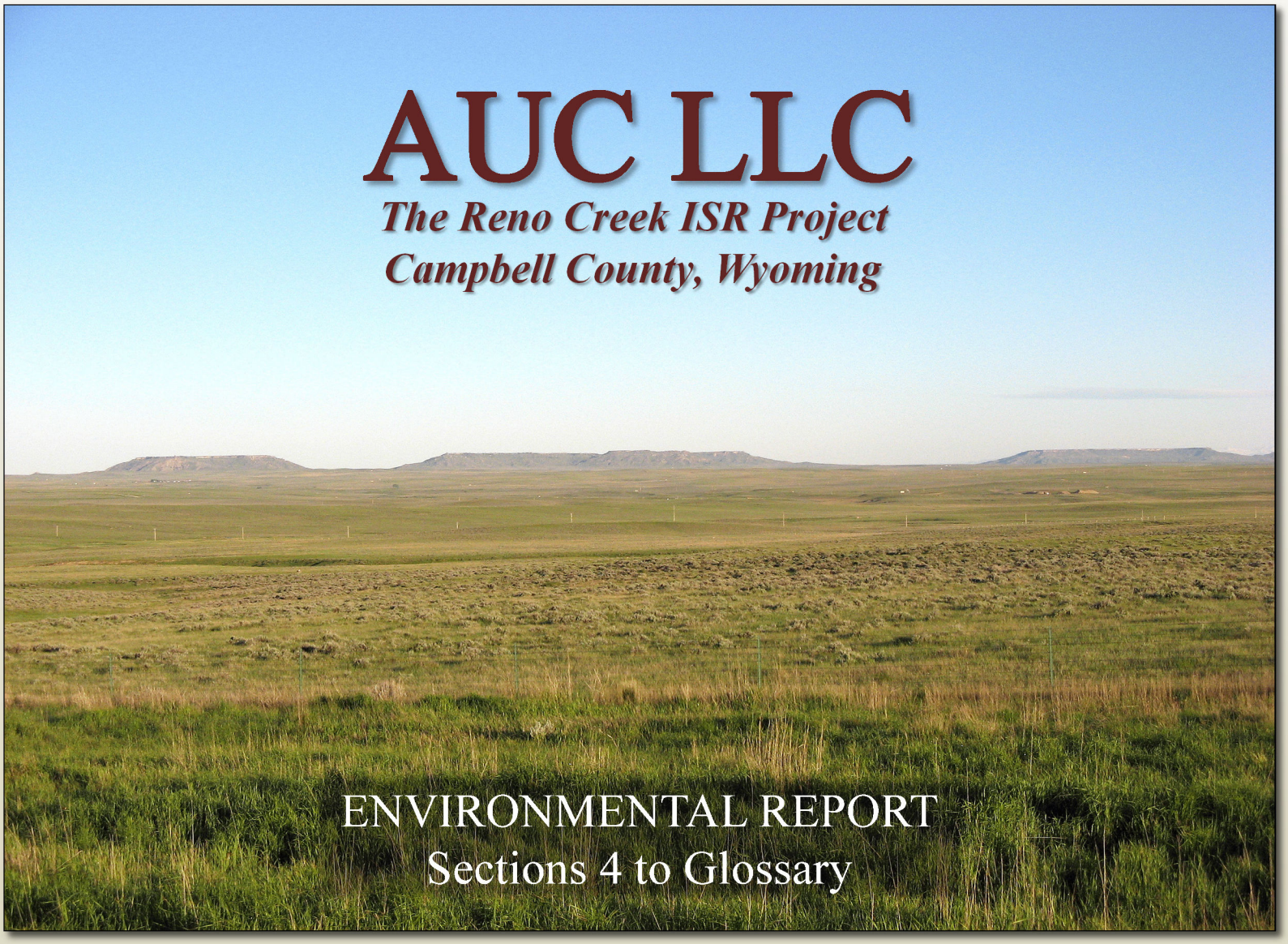
USNRC APPLICATION

Combined Source and 11e.(2) Byproduct Material License



September 2012

AUC LLC
1536 Cole Blvd., Suite 330
Lakewood, Colorado 80401

TABLE OF CONTENTS

ENVIRONMENTAL REPORT

SECTION 1 – INTRODUCTION

1 INTRODUCTION 1-1
1.1 Purpose and Need for the Proposed Action 1-2
1.2 The Proposed Action 1-3
1.2.1 Background 1-3
1.2.2 Corporate Entities Involved 1-5
1.2.3 Description of the Proposed Action 1-5
1.2.4 Proposed Reno Creek ISR Project Ore Body 1-7
1.2.5 ISR Production Unit Production Units 1-8
1.3 Proposed Schedule 1-15
1.4 Central Processing Plant, Chemical Storage Facilities, Equipment Used, and Materials Processed 1-17
1.4.1 Central Processing Plant Design and Equipment 1-18
1.4.2 Ion Exchange Circuit 1-18
1.4.3 Elution Circuit 1-19
1.4.4 Precipitation Circuit 1-19
1.4.5 Yellowcake De-Watering/Drying/Packaging Circuit 1-19
1.4.6 Yellowcake Storage/Shipment 1-21
1.4.7 Groundwater Restoration Circuit 1-22
1.4.8 Chemical Storage Facilities 1-22
1.4.9 Byproduct Material Management 1-25
1.5 Instrumentation and Control 1-29
1.5.1 Wellfield Operations/Ion Exchange Circuit 1-29
1.5.2 Process Areas 1-30
1.5.3 Yellowcake Drying System 1-31
1.6 Applicable Regulatory Requirements, Permits, and Required Consultations ... 1-31
1.7 Financial Assurance 1-31

SECTION 2 - ALTERNATIVES

2 ALTERNATIVES 2-1
2.1 Description of Alternatives 2-1
2.1.1 No-Action Alternative 2-1
2.1.2 Proposed Action 2-2
2.1.3 Reasonable Alternatives Considered But Rejected 2-3

TABLE OF CONTENTS (CONTINUED)

2.1.4 Central Processing Plant versus Satellite Facilities 2-5
2.1.5 Lixiviant Chemistry 2-6
2.1.6 Groundwater Restoration 2-8
2.1.7 Alternate 11e.(2) Byproduct Management Options 2-8
2.1.8 Uranium Processing Alternatives 2-11
2.1.9 Comparison of the Predicted Environmental Impacts 2-12

SECTION 3 – DESCRIPTION OF THE AFFECTED ENVIRONMENT

3 DESCRIPTION OF THE AFFECTED ENVIRONMENT
3.1 Land Use 3.1-1
3.1.1 General Setting 3.1-2
3.1.2 Land Use Classification 3.1-2
3.1.3 Aesthetics 3.1-3
3.1.4 Agriculture 3.1-3
3.1.5 Residences 3.1-3
3.1.6 Transportation and Utilities 3.1-4
3.1.7 Recreation 3.1-5
3.1.8 Mineral Resources 3.1-6
3.2 Transportation 3.2-1
3.2.1 Highways and Local Roads 3.2-1
3.2.2 Traffic 3.2-2
3.2.3 Railroads 3.2-3
3.3 Geology 3.3-1
3.3.1 Regional Geology 3.3-1
3.3.2 Site Geology 3.3-5
3.3.3 Drill Holes 3.3-18
3.3.4 Soils 3.3-20
3.3.5 Seismology 3.3-25
3.4 Water Resources 3.4-1
3.4.1 Surface Water Hydrology 3.4-2
3.4.2 Groundwater 3.4-17
3.5 Ecological Resources 3.5-1
3.5.1 Introduction 3.5-1
3.5.2 Regional Setting 3.5-1
3.5.3 Climate 3.5-2
3.5.4 Terrestrial Ecology 3.5-3
3.6 Meteorology, Climatology and Air Quality 3.6-1
3.6.1 Introduction 3.6-1

TABLE OF CONTENTS (CONTINUED)

3.6.2 Regional Overview 3.6-4
3.6.3 Site Specific Analysis 3.6-8
3.6.4 Air Quality 3.6-15
3.7 Noise 3.7-1
3.7.1 Affected Environment 3.7-1
3.8 Historic and Cultural Resources 3.8-1
3.8.1 Regional/Site History 3.8-1
3.8.2 Cultural Resources Survey 3.8-5
3.8.3 Paleontological Resources 3.8-6
3.8.4 Tribal Consultation 3.8-7
3.9 Visual and Scenic Resources 3.9-1
3.9.1 Methods 3.9-1
3.10 Socioeconomics 3.10-1
3.10.1 Population 3.10-1
3.10.2 Demography 3.10-3
3.10.3 Local Socioeconomic Baseline Conditions 3.10-4
3.10.4 Environmental Justice 3.10-9
3.11 Public and Occupational Health 3.11-1
3.11.1 Background Radiological Conditions 3.11-1
3.11.2 Current and Historical Sources, and Levels of Exposure to Radioactive Materials 3.11-3
3.11.3 Major Sources and Levels of Chemical Exposure 3.11-3
3.11.4 Occupational Health and Safety 3.11-4
3.11.5 Summary of Health Effects Studies 3.11-5
3.12 Waste Management 3.12-1
3.12.1 Liquid Non-11e.(2) Byproduct Material 3.12-2
3.12.2 Solid Non-11e.(2) Byproduct Material 3.12-4

SECTION 4 – POTENTIAL ENVIRONMENTAL IMPACTS

4 POTENTIAL ENVIRONMENTAL IMPACTS 4-1
4.1 Potential Land Use Impacts 4-1
4.1.1 Proposed Action 4-2
4.1.2 No Action Alternative 4-9
4.2 Potential Transportation Impacts 4-11
4.2.1 Proposed Action 4-11
4.2.2 No Action Alternative 4-18
4.3 Potential Geology and Soil Impacts 4-26
4.3.1 Proposed Action 4-26

TABLE OF CONTENTS (CONTINUED)

4.3.2 No Action Alternative 4-30
4.4 Potential Water Resources Impacts 4-31
4.4.1 Potential Surface Water Impacts 4-31
4.4.2 Potential Groundwater Impacts 4-34
4.5 Potential Ecological Resource Impacts 4-45
4.5.1 Proposed Action 4-45
4.5.2 Potential Construction Impacts to Ecological Resources 4-45
4.5.3 Potential Operations Impacts to Ecological Resources 4-58
4.5.4 Potential Groundwater Restoration Impacts to Ecological Resources 4-59
4.5.5 Potential Decommissioning Impacts to Ecological Resources 4-59
4.5.6 No Action Alternative 4-59
4.6 Potential Air Quality Impacts 4-60
4.6.1 Proposed Action 4-60
4.7 Potential Noise Impacts 4-73
4.7.1 Proposed Action 4-73
4.7.2 No Action Alternative 4-76
4.8 Potential Historic and Cultural Resources Impacts 4-77
4.8.1 Proposed Action 4-77
4.8.2 No Action Alternative 4-80
4.9 Potential Visual and Scenic Resources Impacts 4-81
4.9.1 Proposed Action 4-81
4.9.2 No Action Alternative 4-84
4.10 Potential Socioeconomic Impacts 4-85
4.10.1 Proposed Action 4-85
4.10.2 No Action Alternative 4-90
4.11 Environmental Justice 4-91
4.12 Potential Public and Occupational Health Impacts 4-92
4.12.1 Proposed Action 4-92
4.12.2 No Action Alternative 4-111
4.13 Potential Byproduct Management Impacts 4-114
4.13.1 Proposed Action 4-114
4.13.2 No Action Alternative 4-128

SECTION 5 – CUMULATIVE IMPACTS

5 CUMULATIVE IMPACTS 5-1
5.1 Introduction 5-1
5.1.1 Other Past, Present, and Reasonably Foreseeable Future Actions 5-2
5.2 Land Use 5-7

TABLE OF CONTENTS (CONTINUED)

5.3 Transportation 5-7
5.4 Air Quality 5-9
5.5 Geology and Soils 5-13
5.6 Water Resources 5-14
5.6.1 Surface Waters and Wetlands 5-14
5.6.2 Groundwater 5-15
5.7 Ecological Resources 5-17
5.7.1 Terrestrial Ecology 5-17
5.7.2 Aquatic Ecology 5-17
5.7.3 Threatened and Endangered Species 5-18
5.8 Noise 5-19
5.9 Historical and Cultural Resources 5-20
5.10 Visual and Scenic Resources 5-21
5.11 Socioeconomics 5-22
5.12 Environmental Justice 5-23
5.13 Public and Occupational Health and Safety 5-23
5.14 Byproduct Material Management 5-24

SECTION 6 - MITIGATION MEASURES

6 MITIGATION MEASURES 6-1
6.1 Mitigation of Potential Land Use Impacts 6-1
6.1.1 Mitigation of Potential Construction Impacts 6-1
6.1.2 Mitigation of Potential Operation and Groundwater Restoration Impacts 6-4
6.1.3 Mitigation of Potential Decommissioning Impacts 6-4
6.2 Mitigation of Potential Transportation Impacts 6-9
6.2.1 Mitigation of Potential Access Road Construction Impacts 6-9
6.2.2 Mitigation of Potential Traffic Impacts 6-12
6.2.3 Mitigation of Potential Accidents during Material Transport 6-13
6.3 Mitigation of Potential Geology and Soils Impacts 6-16
6.3.1 Mitigation of Potential Geologic Impacts 6-16
6.3.2 Mitigation of Potential Soil Impacts 6-16
6.4 Mitigation of Potential Water Resources Impacts 6-21
6.4.1 Mitigation of Potential Surface Water Impacts 6-21
6.4.2 Mitigation of Potential Groundwater Impacts 6-25
6.5 Mitigation Measures for Potential Ecological Resources Impacts 6-34
6.5.1 Vegetation 6-34
6.5.2 Wildlife and Fisheries 6-35
6.6 Mitigation of Potential Air Quality Impacts 6-37

TABLE OF CONTENTS (CONTINUED)

6.7 Mitigation of Potential Noise Impacts 6-39
6.8 Mitigation of Potential Historic and Cultural Resources Impacts 6-40
6.9 Mitigation of Potential Visual and Scenic Resources Impacts 6-41
6.10 Mitigation Measures for Potential Public and Occupational Health Impacts 6-42
6.10.1 Mitigation of Potential Construction Impacts 6-42
6.10.2 Mitigation of Potential Operation Impacts 6-42
6.10.3 Mitigation of Potential Groundwater Restoration Impacts 6-44
6.11 Mitigation of Potential Byproduct Management Impacts 6-45

SECTION 7 – ENVIRONMENTAL MEASUREMENTS AND MONITORING

7 ENVIRONMENTAL MEASUREMENTS AND MONITORING 7-1
7.1 Radiological Monitoring 7-1
7.1.1 Radiation Monitoring 7-2
7.1.2 External Radiation Exposure Monitoring 7-3
7.1.3 Soil and Sediment Sampling 7-3
7.1.4 Vegetation, Food, and Fish Monitoring 7-4
7.1.5 Water Resource Monitoring 7-4
7.2 Physiochemical Monitoring 7-6
7.2.1 Physiochemical Groundwater Monitoring 7-6
7.2.2 Wellfield Hydrologic Data Package 7-8
7.2.3 Wellfield and Pipeline Flow and Pressure Monitoring 7-12
7.2.4 Backup Pond Leak Detection Monitoring 7-12
7.2.5 Meteorological Monitoring 7-13
7.3 Ecological Monitoring 7-13
7.3.1 Vegetation, Food and Fish 7-13
7.3.2 Wildlife 7-13
7.4 Quality Assurance Program 7-14
7.5 Historic and Cultural Resource Monitoring 7-16

SECTION 8 – BENFIT COST ANALYSIS

8 BENEFIT-COST ANALYSIS 8-1
8.1 Benefit-Cost Analysis General Background 8-1
8.2 Alternatives and Assumptions 8-2
8.2.1 Development Alternatives 8-2
8.2.2 Key Assumptions and Limitations 8-2
8.3 Potential Economic Benefits of Project Construction and Operation 8-4

TABLE OF CONTENTS (CONTINUED)

8.3.1 IMPLAN Input Data 8-4
8.3.2 Potential Employment Benefits 8-5
8.3.3 Potential State and Local Tax Revenue Benefits 8-6
8.4 Potential External Costs of Project Construction and Operation 8-7
8.4.1 Short Term External Costs 8-8
8.4.2 Long Term External Costs 8-10
8.4.3 Groundwater Impacts 8-11
8.4.4 Radiological Impacts 8-11
8.5 Benefit-Cost Summary 8-12

