agencies, as well as additional coordination meetings with the BLM, USFWS, USACE, and CDPHE. All cooperating agencies have reviewed and commented on this DEIS.

5.4 Tribal Coordination

In 2018, Reclamation sent letters to Native American Indian tribes that could have an interest in the project. It invited the tribes to meet with Reclamation to discuss the identification of properties of religious or cultural significance that could be affected by the project. Letters were sent to the Hopi Tribe, the Southern Ute Indian Tribe, the Ute Indian Tribe, the Ute Mountain Ute Tribe, and Zuni Pueblo. All five tribes indicated an interest in being involved with the project as it progresses. In 2019, based on the Class I overview results, Navajo Nation was also identified as a potential interested tribe.

In 2019, Reclamation invited these same tribes to participate in the development of the Programmatic Agreement and the Native American Graves Protection and Repatriation Act of 1990 Plan of Action developed for the project. Reclamation will continue to involve the tribes and to coordinate and consult with them after a preferred alternative is identified.

5.5 Other Consultation and Coordination

After a preferred alternative is identified in the ROD, Reclamation will further coordinate and consult with the USFWS to comply with Section 7 of the Endangered Species Act, with the USACE to comply with Section 404 of the CWA, and with the Colorado SHPO to comply with the NHPA (see **Table 2-6**).

This page intentionally left blank.

Chapter 6 – List of Preparers

Reclamation, Upper Colorado Region, Western Colorado Area Office (WCAO) in Grand Junction, Colorado, prepared this DEIS. It had assistance from the following:

- Reclamation's Upper Colorado Regional Office in Salt Lake City, Utah
- Technical Service Center (TSC) in Denver, Colorado
- Paradox Facility Office in Bedrock, Colorado
- Western Colorado Area Office in Durango, Colorado
- Environmental Management and Planning Solutions, Inc. (EMPSi) in Boulder, Colorado

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.

Name	Position	Office	EIS Responsibility
Reclamation			
Nancy Coulam	Environmental Compliance Officer (retired)	Upper Colorado Region	Paradox EIS Upper Colorado Region lead, socioeconomic resources team lead, general EIS documentation, mining, solid waste, hazardous waste, and environmental media, environmental justice, cumulative impacts
Lesley McWhirter	Environmental and Planning Group Chief	WCAO	Paradox EIS team lead, biological resources team lead, general EIS documentation, wetlands and other waters
Frederick Busch	Civil Engineer	WCAO	Lead for alternatives studies, physical resources team lead, surface water and water rights, solid waste, hazardous waste, and environmental media, economy and employment, costs and cost effectiveness, noise, traffic and transportation
Jenny Ward	Environmental Protection Specialist	WCAO	General EIS documentation, air quality and odors, water quality, mining, grazing, BLM land and management transfers, private lands and uses, visual resources, solid waste, hazardous waste, and environmental media, property values, property taxes, cumulative impacts

Name	Position	Office	EIS Responsibility
Amanda Ewing	Biologist	WCAO	Vegetation, special status plant species, terrestrial and aquatic wildlife, Federally listed species, areas of special designation, recreation
Andy Nicholas	Facility Operations Specialist	Paradox Facility Office-Bedrock	Energy demand and utility systems, noise
Bob Norman	Civil Engineer	WCAO	Energy demand and utility systems, economy and employment, costs and cost effectiveness
John Sottilare	Hydrologist (former)	WCAO	Water resources, water quality
Kristin Bowen	Lead Archaeologist	WCAO-Durango	Cultural resources, tribal coordination
Christopher K. Wood	Geophysicist	TSC	Injection well geotechnical investigations, geology and geologic hazards
Francisco Hernandez	Geographic Information System Specialist	WCAO	Map developer, visual resource viewshed analysis
Teri Manross	Technical Editor	TSC	EIS formatting and technical editing
Sharon Leffel	Technical Editor	TSC	EIS formatting and technical editing
Consultant Preparers			
Katie Patterson	Project Manager	EMPSi	Project manager
Molly McCarter Good	Assistant Project Manager	EMPSi	Assistant project manager and public involvement lead
Alexis Kantor	Project Planner	EMPSi	Project planner and decision file specialist
Becky Boyle	Project Planner	EMPSi	Project planner
Cindy Schad	Word Processor	EMPSi	Formatting
Josh Schnabel	Air Quality and Light Pollution Specialist	EMPSi	Assistance with air quality and light pollution analysis
Randolph Varney	Technical Writer-Editor	EMPSi	Technical editing

Index

This page intentionally blank.