SECTION 9 – SUMMARY OF ENVIRONMENTAL CONSEQUENCES

9 SUMMARY OF ENVIRONMENTAL CONSEQUENCES 9-1

SECTION 10 – REFERENCES

10 ENVRIONMENTAL REPORT REFERENCES 10-1

TABLE OF CONTENTS (CONTINUED)

LIST OF ADDENDA

Addendum 1-A: NRC Pre-Submission Application Audit Matrix
Addendum 3.3-A: Soils Map
Addendum 3.3-B: Soils Table
Addendum 3.3-C: Soil Mapping Unit Descriptions
Addendum 3.3-D: Sampled Soil Series Descriptions
Addendum 3.3-E: Laboratory Results
Addendum 3.3-F: Soil Sample Photographs
Addendum 3.3-G: Prime Farmland Designation
Addendum 3.5-A: Vegetative Cover Summaries
Addendum 3.5-B: Vegetative Species Summary
Addendum 3.5-C: Summary of Shrub Density
Addendum 3.5-D: Vegetation Photos
Addendum 3.5-E: Vegetation Map
Addendum 3.5-F: Wetlands Report
Addendum 3.5-G: U.S. Army Corp of Engineers Aquatic Inventory Letter
Addendum 3.5-H: Wyoming Game and Fish Department Wildlife Baseline Survey Letters
Addendum 3.5-I: Wildlife Species List
Addendum 3.8-A: Historic and Cultural Resources Report

ABBREVIATIONS AND ACRONYMS

-A-

AADT	Annual Average Daily Traffic
ALARA	As Low As Reasonably Achievable
ALI	Annual Limit Intake
amsl	above mean sea level
ANSI	American National Standards Institute
AP	Airport
APD	Application for Permit to Drill
APE	Area of potential effect
API	American Petroleum Institute
AQD	Air Quality Division
ASME	American Society of Mechanical Engineers
ASOS	Automated Surface Observing System
AUC	AUC, LLC

-B-

BACT	Best Available Control Technology
BCA	Benefit-Cost Analysis
BEA	United States Bureau of Economic Analysis
bgs	below ground service
BKS	BKS Environmental Associates, Inc.
BLM	United States Department of the Interior, Bureau of Land Management
BMP	Best Management Practices
BOE	Bureau of Explosives
BPT	Best Practicable Technology

-C-

CA/T	Central Artery/Tunnel
CAD	Computer-Aided Design
CBM	Coal Bed Methane
CBNG	Coal Bed Natural Gas
CEDE	Committed Effective Dose Equivalent
CERCLA	Comprehensive Environmental, Response, Compensation and Liability Act
CESQG	Conditionally Exempt Small Quantity Generator
CGA	Compressed Gas Association

ABBREVIATIONS AND ACRONYMS (CONTINUED)

CGP	Construction General Permit
CMF	Central Measuring Facility
CO_2	Carbon Dioxide
COOP	Cooperative Observer Program
CPP	Central Processing Plant
CPVC	Chlorinated Polyvinyl Chloride

-D-

DAC	Derived Air Concentration
DDE	Deep Dose Equivalent
DDW	Deep Disposal Well
DEQ	Department of Environmental Quality
DHS	Department of Homeland Security
DVD	Digital Video Disk

-E-

E	East
EA	Environmental Assessment
EDR	Electro Dialysis Reversal
EFI	Energy Fuels Inc.
Eh	oxidation-reduction potential
EIS	Environmental Impact Statement
EJ	Environmental Justice
EJ Study Area	Environmental Justice Study Area
ER	United States Nuclear Regulatory Commission Environmental Report
ESA	Endangered Species Act
ESO	Ecological Services Office
ESRI	Environmental Systems Research Institute

-F-

FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FIDLER	Field Instrument for the Detection of Low Energy Radiation
FSER	Final Safety Evaluation Report

-G-

ABBREVIATIONS AND ACRONYMS (CONTINUED)

GIS	Geographical Information System
GPS	Global Positioning System
GWR	Ground Water Restoration

-H-

H_2O_2	Hydrogen Peroxide
HDPE	High Density Polyethylene
HMR	Hazardous Materials Regulations
HPIC	High Pressure Ionization Chamber
HTF	Heat Transfer Fluid
HUC	Hydrologic Unit Code
HVAC	"Heating, Ventilation, and Air Conditioning"

-I-

IBC	International Building Code
ICF	ICF International
ICRP	International Commission on Radiological Protection
IDLH	Immediately Dangerous To Life And Health
IML	Inter-Mountain Labs
IMPLAN	Impact Analysis for Planning
ISC3	Industrial Source Complex
ISR	In Situ Recovery
IUC	International Uranium Corporation
IX	Pressurized Downflow Ion Exchange

-J-

-K-

-L-

LLD	Lower Limits Of Detection
LQD	Land Quality Division
LSA	Low Specific Activity

-M-

MCL	Maximum Containment/Concentration Level
MDL	Method Detection Limit
MET	Meteorological

ABBREVIATIONS AND ACRONYMS (CONTINUED)

MIT	Mechanical Integrity Test
MP wells	Baseline production monitor wells
MSL	Mean Sea Level Elevation

-N-

N	North
NAAQS	National Ambient Air Quality Standards
Na_2CO_3	Sodium Carbonate or Soda Ash
NAD	North American Datum
$NaHCO_3$	Sodium Bicarbonate (commonly known as baking soda)
NAICS	North American Industrial Classification System
NEPA	National Environmental Policy Act
NFPA	National Fire Protection Association
NHD	National Hydrography Dataset
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPV	Net Present Value
NRC	United States Nuclear Regulatory Commission
NRCS	Natural Resource Conservation Service
NRHP	National Register of Historic Places
NVLAP	National Voluntary Laboratory Accreditation Program
NWI	National Wetlands Inventory
NWP	Nationwide Permit
NWS	National Weather Service

-O-

OHV	Off-Highway Vehicle
OA	Overlying aquifer
OM	Overlying aquifer well
OSHA	Occupational Safety and Health Administration
OSL	Optically-Stimulated Luminescent Dosimeter
OWUS	Other Waters of the United States

-P-

PBL	Performance Based License
PBLC	Performance Based License Condition
PCN	Pre-construction Notification
PFYC	Potential Fossil Classification System

ABBREVIATIONS AND ACRONYMS (CONTINUED)

PM_{10}	Particulate Matter 10 Microns or Larger
PRB	Powder River Basin
PRI	Power Resources, Inc.
PSM	Process Safety Management
PV	Pore volumes
PVC	Polyvinyl Chloride
PZA	Production zone aquifer
PZM	Production zone monitor well

-Q-

QA	Quality Assurance
QAM	Quality Assurance Manual
QC	Quality Control

-R-

R	Range
RAP	Restoration Action Plan
RCRA	Resource Conservation and Recovery Act
REIS	Regional Economic Information System
Reno Creek Project	Reno Creek ISR Uranium Project (Proposed Project)
RM	Monitor well ring wells during production
RME	Rocky Mountain Energy
RMP	Risk Management Plan
RO	Reverse Osmosis
ROD	Record of Division
RPC	Regional Purchase Coefficient
RPP	Radiation Protection Program
RQ	Reporting Quantities
RSO	Radiation Safety Officer
RST	Radiation Safety Technician
RTV	Restoration Target Values
RWP	Radiation Work Permit

-S-

S	South
SA	Shallow water aquitard
SCS	Soil Conservation Service
SDR-17	Standard Dimension Ratio 17

ABBREVIATIONS AND ACRONYMS (CONTINUED)

SDWA	Safe Drinking Water Act
SEO	State of Wyoming Engineering Office
SER	Safety Evaluation Report
SERP	Safety and Environmental Review Panel
SGCN	Species Of Greatest Conservation Need
SHPO	Wyoming State Historic Preservation Office
SIL	Significant Impact Level
SM	Shallow water monitor well
SM unit	Shallow water table unit present in some locations
SODAR	Sonic Detection and Ranging
SOP	Standard Operating Procedures
SP	Spontaneous Potential
SRWP	Standard Radiation Work Permit
SSC	"Structure, System, or Component"

-T-

T	Township
T&E	Threatened and Endangered
TCP	Traditional Cultural Places
TDS	Total Dissolved Solids
TEDE	Total Effective Dose Equivalent
TENORM	Technologically Enhanced Naturally Occurring Radioactive Material
TER	Technical Evaluation Report
TLD	Thermo Luminescent Dosimeters
TPQ	Threshold Planning Quantities
TR	United States Nuclear Regulatory Commission Technical Report
TQ	Threshold Quantities

-U-

UA	Underlying aquitard
UM	Underlying aquitard well
U.S.	United States
U_3O_8	"Triuranium Octoxide, or Yellowcake"
UBC	Uniform Building Code
UCL	Upper Control Limit
UIC	Underground Injection Control
USACE	United States Army Corps of Engineers

ABBREVIATIONS AND ACRONYMS (CONTINUED)

USDA	United States Department of Agriculture
USDW	Underground Source Of Drinking Water
USEPA	United States Environmental Protection Agency
USFWS	"United States Department of the Interior, Fish and Wildlife Service"
USGS	United States Geological Survey
UTM	Universal Transverse Mercator

-V-

VRM	Visual Resource Management

-W-

W	West
WAAS	Wide Area Augmentation System
WDEQ	Wyoming Department of Environmental Quality
WDEQ-LQD	Wyoming Department of Environmental Quality – Land Quality Division
WDEQ-SHWD	Wyoming Department of Environmental Quality – Solid and Hazardous Waste Division
WDEQ-WQD	Wyoming Department of Environmental Quality – Water Quality Division
WGFD	Wyoming Game and Fish Department
WL	Working Level
WLM	Working Level Month
WOGCC	Wyoming Oil and Gas Conservation Commission
WoUS	Waters of the United States
WQD	Water Quality Division
WRCC	Western Regional Climate Center
WY	Wyoming
WYDOT	Wyoming Department of Transportation
WYGISC	Wyoming Geographic Information Science Center
WYPDES	Wyoming Pollutant Discharge Elimination System

-X-
-Y-
-Z-

UNITS OF MEASURE

%	percent
% g	percent of gravitational acceleration
µg/Kg	micrograms per kilogram or parts per billion
µg/L	micrograms per liter or parts per billion
µCi/g	microcuries per gram
µCi/Kg	microcuries per kilogram
µCi/L	microcuries per liter
$\mu Ci/m^3$	microcurie(s) per cubic meter
µrem	microrem
µR/h	microrem per hour
µSv	microsievert
^{o}	degrees
^oC	degrees Celsius
^oF	degrees Fahrenheit
ac	acre
ac-ft	acre-feet
cfm	cubic feet per minute
cfs	cubic feet per second
Ci/yr	Curies per year
cm	centimeters
cm^3	cubic centimeter(s)
cpm	counts per minute
dB	decibel
dBA	decibel A-weighting
DPM	disintegrations per minute
ft	foot
ft^3	cubic foot (feet)
g/l	grams per liter
gpm	gallon per minute
in	inch
Km	kilometer
lpm	liter per minute
m	meter
m^2	square meter
mg/L	milligrams per liter or part per million
mi	mile
mph	miles per hour
mR	milli Roentgens
mrem	millirem

UNITS OF MEASURE (CONTINUED)

mrem/hr	millirem per hour
mSv	millisievert
pCi/g	picocuries per gram
pCi/L	picocuries per liter
pCi/Kg	picocuries per kilogram
pCi/m^3	picocurie(s) per cubic meter
ppm	parts per million
psi	pound per square inch
psig	pound per square inch
R	rem
Sv	sievert
yd^3	cubic yard(s)

TABLE OF CONTENTS

4 POTENTIAL ENVIRONMENTAL IMPACTS 4-1
4.1 Potential Land Use Impacts 4-1
4.1.1 Proposed Action 4-2
4.1.1.1 Potential Construction Impacts 4-4
4.1.1.1.1 Changing and Disturbing Existing Land Uses 4-4
4.1.1.1.2 Access Restrictions and Establishment of Right-of-Way 4-6
4.1.1.1.3 Mineral Rights 4-7
4.1.1.1.4 Livestock Grazing 4-7
4.1.1.1.5 Restrictions on Recreational Activities 4-7
4.1.1.1.6 Altering Historic and Cultural Resources 4-8
4.1.1.2 Potential Operations Impacts 4-8
4.1.1.3 Potential Groundwater Restoration Impacts 4-8
4.1.1.4 Potential Decommissioning Impacts 4-9
4.1.2 No Action Alternative 4-9
4.2 Potential Transportation Impacts 4-11
4.2.1 Proposed Action 4-11
4.2.1.1 Potential Construction Impacts 4-11
4.2.1.2 Potential Operations Impacts 4-13
4.2.1.3 Potential Groundwater Restoration Impacts 4-18
4.2.1.4 Potential Decommissioning Impacts 4-18
4.2.2 No Action Alternative 4-18
4.3 Potential Geology and Soil Impacts 4-26
4.3.1 Proposed Action 4-26
4.3.1.1 Potential Construction Impacts 4-27
4.3.1.1.1 Potential Construction Impacts to Geology 4-27
4.3.1.1.2 Potential Construction Impacts to Soils 4-27
4.3.1.2 Potential Operation Impacts to Geology and Soils 4-28
4.3.1.2.1 Potential Operations Impact to Geology 4-28
4.3.1.2.2 Potential Operation Impacts to Soils 4-28
4.3.1.3 Potential Groundwater Restoration Impacts 4-30
4.3.1.4 Potential Decommissioning Impacts 4-30
4.3.2 No Action Alternative 4-30
4.4 Potential Water Resources Impacts 4-31
4.4.1 Potential Surface Water Impacts 4-31
4.4.1.1 Potential Construction Impacts to Surface Water 4-31
4.4.1.2 Potential Operation Impacts to Surface Water 4-32
4.4.1.3 Potential Groundwater Restoration Impacts to Surface Water 4-33
4.4.1.4 Potential Decommissioning Impacts to Surface Water 4-33
4.4.1.5 No Action Alternative 4-34
4.4.2 Potential Groundwater Impacts 4-34

4.4.2.1 Potential Construction Impacts to the Surficial Aquifer 4-34
4.4.2.2 Potential Construction Impacts to OA and PZA 4-35
4.4.2.3 Potential Operation Impacts on Groundwater 4-35
4.4.2.3.1 Potential Operation Impacts to Surficial Groundwater Quality 4-36
4.4.2.3.2 Potential Operation Impacts to Groundwater Quality of OA and PZA 4-36
4.4.2.3.3 Potential Operational Impact on Groundwater Quantity 4-37
4.4.2.3.4 Potential Operation Impacts to Groundwater from Deep Disposal Wells 4-38
4.4.2.4 Potential Groundwater Restoration Impacts 4-39
4.4.2.4.1 Potential Restoration Impacts to Surficial Groundwater 4-39
4.4.2.4.2 Potential Groundwater Restoration Impacts to Water Quality on PZA and OA 4-39
4.4.2.4.3 Potential Groundwater Restoration Impacts to Water Quantity on PZA and OA 4-40
4.4.2.5 Potential Decommissioning Impacts 4-40
4.4.2.5.1 Potential Decommissioning Impacts to Surficial Groundwater 4-40
4.4.2.5.2 Potential Decommissioning Impacts to PZA and OA 4-41
4.4.2.6 No Action Alternative 4-41
4.5 Potential Ecological Resource Impacts 4-45
4.5.1 Proposed Action 4-45
4.5.2 Potential Construction Impacts to Ecological Resources 4-45
4.5.2.1 Vegetation 4-45
4.5.2.2 Wetlands 4-46
4.5.2.3 Wildlife and Fisheries 4-47
4.5.2.3.1 Raptors 4-48
4.5.2.3.2 Upland Game Birds 4-50
4.5.2.3.3 Sensitive Species 4-52
4.5.2.3.4 Big Game Mammals 4-53
4.5.2.3.5 Small and Medium-Sized Mammals 4-54
4.5.2.3.6 Waterfowl and Shorebirds 4-55
4.5.2.3.7 Reptiles and Amphibians 4-55
4.5.2.3.8 Fish and Microinvertebrates 4-56
4.5.2.4 Threatened and Endangered Species 4-57
4.5.2.4.1 Greater Sage-Grouse (Candidate) 4-57
4.5.2.4.2 Ute's Ladies'-Tresses Orchid (Threatened) 4-57
4.5.2.4.3 Blowout Penstemon (Endangered) 4-58
4.5.3 Potential Operations Impacts to Ecological Resources 4-58
4.5.4 Potential Groundwater Restoration Impacts to Ecological Resources 4-59
4.5.5 Potential Decommissioning Impacts to Ecological Resources 4-59
4.5.6 No Action Alternative 4-59
4.6 Potential Air Quality Impacts 4-60

4.6.1 Proposed Action 4-60
4.6.1.1 Potential Construction Impacts 4-60
4.6.1.2 Potential Operations Impacts 4-64
4.6.1.3 Potential Groundwater Restoration Impacts 4-66
4.6.1.4 Potential Decommissioning Impacts 4-66
4.6.1.5 No Action Alternative 4-66
4.7 Potential Noise Impacts 4-73
4.7.1 Proposed Action 4-73
4.7.1.1 Potential Construction Impacts 4-73
4.7.1.2 Potential Operations Impacts 4-74
4.7.1.3 Potential Groundwater Restoration Impacts 4-75
4.7.1.4 Potential Decommissioning Impacts 4-76
4.7.2 No Action Alternative 4-76
4.8 Potential Historic and Cultural Resources Impacts 4-77
4.8.1 Proposed Action 4-77
4.8.1.1 Potential Construction Impacts 4-78
4.8.1.2 Potential Operations Impacts 4-79
4.8.1.3 Potential Groundwater Restoration Impacts 4-79
4.8.1.4 Potential Decommissioning Impacts 4-79
4.8.2 No Action Alternative 4-80
4.9 Potential Visual and Scenic Resources Impacts 4-81
4.9.1 Proposed Action 4-81
4.9.1.1 Potential Construction Activities 4-81
4.9.1.2 Potential Operations Activities 4-82
4.9.1.3 Potential Groundwater Restoration Impacts 4-83
4.9.1.4 Potential Decommissioning Impacts 4-84
4.9.2 No Action Alternative 4-84
4.10 Potential Socioeconomic Impacts 4-85
4.10.1 Proposed Action 4-85
4.10.1.1 Potential Construction Impacts 4-85
4.10.1.2 Potential Operation Impacts 4-87
4.10.1.3 Potential Groundwater Restoration Impacts 4-89
4.10.1.4 Potential Decommissioning Impacts 4-89
4.10.2 No Action Alternative 4-90
4.11 Environmental Justice 4-91
4.12 Potential Public and Occupational Health Impacts 4-92
4.12.1 Proposed Action 4-92
4.12.1.1 Potential Construction Impacts 4-92
4.12.1.2 Potential Operation Impacts 4-93
4.12.1.2.1 Potential Non-Radiological Impacts from Normal Operations 4-93
4.12.1.2.1.1 Potential Exposures from Air Pathways 4-94
4.12.1.2.1.2 Potential Exposures from Water Pathways 4-94

4.12.1.2.2 Potential Non-Radiological Impacts from Accidents 4-95
4.12.1.2.2.1 Chemical Accidents..... 4-95
4.12.1.2.3 Potential Radiological Impacts from Normal Operations..... 4-101
4.12.1.2.3.1 Exposure from Water Pathways 4-102
4.12.1.2.3.2 Exposures from Air Pathways..... 4-103
4.12.1.2.3.3 Potential Exposure from Flora and Fauna..... 4-105
4.12.1.2.4 Potential Radiological Impacts from Accidents 4-105
4.12.1.2.4.1 Tank Failure 4-106
4.12.1.2.4.2 Plant Pipe Failure 4-107
4.12.1.2.4.3 Production Unit Spill/Pipeline Failure 4-108
4.12.1.2.4.4 Potential Transportation Accidents 4-108
4.12.1.3 Potential Groundwater Restoration Impacts 4-111
4.12.1.4 Potential Decommissioning Impacts..... 4-111
4.12.2 No Action Alternative..... 4-111
4.13 Potential Byproduct Management Impacts 4-114
4.13.1 Proposed Action..... 4-114
4.13.1.1 Proposed Byproduct Management Systems..... 4-114
4.13.1.1.1 Liquid 11e.(2) Byproduct Material 4-115
4.13.1.1.1.1 Brine 4-115
4.13.1.1.1.2 Other Liquid 11e.(2) Byproduct Material 4-117
4.13.1.1.2 Solid 11e.(2) Byproduct Material 4-117
4.13.1.1.3 Solid Non-11e.(2) Byproduct Material 4-120
4.13.1.1.3.1 Solid Waste 4-120
4.13.1.1.3.2 TENORM 4-121
4.13.1.1.3.3 Hazardous Waste..... 4-123
4.13.1.1.3.4 Domestic Sewage 4-124
4.13.1.2 Potential Construction Impacts 4-125
4.13.1.3 Potential Operation Impacts..... 4-126
4.13.1.4 Potential Groundwater Restoration Impacts 4-127
4.13.1.5 Potential Decommissioning Impacts..... 4-127
4.13.2 No Action Alternative..... 4-128

List of Tables

Table 4-1: Disturbance Calculations..... 4-10
Table 4-2: Yellow Cake Shipment Route from the Proposed Project 4-19
Table 4-3: Bulk Chemicals Required at the Proposed Reno Creek Project..... 4-20
Table 4-4: Projected Traffic Volumes 4-21
Table 4-5: Solid 11e.(2) Byproduct Material Shipment Routes from the Proposed Project 4-22
Table 4-6: Gas Fired Equipment..... 4-67

Table 4.7: Mobile Equipment Schedule 4-68
Table 4-8: Emissions Inventory 4-69
Table 4-9: Combustion Emissions Inventory 4-70
Table 4-10: Fugitive Emissions Inventory 4-71
Table 4-11: Stationary Equipment Emissions 4-72
Table 4-12: Number and Rate of Nonfatal Occupational Injuries and Illnesses for the Mining Industry, Wyoming 4-112
Table 4-13: Byproduct Material Management Systems and Anticipated Quantities 4-129

List of Figures

Figure 4-1: Yellowcake Conversion Facility Transportation Route 4-23
Figure 4-2: Solid 11e.(2) Byproduct Transportation Route 4-24
Figure 4-3: Solid Non-11e.(2) Byproduct Transportation Route 4-25
Figure 4-4: Groundwater Drawdown during Production Only 4-42
Figure 4-5: Groundwater Drawdown during Concurrent Production and Restoration 4-43
Figure 4-6: Groundwater Drawdown during Restoration Only 4-44
Figure 4-7: Exposure Pathways 4-113
Figure 4-8: Anticipated Water Balance-Production Phase Only 4-130
Figure 4-9: Anticipated Water Balance-Production and Restoration Phases 4-131
Figure 4-10: Anticipated Water Balance-Restoration Phase Only 4-132

4 POTENTIAL ENVIRONMENTAL IMPACTS

This section discusses and describes the degree of potential environmental impacts associated with the Proposed Action and No Action Alternative of the proposed Reno Creek Project (Proposed Project). Potential environmental impacts can be direct, indirect, and/or cumulative in nature and can be temporary (short term) or permanent (long term). Potential impacts to each resource described in Section 3 of this ER are presented for normal operational events as well as reasonably foreseeable accidents. Related information can be found in:

-
- Section 3 of this ER (Affected Environment);
- Section 6 of this ER (Mitigation Measures);
- Section 7 of this ER (Environmental Measurements/Monitoring);
- Section 9 of this ER (Summary of Environmental Consequences); and
- Section 7 of the TR (Environmental Effects).

As noted in NRC NUREG-1910 (GEIS, Chapter 4), potential impacts are discussed in four phases (potential construction impacts, potential operations impacts, potential groundwater restoration impacts, and potential decommissioning impacts) and are described according to the following categories:

- **SMALL:** The potential environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource;
- **MODERATE:** The potential environmental effects are sufficient to noticeably alter, but not destabilize, important attributes of the resource; and
- **LARGE:** The potential environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

While it is recognized that official determinations of the potential impacts resulting from the Proposed Project are made by the respective governing agencies, AUC has used the NRC's GEIS as guidance for evaluating the scale of each potential impact.

4.1 Potential Land Use Impacts

As discussed in Section 3.1 of this ER, rangeland and wildlife habitat are the primary land uses within the Proposed Project area and the surrounding five-mile land use review area. Oil and gas and CBM facilities and infrastructure are also located on land within the review area. There is one occupied residence currently within the Proposed Project area.

AUC will acquire that residence prior to the commencement of operations so that there will be no occupied residences within the Proposed Project area during operations. There are five housing units within an area of five miles outside of the Proposed Project area. Figure 3.1-1 of this document depicts land use in the review area.

4.1.1 Proposed Action

The Proposed Action will consist of significant features associated with ISR recovery operations as described below:

- A series of sequentially developed Production Units (12 total) consisting of multiple well fields of production (injection and recovery) wells to inject barren lixiviant and to recover pregnant lixiviant;
- Horizontal and vertical excursion monitoring well networks for detection of lixiviant migrating outside of the ore body/recovery zones (excursions);
- Central Processing Plant (CPP) consisting of pressurized, down-flow ion exchange (IX) columns, elution circuit, precipitation circuit, and yellowcake drying and packaging facilities. The CPP also will be used to facilitate the necessary solutions and processes for groundwater restoration after uranium recovery operations have ceased;
- The CPP will be equipped to receive and process equivalent feed, pursuant to NRC RIS 2012-06;
- On-site laboratory, office and maintenance building, reagent storage facilities, and other facilities or areas used to house work areas or equipment storage; and
- Up to four Class I UIC disposal wells (DDW) to dispose of liquid 11e.(2) byproduct material in the form of production bleed and groundwater restoration fluids generated during ISR operations with adequate backup storage capacity.

In accordance with the conceptual operation and restoration schedule shown in Figure 1-6 of the ER, Construction of each Production Unit is anticipated to take one year to two years, including installation and development of injection, recovery, and monitor wells; and installation of header houses, piping, and utilities. Production Unit construction will be phased, with three to seven wellfields in various stages of construction at one time. Additional Production Unit plans are developed approximately one year prior to the planned commencement of the new wellfield operations. The overall duration of construction is anticipated to be approximately 9 years.

Uranium recovery operations are anticipated to begin approximately 9 to 12 months after initiating construction of the CPP and first Production Unit. The duration of operation of each Production Unit is estimated to be two to three years, but this interval may be longer

or shorter depending on uranium recovery levels and available CPP capacity. The overall duration of operations is approximately 11 years for the Proposed Action.

Production and restoration will occur simultaneously. Restoration (and stability monitoring) will operate without production for the approximately 1.5 years, followed by decommissioning, reclamation and regulatory review.

Although the Proposed Action covers a total of 6,057 acres, not all lands will be affected by the proposed operations. Potentially affected lands during the Proposed Action's 16 year life span include:

- Disturbed lands will total approximately 154 acres or around 2.5 percent of the Proposed Project area. Of the 154 acres, there will be two types of disturbance:
  1) Short term- disturbance will be small in time duration (< six months) including trunklines, drill pits and drill pads, top soil storage;
  2) Long term- disturbance will be extended in time duration (> six months) including the fenced area around the CPP and, backup pond, Deep Disposal Well (DDW) pad, and top soil storage.
- Controlled areas will be fenced to limit access to project associated operations and is estimated to encompass 481 acres or approximately 8 percent of the Proposed Project Area. Anticipated controlled areas include all fenced areas around the CPP, wellfields, backup pond, and DDWs. Restricted areas can be located within controlled areas;
- Restricted areas will control access to protect individuals from exposure to radiation and 11e.(2) byproduct materials including selected areas within the CPP building, 11e.(2) byproduct storage areas, backup pond, DDW buildings, and/or areas exceeding 2 mrem per hour; and
- Unrestricted areas are within the Proposed Project area to which access is neither limited nor controlled by the Proposed Action. These areas encompass approximately 5,576 acres or around 92 percent of the Proposed Project area.

Considering the relatively small size of the area affected by operations, the exclusion of grazing from this area over the course of the Proposed Project will have an insignificant impact on local livestock production. Fencing will be kept to the smallest possible area to minimize impacts from livestock exclusion. Oil and Gas and CBM facilities and infrastructure near the Proposed Project will not be affected.

If a conventional uranium recovery technique, such as open pit mining, were proposed to recover the uranium the amount of surface area disturbed would be much greater. According to the Moore Ranch SEIS (NRC, 2010), NRC notes that a conventional

surface, open-pit mine could significantly impact up to five times more surface area than that of an ISR operation.

Mitigation measures for the loss of agricultural production over the course of the Proposed Project are discussed in Section 6.1 of this ER.

4.1.1.1 Potential Construction Impacts

The construction of the Proposed Project infrastructure has the potential to impact the land use by:

- Changing and disturbing existing land uses;
- Restricting access and establishment of right-of-ways;
- Limiting livestock grazing;
- Limiting recreational activities;
- Altering historic and cultural resources.

These potential impacts to land use are considered temporary and reversible through the process of post-operation surface reclamation, well plugging, and returning the land to unrestricted use consistent with pre-operational conditions. AUC may leave affected areas unrestored at the request of landowners (e.g. roadways and structures). Regardless of the final disposition, all areas and structures will be decontaminated to allow for unrestricted use as described in further detail in TR Section 6.

4.1.1.1.1 Changing and Disturbing Existing Land Uses

Minimal surface disturbance will occur as a result of construction of the Proposed Project CPP and associated structures. A significant portion of the project area to be utilized by the Proposed Action has previously been disturbed by infrastructure and other prior and on-going activities. Normal rangeland use will be temporarily excluded from the areas of active ISR operations. Gas pipeline facilities will not be affected as AUC has developed close working relationships with their potentially affected developers and operators. The infrastructure and disturbance described below is shown in ER Figure 1-5 and tabulated in Table 4-1.

Central Processing Plant

The CPP area will include the CPP building, office/maintenance building, backup pond, parking area, laydown area, and a solid11e.(2) storage area. Conceptually, the CPP area will disturb approximately 15.5 acres and will be fenced to control access. Surface disturbing activities associated with construction of the CPP area will include topsoil

stripping; excavation, backfilling, compacting, and grading to prepare a level site. The Taffner homestead is currently positioned where the proposed CPP will be located. AUC will acquire the Taffner property prior to construction and it will not thereafter be used as a residence.

These land uses will be temporarily changed as the CPP area will be used for industrial purposes throughout the construction, operation, aquifer restoration, and decommissioning phases.

Production Unit Areas

Each Production unit constructed under the Proposed Action will consist of injection and recovery wells connected to a header house (via lateral trunklines), and associated monitor wells. Construction of the 12 planned Production Units within the Proposed Project area is estimated to disturb approximately 113 acres; although, disturbance will consist of both long term (> six months) and short term (< six months) disturbance. As noted in Section 2.11.1 of the ISR GEIS, less than half of the wellfield areas are typically disturbed by construction activities, including access roads, mud pits, header houses, and pipelines. Construction will be phased, with three to seven wellfields in various stages of construction at one time. Surface disturbing activities associated with Production Unit construction will include topsoil stripping, constructing temporary well pads, constructing temporary access roads, excavating mud pits, trenching for pipelines and buried electrical utilities, and excavating foundations for header houses.

The Production Units will be constructed on land currently used for livestock grazing. The Production Unit areas will be fenced using 4-line stranded barbed wire fence to restrict access of livestock. The fenced areas associated with the Production Units are estimated to encompass 461 acres. This land use will temporarily change land use for all areas actively disturbed or fenced by Production Unit construction. However, temporary well pads, mud pits, well pad access roads, and pipelines will be restored and reseeded at the end of construction. Therefore, disruption to livestock grazing will be temporary except around fenced Production Unit areas.

Access Roads

Access roads constructed under the Proposed Action will include secondary access roads between the CPP area and the Production Unit header houses, and tertiary access roads used to access monitor wells. The estimated surface disturbance associated with access road construction is approximately 23 acres and is calculated assuming approximately seven miles of 12 feet wide access roads plus 19 miles of monitor well ring tertiary roads eight feet wide. Surface disturbance activities associated with access road construction include topsoil stripping and stockpiling, excavation, backfill, compaction, and grading.

Secondary access roads will generally follow the existing topography, and tertiary roads will be unconstructed, two-track roads.

Access roads will be constructed on land currently used for livestock grazing. Potential changes in this land use will be small and temporary. Surface disturbance will also be minimized by locating access roads, pipelines, and utilities in common corridors and by utilizing existing roads wherever possible. There are numerous existing access roads that traverse the Proposed Project area which AUC will use whenever possible. Majority of these roads were developed and utilized for oil and gas, CBM, and ranching activities.

Deep Disposal Wells

AUC will construct up to four deep disposal wells as part of the Proposed Action. Each deep disposal well has the potential to disturb approximately one acre as these will be fenced to exclude wildlife. Surface disturbing activities associated with deep disposal well construction include topsoil stripping, well pad grading, and mud pit excavation. The locations of the four deep disposal wells are all on land currently used for livestock grazing on rangeland.

Pipelines

Pipelines will include trunk lines carrying barren lixiviant and recovery solutions between the CPP and feeder lines, feeder lines carrying these solutions between the trunk lines and header houses, individual well lateral lines carrying these solutions between the header houses and injection/recovery wells, and deep disposal well pipelines. The total estimated disturbance area resulting from the main trunk line and deep disposal pipeline will be approximately 22 acres. Surface disturbing activities associated with pipeline construction will include topsoil stripping, trenching, backfill, topsoil replacement, and reseeding. Pipeline corridors will be restored and re-seeded, typically within the same construction season, and changes in land use will be short term (< six months). Potential changes in land use are small and similar to those described previously for Production Unit construction, but the potential impacts will be smaller due to a smaller disturbance area, lack of fences, and short term disturbance. Surface disturbance will be minimized by locating pipelines in common corridors with access roads and utilities wherever possible.

4.1.1.1.2 Access Restrictions and Establishment of Right-of-Way

Access during construction activities will be controlled by fencing. Controlled areas will be relatively small and located primarily around the proposed CPP, Production Units, and deep disposal wells. As previously mentioned, Production Unit development will occur in phases and accordingly not all construction disturbances will occur simultaneously.

Disturbed areas will be reclaimed re-seeded and made accessible as Production Units are exhausted and decommissioned.

No public right-of-way will be established during construction of the Proposed Project. All access roads will be private access roads for authorized AUC employees and contractors. All access roads constructed will be reclaimed during decommissioning unless transferred to the affected landowner after decommissioning is complete.

4.1.1.1.3 Mineral Rights

The only known minerals currently being recovered in the Proposed Project area include conventional oil and gas and CBM. There are numerous existing access roads and well pads on-site associated with each of these operations. One producing oil well and 46 producing CBM wells are located within the Proposed Project boundary. The location of these wells are shown in Figure 2.7B-59 in Addendum 2.7-B of the TR.

The existing CBM wells and DDWs will not be impacted by the Proposed Action due to the substantial difference in target completion intervals between CBM production (631 to 1,424 feet) and ISR injection and recovery wells (250 to 400 feet).

4.1.1.1.4 Livestock Access Restrictions

The primary land use within the Proposed Project area is livestock grazing on rangeland. Some of this land use will be impacted during construction through the exclusion of livestock from disturbed and controlled areas. Production Unit development will occur in phases, resulting in temporary and staggered access restrictions. Much of the disturbed area will be restored, re-seeded and made accessible as production units are reclaimed (i.e., properly plugged & abandoned in accordance with WDEQ and WSEO specifications) and decommissioned. AUC estimates approximately 481 acres (8 percent) of the Proposed Project area will be controlled to exclude livestock. Considering the relatively small size of the area impacted by construction, the exclusion of grazing from this area over the course of the Proposed Project will have a small impact on local livestock production. AUC will establish surface use agreements with surface owners/lessees to provide compensation for the temporary loss of area currently used for grazing purposes.

4.1.1.1.5 Restrictions on Recreational Activities

Currently, the primary recreational activity in the vicinity of the Proposed Project is hunting, which will be restricted to protect workers. Hunting will be restricted within the

Proposed Project area on private lands for the life of the project. There is no public access to private lands and limited recreation opportunity on State of Wyoming managed lands within the Proposed Project area. Therefore, the potential impact on such land uses due to the restricted access areas is anticipated to be small.

4.1.1.1.6 Altering Historic and Cultural Resources

Potential historic and cultural resource impacts from the Proposed Action are discussed in Section 4.8, and mitigation measures are presented in Section 6.8 of this document. Potential impacts to historic and cultural resources will be minimized by avoiding construction at sites identified by the Class III inventory as potentially eligible for listing on the NRHP. Consultation with the appropriate SHPO and Tribal Historic Preservation Office (THPO) will ensure all sites existing or located during AUC's operations are properly managed. An Unanticipated Discovery Plan (UDP) will be implemented prior to construction for phased identification of previously unidentified historic and cultural resources encountered during all phases of the Proposed Action. This will include a stop-work provision and a requirement to seek expert advice and approval prior to resuming activities, if any previously undiscovered cultural resources are encountered. A brief outline of the UDP can be found in Section 7.5 of this ER.

4.1.1.2 Potential Operations Impacts

Potential impacts to land use specific to the Proposed Action are expected to be small, and less than those during construction since many of the short-term disturbance areas will be reclaimed. During the operation phase of the project, the primary impacts to land use will occur with Production Unit development. These potential construction related impacts are addressed in Section 4.1.1.1. Topsoil stockpiles, and as much as practicable of the disturbed Production Unit areas, will be seeded as soon as reasonably possible to establish vegetative cover to minimize wind and water erosion.

4.1.1.3 Potential Groundwater Restoration Impacts

Potential land use impacts during groundwater restoration will be similar to those during operations and are expected to be small. Access by livestock will be restricted on relatively small portions of the Proposed Project area and temporarily during restoration activities. Access will be restricted in controlled areas, but the total fenced area will be a small portion of the Proposed Project area.

4.1.1.4 Potential Decommissioning Impacts

During decommissioning, some surface disturbance activities will temporarily increase compared to operations and groundwater restoration because of additional equipment associated with dismantling, removing, and disposing of production unit materials, pipelines and processing facilities. The decommissioning-only phase of the operation will be focused largely on the CPP, with decommissioning on the last one or two Production Units as routine decommissioning will begin as soon as stability monitoring of each Production Unit has been approved by NRC and the WDEQ. Decommissioning of surface and subsurface facilities in individual Production Unit header houses will commence after groundwater restoration and stabilization have received final regulatory approval. Production unit decommissioning includes plugging and abandonment of all wells and the removal of production unit piping and header houses. Due to the size of the Proposed Project, some Production Units will be undergoing decommissioning while other Production Units are undergoing construction or production or restoration. Other surface facilities and support structures that are no longer required and not turned over to landowners or other parties also will be removed.

During decommissioning, the land will be returned to the approximate pre-construction surface topography and drainage patterns. All roads and portions of roads constructed and utilized for access to the facilities and Production Units will be removed and reclaimed unless exempted from reclamation at the request of landowners/lessees.

Revegetation will be conducted in accordance with WDEQ/LQD requirements, in accordance with other ISR operators approved by NRC. After spreading topsoil, the area will be seeded with a permanent seed mix. The mix may contain a nurse crop to establish a standing vegetative cover along with the permanent seed mix. Mulch may also be used to cover the seed. The seed mix will be chosen to be compatible with the prior land use. The landowner or surface lessee and WDEQ/LQD will be consulted when selecting the seed mix. Table 6-1 in this document displays the seed mix proposed for use at the Proposed Project.

4.1.2 No Action Alternative

Under the No Action Alternative, the Proposed Project will not be constructed and associated disturbance and impacts to land use will not occur on the portions of the Proposed Project area projected for CPP and production unit use.

Table 4-1: Disturbance Calculations

Estimated Production Unit Area Disturbance	Patterns	Area/Pattern (ft^2)	Total Area (ft^2)	Acres
Total Pattern Area per Header House (HH); 67 total	30	10,000	300,000	6.9
Long Term Top Soil Storage (> 6 months)	**Width (ft)**	**Length (ft)**	**Total Area (ft^2)**	**Acres**
Area per Header House	12	30	360	0.01
Proposed Secondary Access Roads to HHs	12	225	2,700	0.06
Long Term Top Soil Storage per HH			3,060	0.07
HH Long Term Top Soil Storage				4.7
Proposed Additional Secondary Roads within Project Boundary	12	18,614	223,369	5.1
Proposed Tertiary Roads (monitor well ring)	8	99,366	794,928	18.2
Total Acres Long Term Disturbance 67 HHs plus Additional New Roads				***28.1***
Short Term Top Soil Disturbance (< 6 Months)	**Width (ft)**	**Length (ft)**	**Total Area (ft^2)**	**Acres**
Well Installation Drill Pit (per pit)(72 total)	7	20	10,080	0.2
Lateral Trenches for pipe from HH to wells	6	5,247	31,482	0.7
Total Area of Short Term Disturbance per HH			***41,562***	***0.95***
Total HH Short Term Top Soil Storage				63.9
Lateral Trunklines to HHs (for 67 HHs)	15	54,269	814,041	18.7
Overlying Monitor Well Installation Drill Pits (134 total)	7	20	18,760	0.4
Ring Monitor Well Installation Drill Pits (469 total)	7	20	65,660	1.5
Total Acres Short Term Disturbance				***84.6***
Estimated Long Term Surface Disturbance (CPP Site Infrastructure)	**Width (ft)**	**Length (ft)**	**Total Area (ft^2)**	**Acres**
Central Processing Plant (CPP)	200	350	70,000	1.6
Backup Pond	100	210	21,000	0.5
Office Building	60	100	6,000	0.1
Maintenance Building	60	100	6,000	0.1
Parking Lot, Chemical Storage Tanks, Laydown area (grading)			570,636	13.1
Total Site Layout			***673,636***	***15.5***
Deep Disposal Well Pad (x4)			174,240	4.0
Total Area of CPP Site Infrastructure Long Term Disturbance			***847,876***	***19.5***
Estimated Short Term Trunkline Top Soil Disturbance (< 6 Months)	**Width (ft)**	**Length (ft)**	**Total Area (ft^2)**	**Acres**
Main Trunklines	25	28,347	708,675	16.3
DDW pipeline	8	32,138	257,104	5.9
Total Area of Short Term Trunkline Disturbance			***965,779***	***22.2***
				Acres
Total Long Term Surface Disturbance				**47.5**
Total Short Term Surface Disturbance				**106.7**
Total Disturbance Area for Removal of Vegetation and Topsoil				**154.3**
				Acres
Total Controlled Area (fenced with or without the removal of topsoil and/or vegetation)				**480.9**
Total Unrestricted Area (all areas outside of controlled area and 2mrem per hour)				**5,576.1**

4.2 Potential Transportation Impacts

The following sections describe the potential impacts during activities associated with each phase of the Proposed Action, including construction of approximately seven miles of access roads and 18.8 miles of tertiary monitor well ring roads (ER Figure 1-6) and transportation of materials and workers to and from the Proposed Project area.

It is not anticipated that the Proposed Action will have noticeable impact to local transportation systems.

4.2.1 Proposed Action

The primary transportation route to the Proposed Project area from nearby communities is along State Highway 387 that connects the Proposed Project area to regional population and economic centers along I-25 to the west and State Highway 59 to the east. Highway 387 runs east to west from the town of Wright to I-25 at the town of Midwest, transecting the project area. The City of Gillette is located approximately 41 miles north of the Proposed Project and has two transportation routes available to access the Proposed Project area, State Highway 50 and 59. Highway 50 originates in Gillette and runs to the south and connects with Highway 387 approximately 4.5 miles west of the Proposed Project. Highway 59 connects with Highway 387 at Wright, located approximately 7.5 miles northeast of the Proposed Project.

Local access roads within the Proposed Project area are County Roads 22 (Clarkelen/Turnercrest Road) and 25 (Cosner Road). Clarkelen Road accesses the general location selected for construction of the CPP and is currently used for agricultural and oil and gas activities in the area. The proposed location of the CPP is approximately 1,800 feet from the intersection of Highway 387 and Clarkelen Road. Clarkelen Road may require minor improvements to accommodate trucks and heavy equipment access during construction and operation phases of the Proposed Project.

4.2.1.1 Potential Construction Impacts

The limited duration of construction activities suggest potential impacts will be minimal. Any temporary dust and noise impacts to nearby receptors or to AUC's staff or contractors will be Small. Mitigation measures for potential construction impacts can be reviewed in Section 6 of this ER.

Access Road Construction

State Highway 387 traverses the Proposed Project area and is considered the primary access road to most of the Proposed Project Area. Construction materials will be delivered to the site on this highway. Clarkelen Road accesses the general location selected for construction of the CPP and is currently used for agricultural and oil and gas activities in the area. The proposed location of the CPP is approximately 1,800 feet from the intersection of Highway 387 and Clarkelen Road. Clarkelen Road may require minor improvements to accommodate trucks and heavy equipment access during construction and operation phases of the Proposed Action.

Secondary access roads will include roads constructed between the CPP and Production Units will be 12 to 20 foot wide gravel surfaced roads that will allow easy movement of opposing vehicles, at low speeds, on an all-weather surface. Secondary access roads will generally follow existing topography, and little cut or fill will be required for their construction. Temporary tertiary access roads to Production Units and monitor wells will generally be un-constructed, two-track trail roads approximately 8 to 10 feet wide. Temporary tertiary access roads will typically not have any surfacing and will generally have no cut or fill associated with their construction. As these roadways become unused they will be reclaimed to their natural condition by ripping the soil, as needed, to reduce compaction and re-seeding.

Access road construction activities will have minor and temporary air quality impacts, which are discussed in detail in Section 4.6. The potential transportation impacts of these minor improvements will be Small.

Traffic

Projected daily truck and auto traffic volume data for State Highway 387 during the all phases of the project are presented in Table 3.2-5 of this ER. The projected increase in vehicle traffic resulting from the Proposed Action are calculated for each local highway segment used for access to the Proposed Project. Based on a 1.5 percent annual increase, the average daily projected volume of traffic in 2015 at Pine Tree Junction (ER Figure 3.2-1) on Hwy 387 is 942 vehicles including 197 heavy-duty trucks or 20.9 percent of the total. This compares to a 13.5 percent heavy-truck volume (535 vehicles) at Reno Junction on Hwy 387 east of the Proposed Project area (shown in ER Figure 3.2-1). This vehicle traffic increase calculation addresses the maximum amount of traffic that could be expected for each local highway. Truck traffic includes trucks that haul heavy equipment (cranes, bulldozers, graders, track hoes, trenchers, front-end loaders, etc.) to the construction site, and haul the facilities and equipment during the construction phase of the project. The daily vehicle traffic volume related to the Proposed Project in 2015 is

projected to be approximately 75 vehicles or 8.0 percent of the projected total at Pine Tree Junction, and approximately 1.9 percent of the projected total number of vehicles at Reno Junction. The average daily estimated increase in auto traffic is based on the workforce level, which varies depending upon the phase of the project. Vehicle traffic includes passenger vehicles, light duty trucks, other personal or work vehicles, and commercial delivery and pickup vehicles to and from the Proposed Project site during construction and operation.

4.2.1.2 Potential Operations Impacts

All shipments will be transported by appropriately licensed transporters and subject to both federal (NRC 10 CFR Part 71; DOT 49 CFR Part 173) and state transportation regulations. The following sections identify the materials that will be shipped during operations. Potentially, up to 75 vehicles will be traveling to and from the site on a daily basis, approximately 15 of which will be for the delivery of packages and office supplies, process related fuels and chemicals, and yellowcake.

Transportation of regulated materials to and from the Proposed Project can be classified as follows:

- Shipments of dried yellowcake. Yellowcake will be transported in 55 gallon drums to a conversion facility for refining and conversion located in Metropolis, Illinois;
- Shipments of process chemicals or fuel from suppliers to the site;
- Shipments of non-11e.(2) byproduct material;
- Shipment of 11e.(2) byproduct material from the site to a licensed disposal facility. A detailed list of potential disposal sites can be found in ER Section 3.2.2; and
- Potential acceptance of shipments of uranium loaded resins from future satellite or non-AUC facilities.

Yellowcake Shipment

As stated in NUREG-1910 (GEIS Section 3.3.2), yellowcake shipments will be made in accordance with U.S. DOT and USNRC regulations including 10 CFR 71.5 (Transportation of Licensed Materials) and will be handled as LSA material. Currently the only permitted conversion facility in the United States is in Metropolis, Illinois. Transportation of dried yellowcake will be made in exclusive-use transport vehicles to facility for further processing. AUC anticipates that approximately one yellowcake shipment per week will occur.

AUC will contract with an appropriately licensed transport company that specializes in shipment of yellowcake. The transport company will have extensive emergency response programs including spill response equipment on board. Drivers will be trained in emergency response procedures, and there will be constant monitoring of truck location and operating parameters. The transport companies will also have standing contracts with environmental emergency response contractors for spill cleanup. Yellowcake shipments will be handled as low-specific-activity (LSA) material. The anticipated route from the Proposed Project area to the conversion facility is described and illustrated in Table 4-2 and Figure 4-1. Shipment distances for alternate routes are not expected to differ significantly from those estimated for the primary routes (NUREG- 1910, p. 3.2-7).

NUREG-0706 assumes that the probability of a truck accident involving shipments of yellowcake in any year is 11 percent for each uranium production facility. This calculation used average accident probabilities (4.0×10^{-7}/km for rural interstate, 1.4×10^{-6}/km for rural two-lane road, and 1.4×10^{-6}/km for urban interstate) which NUREG 1910 and supplements determines is conservative.

AUC will develop an emergency response plan for yellowcake and other transportation accidents to or from the Proposed Project. The emergency response plan will include descriptions of the following provisions:

- DOT Regulations including applicable sections of 10 CFR 71.5;
- Carrier Emergency Response Procedures;
- Spill Kits;
- Immediate Response and notification, in coordination with local and State agencies and in accordance with ;
- Accident Scene Response;
- Spill cleanup;
- Review of Accident Documentation;
- Review of Monitoring and Sampling Data;
- Site Abandonment; and
- Reporting/Lessons Learned.

The worst case accident scenario involving yellowcake transportation would be an accident involving the transport truck in which the integrity of one or more drums containing yellow cake is breached, resulting in a release to the environment. The primary potential environmental impact associated with an accident involving the spill of yellowcake will be the remediation of road surfaces and soils impacted at the spill area and repair of related damage to the topsoil and vegetation structure. To minimize the impacts from such an accident, AUC, after licensing, will develop and implement

detailed SOPs for all yellowcake transport. The SOPs will be available for inspection by NRC. They will include at a minimum the following procedures:

- AUC will have a fully developed communication and emergency response plan produced cooperatively with local, State of Wyoming authorities and agencies for all transport and emergency conditions. The plan will include adequate communication and training of appropriate staff;
- Each truck will be equipped with a communication device that will allow the driver to communicate with either the shipper or receiver to obtain any assistance needed;
- A check-in and check-out procedure will be instituted where the driver will notify the receiving facility prior to departure from his location. If the yellowcake shipment fails to appear within a set time, an emergency response team will respond and search for the vehicle. This system will assure reasonably quick response time in the case that the driver is incapacitated in an accident or medical emergency;
- Each yellowcake transport vehicle will be equipped with an emergency spill kit which the driver will be trained to use for containment of any spilled material. The kit will include plastic sheeting to cover spilled material until cleanup operations can begin;
- AUC will dispatch either properly trained and equipped AUC employees, or, if the accident is distant, nearby contractor personnel qualified and trained as RSO/RST to supervise spill cleanups and conduct post-accident surveys to ensure that any spill has been properly addressed; and
- Both shipping and receiving facilities will be equipped with emergency response kits to quickly respond to a transportation accident.

Process Chemicals and Fuel Shipment

It is estimated that up to four bulk chemical, fuel, and supply deliveries will be made per working day throughout the operational life of the project. Transportation of process chemicals and fuel will follow all applicable DOT hazardous material shipping regulations and requirements. Truck shipments of process chemicals to the Proposed Project site could result in potential local environmental impacts if trucks are involved in an accident. In the unlikely case of an accident, all spills will be immediately remediated within the affected area. The process chemicals used at an ISR facility in truck load quantities are common to many industries and present no potentially abnormal risk. Types of deliveries potentially will include carbon dioxide, oxygen, soda ash and fuel.

As noted in Table 4-3, bulk chemical shipments for the Proposed Project will total approximately 1,217 shipments per year or 3.3 shipments per day. Utilizing WYDOT's

1.5 percent annual traffic increase in Table 4-4, these chemical shipments represent a daily increase of less than 0.4 percent for truck traffic for 2015 and even less for 2020. Transportation accidents involving fuel (diesel, gasoline, and propane) shipment also present potential environmental impacts. During operation it is estimated that approximately 1 shipment of fuel will be transported to the site each day. Fuel will be transported from a nearby town such as Gillette or Wright, which will minimize the trip distance and keep the probability of an accident very low.

Since most of the material could be removed, no significant potential long-term environmental impacts will result from an accident involving the process chemicals.

Loaded Resin Shipments

The uranium recovery circuit at the CPP will be designed to process up to two million pounds per year of U_3O_8. The CPP will be capable of processing additional uranium-loaded IX resin from satellite ISR facilities, including those owned and/or operated by AUC and those owned and/or operated by other ISR licensees. Uranium-loaded IX resin would be transported to the Proposed Project in tanker trailers with 500 yd^3 capacity. Based on a typical concentration of 50 g/L U_3O_8 (ISR GEIS Section 4.2.2.2), each truckload of uranium-loaded IX resin will contain approximately 1,500 pounds U_3O_8. Based on the CPP processing rate, a potential of up to four uranium-loaded IX resin shipments would be made to the facility each day. A transportation accident resulting in release of uranium-loaded IX resin would have a lower risk than an accident involving yellowcake described previously.

11e.(2) Byproduct Material Shipment

All solid 11e.(2) byproduct material including unusable contaminated equipment, filters, spent resin, etc. generated during operations will be transported off-site to a licensed disposal facility. Because of the low levels of radioactivity involved, these shipments are considered to have minimal potential environmental impact in the event of an accident. Shipments are generally made in bulk in sealed roll-off containers in accordance with the applicable DOT hazardous materials shipping provisions. Such requirements are provided in 10 CFR 71.5 (Transportation of Licensed Materials).

Current plans by AUC propose shipment of solid 11e.(2) byproduct material to one of three licensed disposal facilities located comparatively near the Proposed Project. AUC will develop an agreement with an off-site disposal facility prior to initiating any activity that will generate solid 11e.(2) byproduct material. Those facilities include:

- Pathfinder Mines Corporation; Shirley Basin (Wyoming) Facility;
- Denison Mines Corporation; White Mesa Uranium Mill, Blanding, Utah; and
- Energy Solutions LLC, Clive Disposal Site, Clive, Utah.

AUC estimates that 100 yd^3 of solid 11e.(2) byproduct material will be shipped each year. Using 20 cubic yard roll-offs approximately five shipments will be made each year. There will be no shipments of liquid 11e.(2) byproduct material, as it will be disposed in one of up to four DDWs on site, as discussed in Section 4.13 of this document. Potential routes for shipment of solid 11e.(2) byproduct material are described and illustrated in Table 4-5 and Figure 4-2.

11e.(2) byproduct material shipments will be very infrequent and will not significantly impact the daily traffic compared to other operations at the site.

Solid Non-11e.(2) Byproduct Material Shipment

Solid Non-11e.(2) byproduct materials and wastes will be transported to the Campbell County municipal landfill in Gillette approximately 41 miles from the Proposed Project site. The solid waste shipments will result in minimal traffic impacts. Section 4.13 describes the estimated quantities, management systems including volume reduction, transport/disposal methods and potential impacts of solid byproduct material disposal in more detail. AUC estimates that two trips per week will be necessary and will result in minimal traffic impacts. The anticipated solid non-11e.(2) byproduct material shipment route is shown on Figure 4-3.

Hazardous Waste Shipment

AUC expects that the Proposed Project will be classified as a conditionally exempt small quantity generator (CESQG) by WDEQ/SHWD. In this classification the Proposed Project facility will generate less than 220 lbs of hazardous waste in a calendar year, generate less than 2.2 lbs of acute hazardous waste in a month, and store less than 2,200 lbs of hazardous waste on-site at any one time (WDEQ/SHWD 2011).

AUC will develop a waste management SOP, following receipt of licensing but prior to commencement of construction, to maximize the amount of recycling, minimize the production of hazardous waste, and for the collection, sorting, and temporary storage of all solid non-11e.(2) solid waste. Hazardous materials generated from the Proposed Project may include used batteries, expired laboratory reagents, fluorescent light bulbs, solvents, cleaners, and degreasers. These items will be transported to an off-site treatment, storage and disposal or recycling facility which is permitted to manage hazardous waste material by WDEQ/SHWD or a nearby State. AUC estimates that one trips per month will be necessary and will result in minimal traffic impacts. The anticipated shipment route is identical to the solid non-11e.(2) byproduct material shipment route is shown on Figure 4-3.

4.2.1.3 Potential Groundwater Restoration Impacts

The potential transportation impacts during groundwater restoration after production ceases are expected to be less than potential impacts during operations. The number of workers on site is expected to decline during the late phases of groundwater restoration. Additionally, yellowcake shipments will decrease due to a decrease in flowrate through the IX columns and a decrease in the uranium concentration in the pregnant lixiviant recovered from the Proposed Project production units during post production groundwater restoration. The shipments of process chemicals will similarly decrease due to a decrease in the number of resin elutions and uranium precipitations during the active phase of groundwater restoration.

4.2.1.4 Potential Decommissioning Impacts

During decommissioning, a small increase in truck traffic along with personal vehicles will occur due to the increased number of contractors and shipments associated with decommissioning activities, focused particularly in the CPP area. However, the number of total workers will be significantly lower than during production and restoration operations. Fuel shipments will increase as a result of the operation of heavy equipment. Decommissioning will result in an increase in shipments of solid 11e.(2) byproduct material and solid non-11e.(2) byproduct material. It is estimated that the frequency of 11e.(2) byproduct material shipments will increase from approximately 5 per year during operation and aquifer restoration to between 100 and 200 shipments per year during decommissioning. These will still be relatively infrequent compared to passenger vehicles and will have a small impact on traffic. Solid waste shipments are expected to increase from about 1 per week during operation and aquifer restoration to about 2 per week during decommissioning. Hazardous waste shipments are expected to remain unchanged at about 1 per month throughout all four project phases. Potential transportation impacts are expected to be similar during decommissioning as those occurring during the previous three project phases

4.2.2 No Action Alternative

There will be no transportation impacts from the No Action Alternative, since the Proposed Project will not be constructed.

Table 4-2: Yellow Cake Shipment Route from the Proposed Project

Origin	Destination	Major Links	Distance (mi)
Proposed Project CPP	Metropolis, Illinois	-Take Hwy 387 east 11 miles to Reno Junction; -Turn south on Hwy 59 76 miles to Douglas, Wyoming; -Turn south on I-25 132 miles to Cheyenne, Wyoming; -Turn east on I-80 440 miles to Lincoln, Nebraska; -Turn east on Hwy 77/NE 2 52.5 miles to Nebraska City, Nebraska; -Turn south on I-29 120 miles to I-435E; -Continue 26.4 miles to I-70; -Turn east on I-70 201 miles to St. Louis, Missouri; -Merge on to I-64 east 40.5 miles to Chesterfield, Missouri; -Continue on I-64 75.2 miles to I-57; -Turn south on I-57 for 47.3 miles to I-24 east; -Turn east on I-24 for 13.6 miles to exit 44 for US 45; then -Turn south on US 45 for 21.4 miles to Metropolis, Illinois.	1,260

Table 4-3: Bulk Chemicals Required at the Proposed Reno Creek Project

Shipped as Dry Bulk Solids				Shipped as Liquid or Gases			
		Volume of shipments	Frequency of Shipments[1]			Volume of shipments	Frequency of Shipments[1]
Sodium carbonate	$NaCO_3$	24 ton	572	Oxygen	O_2	24 ton	81
Sodium chloride	NaCl	24 ton	117	Carbon dioxide	CO_2	24 ton	137
				Mineral acid	HCl or H_2S0_4	24 ton	167
				Hydrogen peroxide	H_2O_2	24 ton	16
				Sodium hydroxide	NaOH	24 ton	23
				Bottled gases			104

[1]On a yearly basis

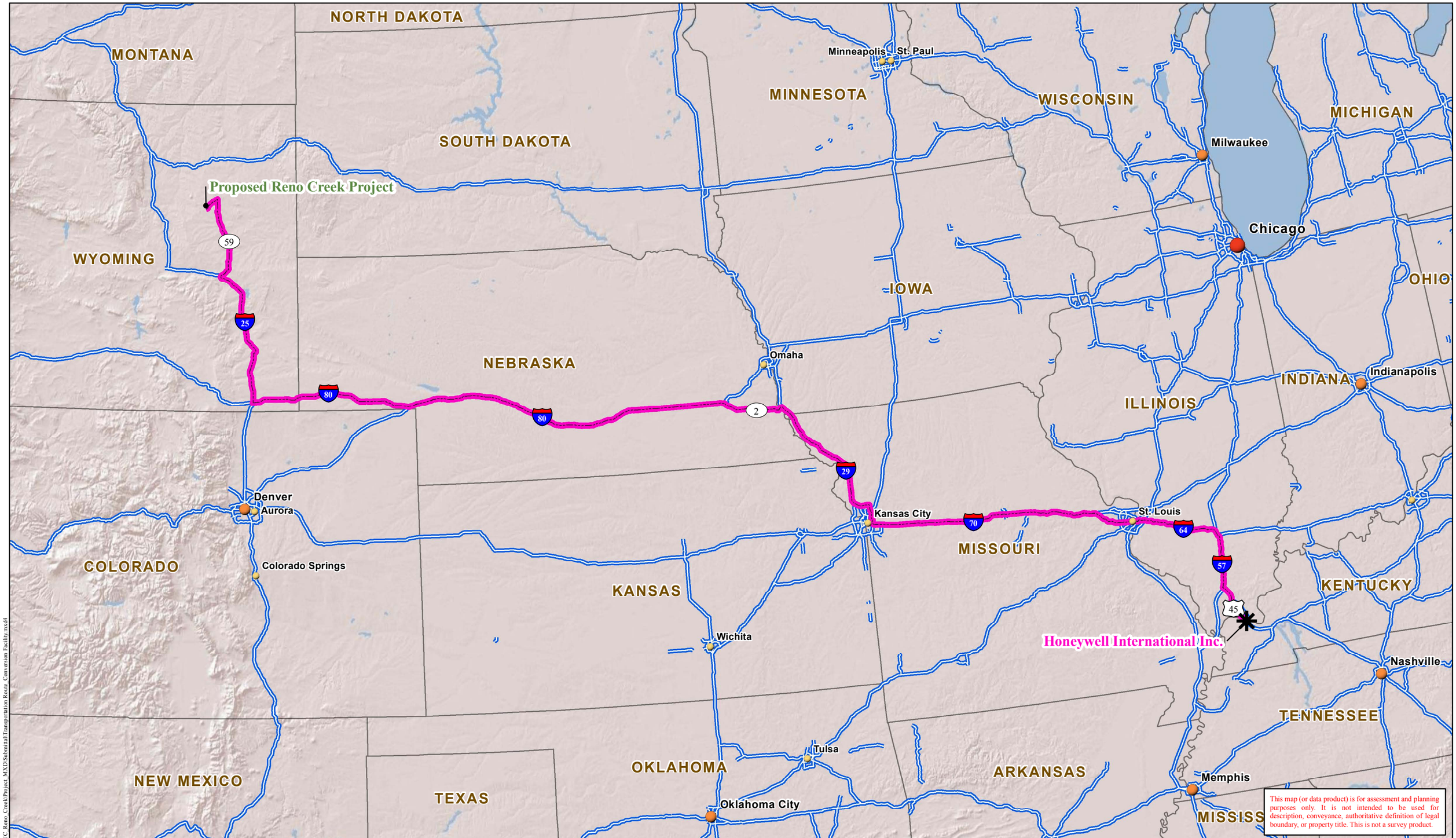
Table 4-4: Projected Traffic Volumes

Project Area Roads	2010		2015		2020		2030	
	All vehicles	Trucks	All vehicles	Trucks	All vehicles	Trucks	All vehicles	Trucks
	(vehicles/day)		(vehicles/day)		(vehicles/day)		(vehicles/day)	
Pine Tree Junction	874	183	942	197	1,014	212	1,177	246
Reno Junction	3,679	497	3,963	535	4,270	577	4,955	669
Gillette South	5,681	838	6,120	903	6,593	973	7,652	1,129

Source: 2010 numbers from WYDOT then 1.5 percent annual increase

Table 4-5: Solid 11e.(2) Byproduct Material Shipment Routes from the Proposed Project

Origin	Destination	Major Links	Distance
Proposed Project	Pathfinder Mines Shirley Basin, Wyoming	-Turn west on Hwy 387 for 37.7 miles to Midwest, Wyoming; -Turn north and continue on Hwy 387 for 6.6 miles to I-25-S; -Turn south on I-25 for 37.6 miles to Casper, Wyoming; -Turn west on Hwy 20/26 for 3.2 miles to W Yellowstone Hwy; -Turn east on W Yellowstone Hwy for 1.5 miles to SR 258; -Turn south on SR 258 for 2.2 miles to SR 220; -Turn west on SR 220 for 16.1 miles to SR 487; -Turn south on SR 487 for 36.5 miles to County Road 6; then -Turn east on County Road 6 for 2.2 miles to Pathfinder Mines.	144 Miles
	White Mesa Uranium Mill Blanding, Utah	-Turn west on Hwy 387 for 37.7 miles to Midwest, Wyoming; -Turn north and continue on Hwy 387 for 6.6 miles to I-25-S; -Turn south on I-25 for 37.6 miles to Casper, Wyoming; -Turn west on Hwy 20/26 for 3.2 miles to W Yellowstone Hwy; -Turn east on W Yellowstone Hwy for 1.5 miles to SR 258; -Turn south on SR 258 for 2.2 miles to SR 220; -Turn west on SR 220 for 69.2 miles to US 287; -Turn south on US 287 for 44.6 miles to I-80; -Turn west onto I-80 for 28.4 miles to exit 187; -Turn south on WY 798/SR 13 for 182 miles to I-70; -Turn west on I-70 for 139.5 miles to US 191; then -Turn left onto US 191 for 113.2 miles to White Mesa, Utah.	666 Miles
	Energy Solutions LLC Clive Disposal Site Clive, Utah	-Turn west on Hwy 387 for 37.7 miles to Midwest, Wyoming; -Turn north and continue on Hwy 387 for 6.6 miles to I-25-S; -Turn south on I-25 for 37.6 miles to Casper, Wyoming; -Turn west on Hwy 20/26 for 3.2 miles to W Yellowstone Hwy; -Turn east on W Yellowstone Hwy for 1.5 miles to SR 258; -Turn south on SR 258 for 2.2 miles to SR 220; -Turn west on SR 220 for 69.2 miles to US 287; -Turn south on US 287 for 44.6 miles to I-80; -Turn west on I-80 for 362.7 miles to I-80W Exit 49 (Clive Rd); then -Take Exit 49 (Clive Rd) south for 2 miles to Energy Solutions, LLC.	567 Miles



This map (or data product) is for assessment and planning purposes only. It is not intended to be used for description, conveyance, authoritative definition of legal boundary, or property title. This is not a survey product.

Path: O:\WY_Projects\2010-100_AUC_Reno_Creek\Project_MXD\Submittal\Transportation Route_Conversion Facility.mxd4

TREC, Inc.
Engineering & Environmental Management
900 Werner Court
Suite 150
Casper, WY 82601
Phone (307) 265-0696
Fax (307) 265-2498
www.treccorp.com

PROPOSED RENO CREEK PROJECT
CAMPBELL COUNTY, WY

PREPARED FOR AUC LLC
LAKEWOOD, CO

Legend
- Yellowcake Conversion Facility Transportation Route
- US Interstate System

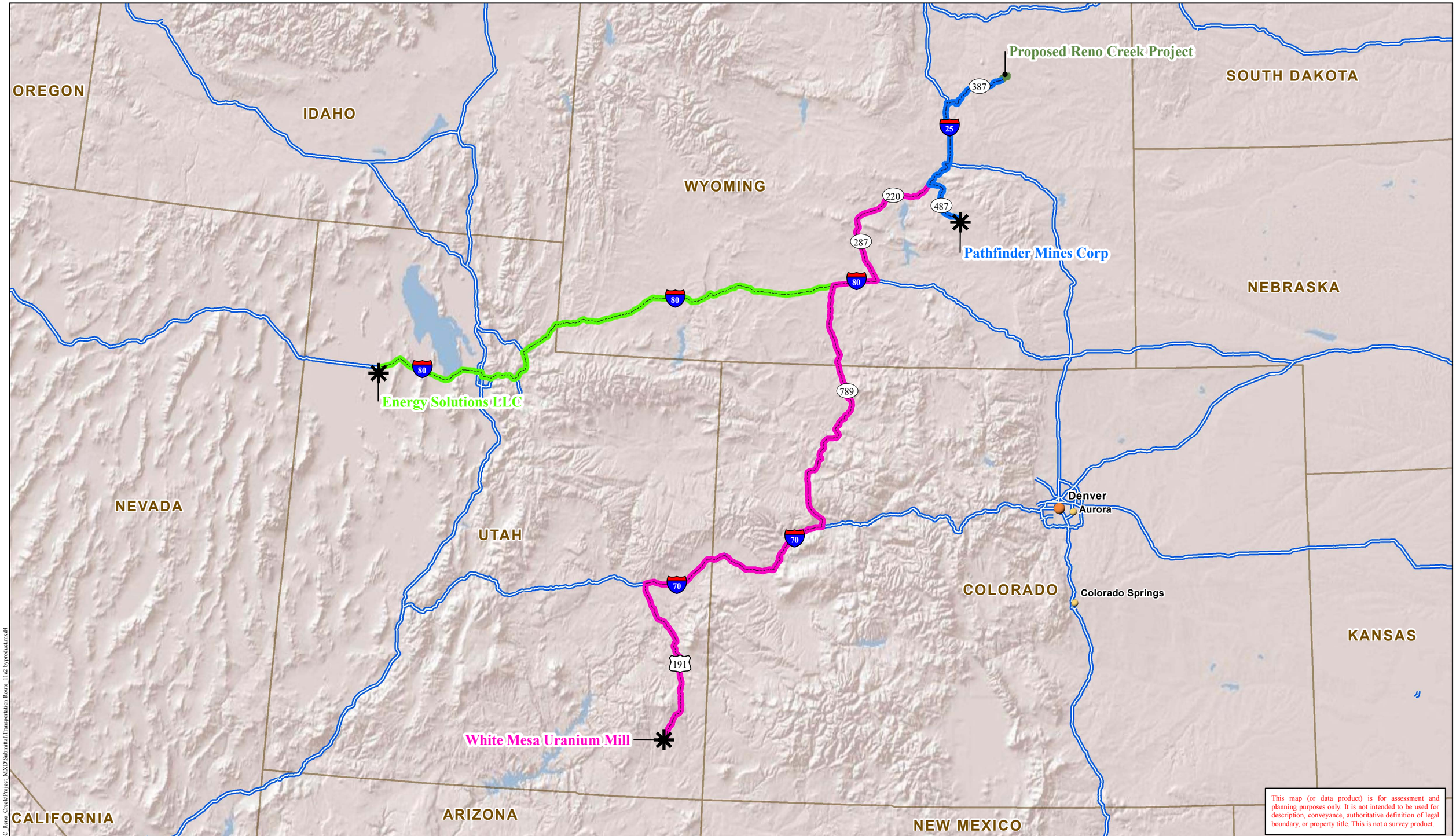
0 25 50 100 150 Miles
1:5,000,000

N W E S

DRAWN BY: RHK
CHECKED BY: RMD
APPROVED BY: JEY

Yellowcake Conversion Facility Transportation Route
Honeywell International Inc., Metropolis, Illinois

REV #	DESCRIPTION	BY	DATE	FIGURE
0	Draft for Review	RHK	02/11/12	4-1
1	Final	RHK	02/12/12	
2				



This map (or data product) is for assessment and planning purposes only. It is not intended to be used for description, conveyance, authoritative definition of legal boundary, or property title. This is not a survey product.

Path: O:\WY Projects\2010-100 AUC Reno Creek\Project MXD\Submittal\Transportation Route 11e2 byproduct.mxd4

TREC, Inc.
Engineering & Environmental Management

900 Werner Court
Suite 150
Casper, WY 82601

Phone (307) 265-0696
Fax (307) 265-2498
www.treccorp.com

PROPOSED RENO CREEK PROJECT
CAMPBELL COUNTY, WY

PREPARED FOR AUC LLC
LAKEWOOD, CO

Legend
- Proposed Reno Creek Project Boundary
- US Interstate System

Route To:
- Pathfinder Mines Corp
- White Mesa Uranium Mill
- Energy Solutions LLC

0 25 50 100 Miles

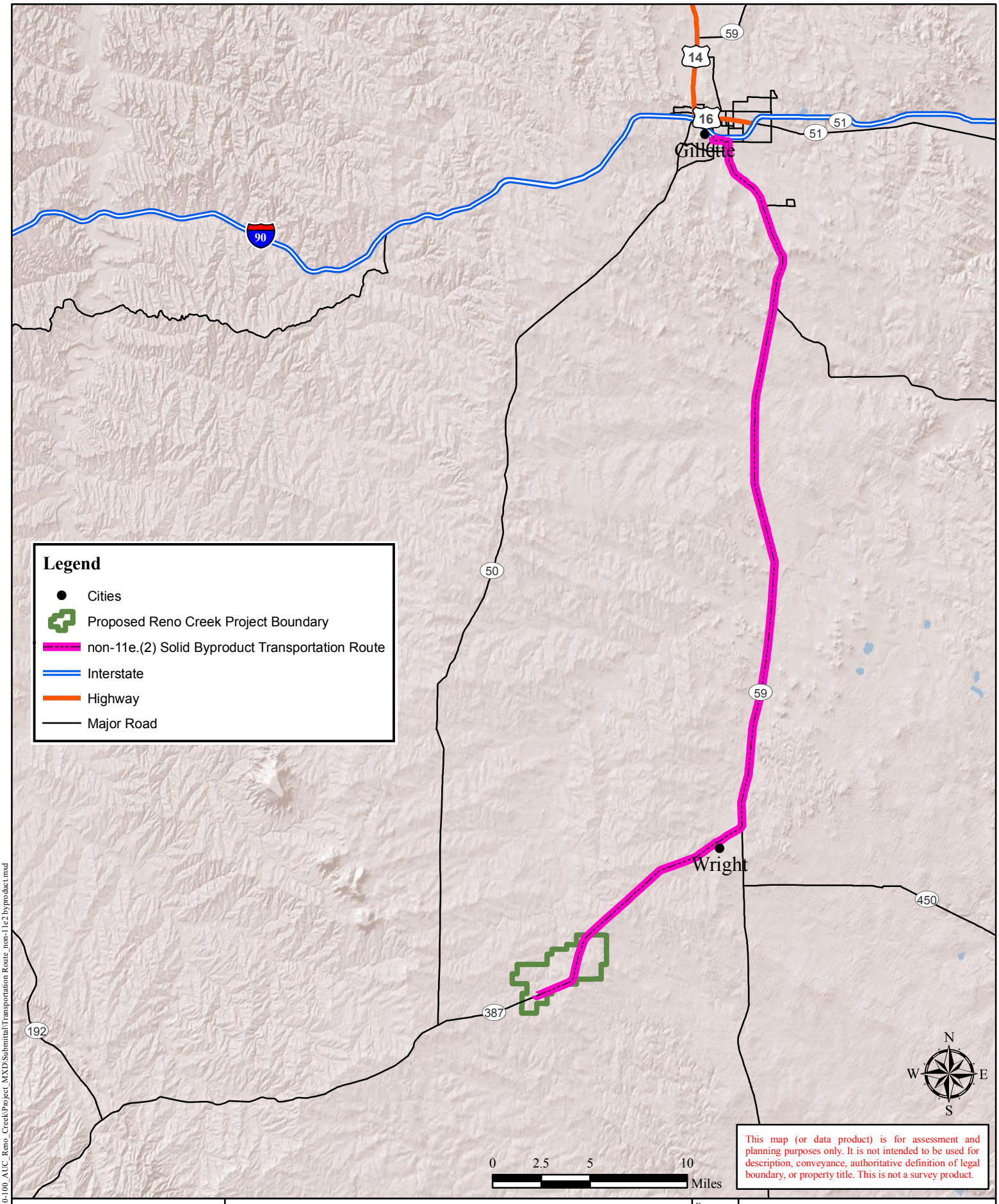
1:3,500,000

N W E S

DRAWN BY: RHK
CHECKED BY: RMD
APPROVED BY: JEY

11e.(2) Solid Byproduct Transportation Routes

REV #	DESCRIPTION	BY	DATE	FIGURE
0	Draft for Review	RHK	02/11/12	4-2
1	Final	RHK	02/12/12	
2				



This map (or data product) is for assessment and planning purposes only. It is not intended to be used for description, conveyance, authoritative definition of legal boundary, or property title. This is not a survey product.

Path: O:\WY_Projects\2010-100_AUC_Reno_Creek\Project_MXD\Submittal\Transportation Route_non-11e2 byproduct.mxd

TREC, Inc.
Engineering & Environmental Management

900 Werner Court
Suite 150
Casper, WY 82601

Phone (307) 265-0696
Fax (307) 265-2498
www.treccorp.com

Proposed Reno Creek Project, Campbell County, Wyoming
AUC, LLC, Lakewood, Colorado
non-11e.(2) Solid Byproduct Transportation Route
Campbell County Landfill

Drawn: RHK
Checked: RMD
Approved: JEY

Figure 4-3

Rev. #	Description	Date
0	Draft for Review	02/11/2012
1	Final	02/12/2012
2		

4.3 Potential Geology and Soil Impacts

4.3.1 Proposed Action

Potential impacts to geology and soils may occur during all phases of the Proposed Action; however, the potential impacts would largely be concentrated during the construction phase of the Proposed Project. Construction of the CPP and associated facilities, Production Units, access roads, deep disposal wells, pipelines, and utilities. Activities potentially resulting in soil impacts include clearing vegetation, topsoil stripping, excavation, backfill, compaction, grading, and utility and pipeline trenching.

Based on the soil mapping unit descriptions in Section 3.3, the potential for water erosion within the Proposed Project area varies from small to moderate and the potential for wind erosion varies from small to large. The potential for wind and water erosion is mainly a factor of surface characteristics of the soil, including texture and organic matter content, and the size of the area exposed. General topography of the area includes rolling hills and ridges, as well as drainages. The soils occurring on the Proposed Project site are generally loamy throughout with patches of sandy loam on upland areas and fine textured soils occurring near or in drainages. The project area contains deep soils on lower toe slopes and flat areas near drainages with shallow and moderately deep soils located on upland ridges and shoulder slopes. Given the texture of the surface horizons throughout the majority of the Proposed Project area and the semi-arid climate, the soils are more susceptible to erosion from wind than water. See Table 3.3B-6 in Addendum 3.3-B of this ER for a summary of wind and water erosion hazards within the Proposed Project area.

Few areas within the Proposed Project area will sustain long term subsoil disturbance due to the relatively minor amount of surface area affected by facility construction and the fact that wherever practicable, AUC will immediately revegetate disturbed areas. Primarily disturbances will occur at the location of the proposed CPP, and at the location of the proposed backup lined storage pond. The location of the proposed CPP and associated backup storage pond are shown in ER Figure 1-6. Following the decommissioning of the facility, the topsoil will be replaced and contoured consistent to pre-disturbance topography. The CPP and related facilities will cover approximately 15.5 acres. If all 15.5 acres require topsoil salvage, approximately 12.95 acre-feet of topsoil will be salvaged for later use. If a landowner petitions to acquire the CPP building, and AUC determines this can be accomplished economically, the CPP building and property potentially will be surveyed for residual contamination and decontaminated to unrestricted use classification prior to being turned over to the requesting landowner. In the event the CPP buildings and infrastructure are transferred, then there will be no project specific long term soils impacts.

4.3.1.1 Potential Construction Impacts

There is very limited long term and minor short term potential impact to geology and soils due to the shallow depth of disturbance and minimal acreage of surface disturbance associated with ISR facility construction. Primarily because all soils will be appropriately stripped, stockpiled, and stabilized for reuse later in the project schedule.

4.3.1.1.1 Potential Construction Impacts to Geology

Potential geological impacts could only occur during construction and decommissioning, when relatively minor, temporary disturbance will occur near the soil surface. NUREG-1748 notes that geological resources are more likely to exert an impact than be impacted by the Proposed Action. The main probable geologic hazard present in Wyoming is earthquakes.

Section 3.3.5 describes the seismic hazard of the Proposed Project area. This section describes how there are no active faults with surface expression in or near the Proposed Project area. Earthquake probabilities and consequences are discussed in Section 3.3, including current earthquake probability maps that are used in the newest building codes (2,500 year maps), which suggest a scenario that will result in moderate damage to buildings and their contents. The probability-based worst-case scenario could result in an Intensity VII earthquake in the area of the Proposed Project. In intensity VII earthquakes, damage is negligible in buildings of good design and construction, slight-to-moderate in well-built ordinary structures, considerable in poorly built or badly designed structures such as unreinforced masonry buildings. The proposed CPP and associated structures will be built to withstand an intensity VII earthquake.

The 2,500-year probabilistic map presented in TR Addendum 2.6C-6 shows that the peak ground acceleration with a 2% probability of exceedance in 50-years is 10 to 12 percent/g, which equates to a Level IV earthquake. Level VI earthquakes are felt by almost everyone around but do not cause significant damage. Since structures at the Proposed Project will be designed according to the 2,500-year probabilistic map, the risk of significant earthquake damage to the proposed facilities is small, as the total anticipated project life is approximately 16 years.

4.3.1.1.2 Potential Construction Impacts to Soils

Potential soil impacts include soil loss, compaction, salinity, loss of soil productivity, and soil contamination. Construction activities at the Proposed Project site will result in a small and temporary disturbance of the soil. Approximately 154 acres or 2.5 percent of the total 6,057 acre Proposed Project area will be affected as a result of vegetation and

topsoil removal activities throughout the life of the project. Topsoil will be removed and stockpiled during construction and will be stabilized to minimize erosion for later use in the decommissioning phase of the project as required. Stockpiles and denuded soil surface will be stabilized by seeding with a cover crop to minimize erosion, in accordance with SOPs prepared post-licensing. Detailed soil impact mitigation measures are found in ER Section 6.3.

4.3.1.2 Potential Operation Impacts to Geology and Soils

4.3.1.2.1 Potential Operations Impact to Geology

Potential geological impacts from operations are highly unlikely and expected to be small. No significant matrix compression or ground subsidence is expected, as the net withdrawal of fluid from the target sandstone during operations and restoration will be on the order of one percent or less. Further, once ISR and restoration operations are completed, groundwater levels will return to near original conditions under a natural gradient.

As previously mentioned in Section 4.3.1.1, the primary geologic hazard to the facility is that from earthquakes, which could potentially damage a pipeline, process vessel, chemical storage tank, or the lined backup pond and cause a contaminant release. Since the low probability of an earthquake occurring in the relatively short project schedule and that the CPP building will be designed according to the 2,500-year probabilistic map, the risk of contaminant release from an earthquake is very small.

4.3.1.2.2 Potential Operation Impacts to Soils

Potential impacts to soils from operations are more likely than geological impacts but are still expected to be small. The three most likely potential impacts are:

- Soil compaction;
- Leakage or spills of lixiviant; or
- Erosion by wind and water.

Soil Compaction

During operation, potential soil impacts could occur from compaction, especially vehicles driving on wellfield access roads. Soil compaction could occur on all access roads, but potential impacts would be most noticeable on tertiary access roads, which will typically be unconstructed, 2-track roads without gravel surfacing. These roads will be used

throughout operation for monitor well sampling and MITs. Compaction will be mitigated by ripping tertiary roads during reclamation and importing topsoil if needed during decommissioning.

Leakage or Spills

During operation, there will be additional soil contamination risks that require specific mitigation measures. These include potential spills from pipelines, header houses, and process vessels. Process monitoring of wellfields and pipelines in the Production Units will detect leaks or spills of lixiviant. Process monitoring will include continuous measurement of flows and pressures for injection and recovery trunklines and feeder lines, inclusion of leak detection sensors in valve manholes, and inclusion of leak detection sensors in well head sumps.

Engineering controls will ensure that there is minimal potential impact to soil from the inadvertent release of process fluids or chemicals within the CPP area. Within the CPP area, potential releases of process fluids or chemicals to the environment include leaking pipelines, leaking chemical storage tanks or process vessels, transportation accidents, or leaking backup pond. The first level of protection is primary containment within pipelines, vessels, ponds, etc., all of which will be leakage tested during construction. The second level of protection is secondary containment. Secondary containment will be provided in the form of curbs, berms, and sumps for chemical storage tanks, process vessels, and all piping and equipment inside the CPP building. A double liner and leak detection system will also be provided for the backup pond within the CPP area.

Water and Wind Erosion

The CPP is underlain by soils with Small to Moderate risks for wind and water erosion. The soils underlying the Proposed Production units are at a Small to Large short term risk of wind erosion and Small to Moderate risk of erosion from water. Though no topsoil will be stripped from the Production Units, construction may result in an increase in the erosion hazard from both wind and water due to the removal of vegetation and the physical disturbance by heavy equipment. Mitigation measures for potential soil impacts are described below and in Section 6.3.2 of this document.

Soil erosion mitigation will be implemented in accordance with WDEQ/LQD Rules and Regulations, Chapter 3, Environmental Protection Performance Standards, consistent with other licensed ISR facilities in Wyoming. Erosion protection measures that may be implemented at the Proposed Project may include the following:

- Temporary diversion of surface runoff from undisturbed areas around the disturbed areas and the use of water velocity dissipation structures;

- Retaining sediment within the disturbed areas through the use of BMPs such as silt fencing, retention ponds, or other effective means; and
- Salvage and stockpiling of topsoil from the CPP areas and from secondary production Unit access roads in a manner to avoid wind and/or water erosion.

4.3.1.3 Potential Groundwater Restoration Impacts

Potential impacts during groundwater restoration phases of the Proposed Project may include soil compaction and contamination from potential spills and leaks. Generally, the risks will be less than those occurring during operation or construction, since there will be less production unit traffic compacting soils and smaller fluid volumes transported (NUREG-1910). No potential impacts to geology have been identified during groundwater restoration.

4.3.1.4 Potential Decommissioning Impacts

As noted in NUREG-1910 (GEIS Section 4.3.3.4), the potential geologic impacts will be temporary and small during this phase of the Proposed Project. The goal of decommissioning and reclamation is to restore the Proposed Project area consistent with pre-production conditions.

During decommissioning, potential soil impacts will be similar to those occurring during construction. The risk of compacting soil will temporarily increase due to increased heavy equipment operation. This is due in part to the heavy machinery that will be utilized along with the potential removal of any contaminated soil. These will be mitigated by ripping compacted soils prior to topsoil replacement and re-seeding and by immediately cleaning up any oil or fuel contaminated soil.

4.3.2 No Action Alternative

There will be no impacts to geology or soils under the No Action Alternative since the Proposed Project will not be constructed.

4.4 Potential Water Resources Impacts

The Proposed Action has the potential to impact surface water and groundwater to varying degrees during each phase of the project. As discussed in ER Section 3.4, surface water and groundwater within the Proposed Project area are used for livestock and wildlife watering and industrial use.

4.4.1 Potential Surface Water Impacts

The Proposed Project site is located within two drainage basins: Antelope Creek and the Upper Belle Fourche River basins. Addendum 2.7-A of the TR depicts the relation of the drainage features to the proposed facility. The site will be constructed to minimize the potential impacts to the drainages.

No active drainages or bodies of water will be significantly modified or altered within the Proposed Project during construction or operations. The potential for erosion is present due to the construction of wells near drainages, however, disturbance is short-term and disturbed areas will be reseeded soon after the production units are constructed, in accordance with previously licensed ISR operations.

4.4.1.1 Potential Construction Impacts to Surface Water

Natural flow in the region is categorized as ephemeral and flows rarely, only occurring during snowmelt and rainstorm events. The headwaters of the Belle Fourche River are located within the Proposed Project area., The Belle Fourche River can be characterized as an ephemeral channel with isolated pockets of water and wetlands. Stock tanks and reservoirs are scattered throughout the Proposed Project area, however, these usually do not contain water, or very little water, by late in the summer season.

The primary potential impact from the removal of vegetation and disturbance of soil is water quality degradation. Surface water quality within the proposed project area has the potential to be adversely impacted by increasing suspended sediment concentrations due to vegetation removal and soil disturbance. A summary of the proposed disturbance is presented in Table 4-1. This includes disturbance of up to 154 acres during the life of the Proposed Action, or about 2.5 percent of the Proposed Project area. ER Figure 1-5 depicts the location of all facilities proposed within the Proposed Project area. During construction temporary sediment control features will be used until vegetation can be re-established to minimize the potential impacts to surface water due to vegetation removal and soil disturbance. Temporary sediment control features include sediment logs, silt fence, straw bale, or other BMPs.

Construction activities for the Proposed Project CPP, ancillary structures, Production Units, and access roads have the potential to temporarily increase the sediment yield of the disturbed areas. The site disturbing activities will include vegetation removal and topsoil stockpiling, limited periods of low impact stream channel disturbance and minor wetland encroachment. These activities have the potential to result in minor hydrocarbon spills, primarily related to fuel and lubricants from heavy equipment operation.

There will be minimal impacts on ephemeral stream channels from construction activities. Roads will be constructed in a manner so as to avoid the ephemeral stream channels where possible. BMPs will be implemented in the occurrence of stream channel crossings. Such BMPs will be consistent with those applied at other licensed ISR facilities.

Construction activities at the CPP, Production Units, along pipeline alignments, and roads have the potential to temporarily increase the sediment yield of disturbed areas. However, the relative size of these disturbances is small when compared to the size of the overall project areas and to the size of the watersheds, and also will have only a short-term impact. Since Production Unit decommissioning and reclamation activities will be on-going throughout the life of the project, the area to be reclaimed at the conclusion of operations will be reduced, although a slight increase in sediment yields and total runoff can still occur. Since all natural flow within the Proposed Project area is ephemeral with no intermittent or perennial streams, potential impacts to surface water from construction, operations, and decommissioning activities are also limited to uncommon precipitation or runoff events.

A Large Construction General Permit (CGP) will be developed by AUC and will be issued from the WDEQ Stormwater Program. Also, a Storm Water Pollution Prevention Plan Permit (SWPPP) will be developed and implemented with oversight by the WDEQ. This will address all storm water drainage impacts from erosion and sedimentation during Proposed Project construction activities. Wyoming Pollutant Discharge Elimination System (WYPDES) permits will be obtained in accordance with WDEQ-WQD regulations. BMPs will be implemented to reduce impacts in accordance with storm water management plans developed for those permits.

4.4.1.2 Potential Operation Impacts to Surface Water

During operation, there are few surface disturbing activities, and vegetation will have been re-established in previously disturbed construction areas. Therefore, the potential water quality impacts from sediment transport will be much lower during operation than during construction. Since new Production Units will continually be constructed during operation, sediment control BMPs will continue to be implemented to ensure that potential sediment transport and related surface water impacts remain small.

Prior to operation, AUC will apply for a WYPDES Storm Water Permit and as such prepare a SWPPP that describes erosion and sediment controls along with operational controls. Part of the WYPDES permit requirements will be written into the SWPPP, ensuring qualified AUC personnel will implement storm water BMPs and obtain discharge samples to ensure compliance with effluent limitations.

Surface facilities including the CPP, Production Units, access roads, pipelines, will not significantly change peak surface water flows. This is due to the topography of the drainages at the site and the low regional precipitation and the absorptive capacity of the soils in the Proposed Project area. In areas where these structures may affect surface water drainage patterns, diversion ditches, and culverts will be used to prevent excessive erosion and control runoff. In areas where runoff is concentrated, energy dissipaters are used to slow the flow of runoff to minimize erosion and sediment loading in the runoff.

Surface water quality could potentially be impacted by exceptional circumstances such as excessive rainwater or runoff in impacted soil areas, or an accidental release of process liquids due to a CPP or Production Unit spill. Section 6.4.2.2.7 of this ER presents a discussion of the measures to be used to prevent, control, and remediate Production Unit spills. Process buildings and chemical storage areas will be constructed with sumps and secondary containment berms/curbing. A regular program of inspections and preventive maintenance will be implemented.

4.4.1.3 Potential Groundwater Restoration Impacts to Surface Water

Potential surface water impacts from groundwater restoration activities are similar to those occurring during operations. These potential impacts include sediment transport due to surface disturbing activities, potential releases of process fluids or chemicals from leaks, spills or equipment ruptures in the Production Unit or proposed CPP area. These potential impacts are all expected to be similarly small to those resulting from operational activities. Surface disturbing activities will be limited during groundwater restoration, reducing the potential for sediment transport from disturbed areas. During groundwater restoration the same levels of protection described previously will be provided to minimize potential surface water impacts from unintended release of process fluids or chemicals within the Production Unit or proposed CPP area.

4.4.1.4 Potential Decommissioning Impacts to Surface Water

Sediment yield and storm water runoff has the potential to increase during decommissioning due to disturbances associated with equipment and structure removal and site soil reclamation activities, especially in the area of the CPP. Surface water impacts during decommissioning will be minimized through implementation of sediment

control and operational BMPs that will be described in the SWPPP and be available to NRC for inspection after license issuance. In general, potential impacts will be slightly less than those discussed during construction, since reclamation and decommissioning of the Production Units will be ongoing throughout the life of the project, thereby reducing the area of disturbance during final decommissioning activities.

4.4.1.5 No Action Alternative

There will be no impacts to surface water from the No Action Alternative since the Proposed Project will not be constructed.

4.4.2 Potential Groundwater Impacts

The potential groundwater impacts of ISR operations are primarily related to the consumption of groundwater and short and long term changes to groundwater quality within the production zone and potential impacts on adjacent non-exempt drinking water aquifers. The most significant environmental impact that could occur as a result of ISR operations is the potential to impact adjacent non-exempt drinking water aquifers.

According to NUREG-1910 (SEIS, Supplement 3, Section 4.5.2.1.2.2), excursions have occurred at ISR operating facilities. Following analysis of 60 events by NRC staff at Commission request, most excursions were controlled through pumping and extraction of nearby wells. NRC staff reported "excursion events are not necessarily environmental impacts, but just indicators of the unintended movement of production fluids. Most excursions were short-term, although a few of them continued for several years. None had resulted in environmental impacts." (Memorandum dated July 10, 2009 from Charles L. Miller to Chairman Jaczko, Commissioner Klein, and Commissioner Sviniki).

Any long term potential impacts are mitigated by groundwater restoration processes.

4.4.2.1 Potential Construction Impacts to the Surficial Groundwater

No near-surface or Surficial Aquifer exists on the Proposed Project, as is described in Section 2.7 of the TR. As a result, the first aquifer that potentially could be impacted by spills of lixiviant or other process fluid is the Overlying Aquifer (OA), which the top ranges from 70 to 155 feet below ground surface. Because the Overlying Aquifer is overlain everywhere across the Proposed Project by a continuous mudstone (See TR Section 2.6), the potential of construction activities to create an impact to groundwater is Small.

4.4.2.2 Potential Construction Impacts to Overlying and Production Zone Aquifers

Water quality of the Overlying Aquifer (OA) and Production Zone Aquifer (PZA) at depth should not be impacted during the construction phase. In addition, as indicated in Section 4.2.4.2.1 of the ISR GEIS, the amounts of groundwater typically used for dust suppression, cement mixing and drilling support are small and would have a small and temporary impact to groundwater supplies.

Improperly abandoned boreholes could result in the mixing of groundwater from the PZA with the Overlying Aquifer. AUC development and delineation drilling programs within and adjacent to the Proposed Project area have and will continue to comply with WDEQ/LQD guidelines for borehole abandonment.

Well installation programs also have the potential to impact groundwater quality in the Overlying Aquifer by mixing with PZA groundwater through poor well completion techniques and lack of well integrity. AUC employs on-site geologic oversight during any drilling project for all phases of well drilling, installation and abandonment. On-site geological supervision would continue during the construction phase to ensure proper well installations. Production wells will pass MIT prior to utilization. Detailed well completion data including WSEO permits, MIT documentation and cement volume calculations will be provided with the wellfield data package in support of the Class III Injection Permit application required by WDEQ/LQD. Based on this evaluation, construction impacts to deeper aquifers are expected to be small.

4.4.2.3 Potential Operation Impacts on Groundwater

During uranium recovery operations, potential impacts to groundwater may result from spills and leaks, excursions, wellfield development drilling, and deep well injection. A number of factors limit the potential for these impacts, including natural conditions, regulatory oversight and final restoration of the exempted aquifer. Natural conditions that limit impacts include geologic isolation of the mineralized sandstones, which results in the hydraulic confinement within the mineralized intervals. A second factor limiting the potential for impacts lies in the amount of regulatory oversight required to recover uranium via these methods. Regulated techniques for ISR operations, including well construction, MIT, Production Unit pump tests, UCLs for highly mobile constituents to provide "early warning" of potential excursions, extensive monitor well systems, and wellfield balance and bleed, have evolved to the point where these procedures complement and enhance the above-noted naturally occurring conditions to provide ongoing, iterative mitigation measures with the flexibility to adjust to site-specific conditions in order to protect adjacent sources of drinking water. Finally, restoration of

the exempted aquifer following operations provides a third significant factor limiting the potential for impacts.

4.4.2.3.1 Potential Operation Impacts to Surficial Groundwater Quality

No near-surface or Surficial Aquifer exists on the Proposed Project, as is described in Section 2.7 of the TR. As a result, the first aquifer that potentially could be impacted by spills of lixiviant or other process fluid is the Overlying Aquifer (OA), which the top ranges from 70 to 155 feet below ground surface. Because the Overlying Aquifer is overlain everywhere across the Proposed Project by a continuous mudstone (See TR Section 2.6), the potential of construction activities to create an impact to groundwater is small.

4.4.2.3.2 Potential Operation Impacts to Groundwater Quality of OA and PZA

During operations, the groundwater quality in the production zone exempted aquifer will be impacted as part of the ISR uranium recovery process. Uranium in the ore zone will be oxidized and mobilized by introducing lixiviant into the PZA through the Class III injection wells. In addition to the uranium other constituents will be mobilized, including redox sensitive trace metals. Impacts to the exempted aquifer water quality will be short term, since groundwater restoration will take place in a phased manner with uranium recovery.

Excursions of lixiviant at ISR facilities have the potential to impact adjacent, non-exempt aquifers with constituents that have been mobilized by the ISR process. These excursions may be classified as horizontal or vertical. A horizontal excursion is a lateral movement of processing solutions outside the subsurface recovery zone of the ore-body aquifer to a monitor well. A vertical excursion is a movement of solutions into an overlying aquifer monitor well (there being no underlying aquifer at the Proposed Project).

Potential impacts to groundwater from the proposed lixiviant result from:

1) Addition of sodium bicarbonate and or carbon dioxide and oxidant to the groundwater;
2) Addition of chloride to the groundwater by the proposed CPP; and
3) Interaction of these chemicals with the mineral and chemical constituents of the Production Zone Aquifer (PZA) being milled. The result is that during the ISR operations, the concentration of some of the naturally occurring dissolved constituents in the PZA will be higher than prior to ISR operations.

According to NUREG-1910 (GEIS, Supplement 3, Section 4.5.2.1.2.2), excursions have occurred at ISR operating facilities. Following analysis of 60 events by NRC staff, most excursions were controlled through pumping and extraction of nearby wells. *In all cases, however, none of these excursions resulted in environmental impacts to adjacent aquifers* (NRC Report to Commission, 2009).

Potential groundwater quality impacts in adjacent non-exempt aquifers from ISR activities are related to the identification, control, and clean-up of excursions. During production, injection of the lixiviant into the Production Unit results in a temporary degradation of water quality compared to pre-operational conditions. Movement of water out of the recovery area to a monitor well, as demonstrated by an exceedance of UCL constituents is an excursion. Past experience from other commercial scale ISR projects in the PRB has shown that with proper steps in monitoring and operating a Production Unit, excursions, if they do occur, can be controlled and recovered through adjustment of the water balance and bleed, such that impacts to groundwater quality are prevented.

No stock or drinking water wells will be located in the currently proposed ISR operation areas and will not be completed in the ore bearing aquifer where production will occur. If future development includes an area(s) where a stock well is located in an ISR production aquifer, AUC commits to the following measures:

- Replacing the wells with new wells completed in either shallower or deeper sands that are not impacted by ISR operations; or
- Providing another source of stock water.

With proper Production Unit balance, ISR operational fluids can be controlled and confined to the PZA until restoration efforts are employed to cease and reverse the oxidation process. As a result, no impacts are anticipated in PZA or OA water quality.

4.4.2.3.3 Potential Operational Impact on Groundwater Quantity

AUC will process up to 11,000 gallons per minute in the Proposed Project CPP for uranium recovery operations. During the short period when only production is occurring prior to the commencement of restoration, the bleed will average up to 1 percent of the lixiviant flow from the Production Units. An average production bleed rate of 1 percent has been successfully used during ISR operations at other ISR facilities, and its appropriateness is demonstrated by the ground water model in Section 2.7 of the TR. During the concurrent production and restoration phase, the average total bleed will rise to as much as 1.2 percent of the lixiviant flow from the Production Units. Thus, water consumption during production and restoration will be slightly higher than during production alone.

As demonstrated by the groundwater model, the potential impact from consumptive use of groundwater is expected to be Small. Potential impacts on groundwater due to consumptive use outside of the Proposed Project area are expected to be negligible.

The numerical groundwater flow model which is included as TR Addendum 2.7-C indicates that an average production bleed rate of one percent will be sufficient to maintain an inward gradient in both the fully and partially saturated portions of the PZA during uranium recovery operations. Also, as demonstrated from the numerical groundwater flow model, the amount of consumptive use during all phases of the Proposed Project will generate negligible drawdown outside of wellfield areas. As a result, no potential impact to other users of groundwater in the area is expected since there is minimal use of groundwater in the recovery zone sands near or adjacent to the wellfield areas. For the same reasons, no potential impacts to water users outside of the Proposed Project boundary are expected.

To assess the impacts from ISR operations and restoration operations on local groundwater, background water levels will be measured in the private domestic or livestock water wells surrounding the project area before ISR operations and every three months during operations;

If significant impacts to either the adjacent domestic wells or to stock wells in the vicinity of the Proposed Project are observed (e.g., water levels drop to a point that impairs the usefulness of the wells), the following mitigation measures will be considered:

- Lowering the pump level in the wells, if possible;
- Deepening the wells, if possible; or
- Replacing the wells with new wells completed in sands that are not impacted by ISR operations.

4.4.2.3.4 Potential Operation Impacts to Groundwater from Deep Disposal Wells

AUC proposes to utilize up to four Class I Deep Disposal Wells within the Proposed Project area. The Class I UIC permit application for the Proposed Project can be found in TR Addendum 4-B.

The wells will target the Cretaceous Teapot and Parkman sandstones at depths of approximately 7,450 to 8,390 feet BGS. The target interval is overlain by the Lewis Shale which is a low-permeability marine shale with a thickness of approximately 850 feet at the Proposed Project. The Teapot and Parkman sandstones are underlain by the Steele Shale. The Steele shale is low-permeability marine shale member within the massive Cody Shale. The Fox Hills sandstone and Lance Formation overlie the Lewis Shale. The

Fort Union and Wasatch Formations overlie the Lance Formation. The strata from the Fox Hills sandstone through the Wasatch Formation have the potential to be a USDW.

Water samples from nearby producing oil wells completed within the Parkman have a total dissolved solids (TDS) concentration of greater than 10,000 mg/l. The potential impacts to adjacent aquifers from injection into the deep disposal wells are negligible since the intervals are confined and located at least 500 feet below the deepest USDW.

4.4.2.4 Potential Groundwater Restoration Impacts

AUC's proposed aquifer restoration will include the following methods:

1) Groundwater transfer:
2) Groundwater sweep;
3) Reverse Osmosis Treatment with Permeate Injection and Reductant Addition;

These methods are discussed in more detail in in Section 6.1.4 of the TR. Potential impacts to groundwater quality and quantity during aquifer restoration are very similar to potential impacts described in the operations sections. Groundwater restoration will be done concurrently with operations where practicable as the potential exists for the two phases to interfere with one another. Consumptive use of groundwater during the aquifer restoration phase is generally greater than during ISR operations (ISR GEIS pg. 4.3-18).

4.4.2.4.1 Potential Restoration Impacts to Surficial Groundwater

No near-surface or Surficial Aquifer exists on the Proposed Project, as is described in Section 2.7 of the TR. As a result, the first aquifer that potentially could be impacted by spills of lixiviant or other process fluid is the Overlying Aquifer (OA), which the top ranges from 70 to 155 feet below ground surface. Because the Overlying Aquifer is overlain everywhere across the Proposed Project by a continuous mudstone (See TR Section 2.6), the potential of construction activities to create an impact to groundwater is Small.

4.4.2.4.2 Potential Groundwater Restoration Impacts to Water Quality on PZA and OA

The potential impacts to water quality of the deeper, confined aquifers during groundwater restoration are similar to those discussed in Section 4.4.2.3.2. The natural conditions present that work to protect adjacent, non-exempted aquifers will continue to prevent impacts to the water quality of the PZA and OA. In addition, through monitoring, instrumentation and control along with data capture and analysis, impacts during groundwater restoration will be minimized.

During restoration of the exempted aquifer, adjacent aquifers will be protected to their class of use and to applicable MCLs per EPA requirements in 40 CFR 141 and WDEQ/LQD requirements.

4.4.2.4.3 Potential Groundwater Restoration Impacts to Water Quantity on PZA and OA

Potential impacts to the water quantity of PZA and OA during groundwater restoration were addressed in detail in Section 4.4.2.3.3. The final phase of the Proposed Project will be groundwater restoration only. During this phase, the average bleed rate is expected to be 9 percent. However due to the lower flow rates recovered during groundwater restoration the consumption rate will be less than the consumption rates incurred during the production only and concurrent production and groundwater restoration phases. This scenario is also discussed in the groundwater model.

4.4.2.5 Potential Decommissioning Impacts

GEIS Section 4.3.4.2.4 describes the potential impact on groundwater during the dismantling and decommissioning of ISR facilities and states the impact would primarily be from consumptive groundwater use, potential spills of fuels and lubricants, and improperly plugged and abandoned wells. Consumptive groundwater use could result from the use of water for dust suppression, revegetation, and reclaiming disturbed areas. The potential impact during the decommissioning phase would be similar to potential impacts during the construction phase. Groundwater consumptive use during the decommissioning phase would be less than groundwater consumptive use during the ISR operation and groundwater restoration phases. Before NRC terminates an ISR source material license, AUC must demonstrate that there would be no long-term impacts to USDWs. NRC review and approval of the wellfield restoration would ensure that the restoration standards were met and were protective of public health and safety.

4.4.2.5.1 Potential Decommissioning Impacts to Surficial Groundwater

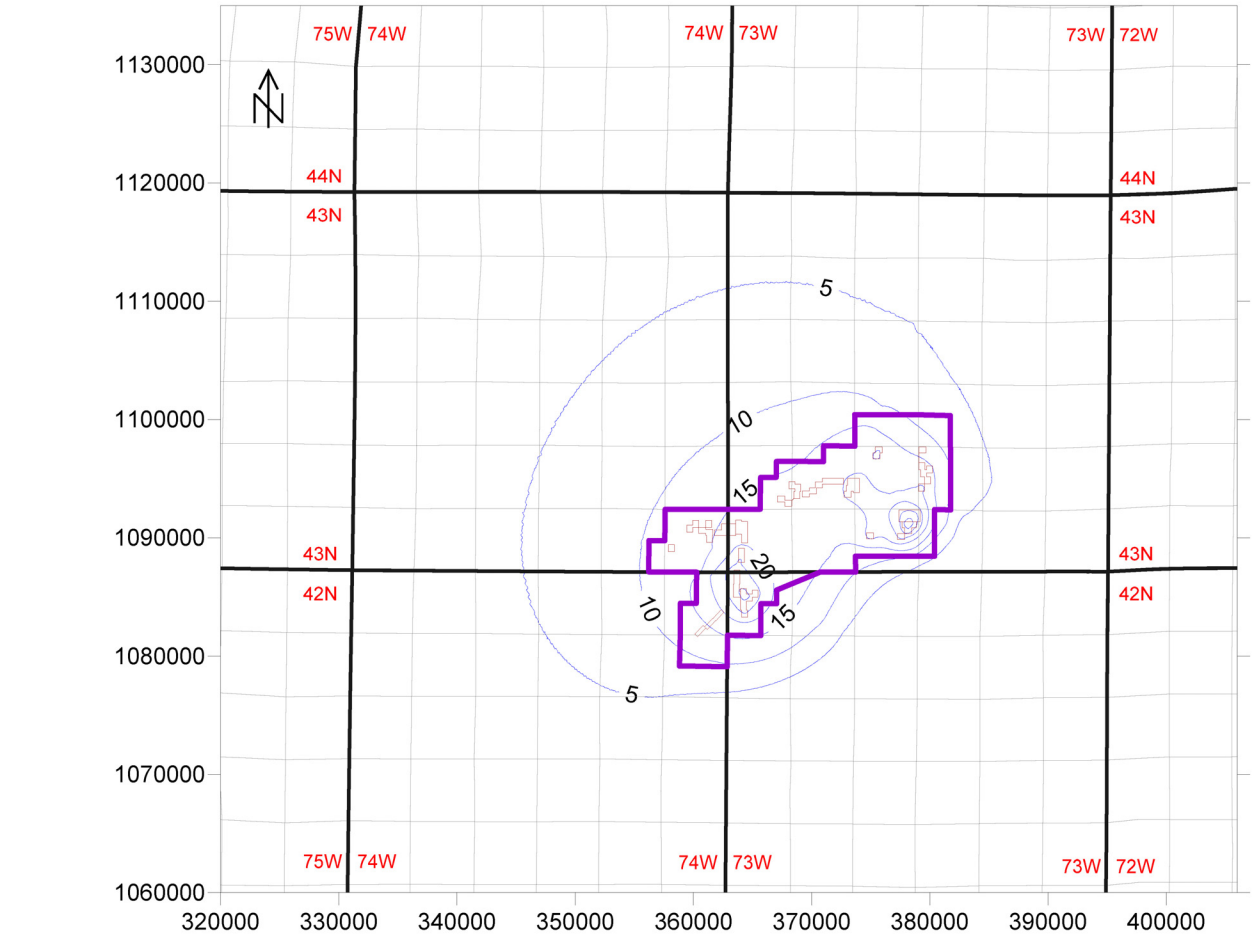
No near-surface or Surficial Aquifer exists on the Proposed Project, as is described in Section 2.7 of the TR. As a result, the first aquifer that potentially could be impacted by spills of lixiviant or other process fluid is the Overlying Aquifer (OA), which the top ranges from 70 to 155 feet below ground surface. Because the Overlying Aquifer is overlain everywhere across the Proposed Project by a continuous mudstone (See TR Section 2.6), the potential of construction activities to create an impact to groundwater is small.

4.4.2.5.2 Potential Decommissioning Impacts to PZA and OA

Water quality and quantity impacts to the deeper, confined groundwater during decommissioning will be small. The primary conduit for either a water quality or quantity impact is through improper plugging of the injection, recovery, and monitor wells. All plugging will be conducted in accordance with WDEQ/LQD Chapter 8 and 11 standards and follow methodology in AUC's plugging and abandonment and plan is provided in TR Addendum 2.6-B. In general, decommissioning impacts to the PZA and OA aquifers are expected to be small.

4.4.2.6 No Action Alternative

There will be no impacts to groundwater from the No Action Alternative since the Proposed Project will not be constructed.



10 Simulated Drawdown (ft amsl; 5 ft contour interval)

Production Units

Project Boundary

0mi 2mi 4mi

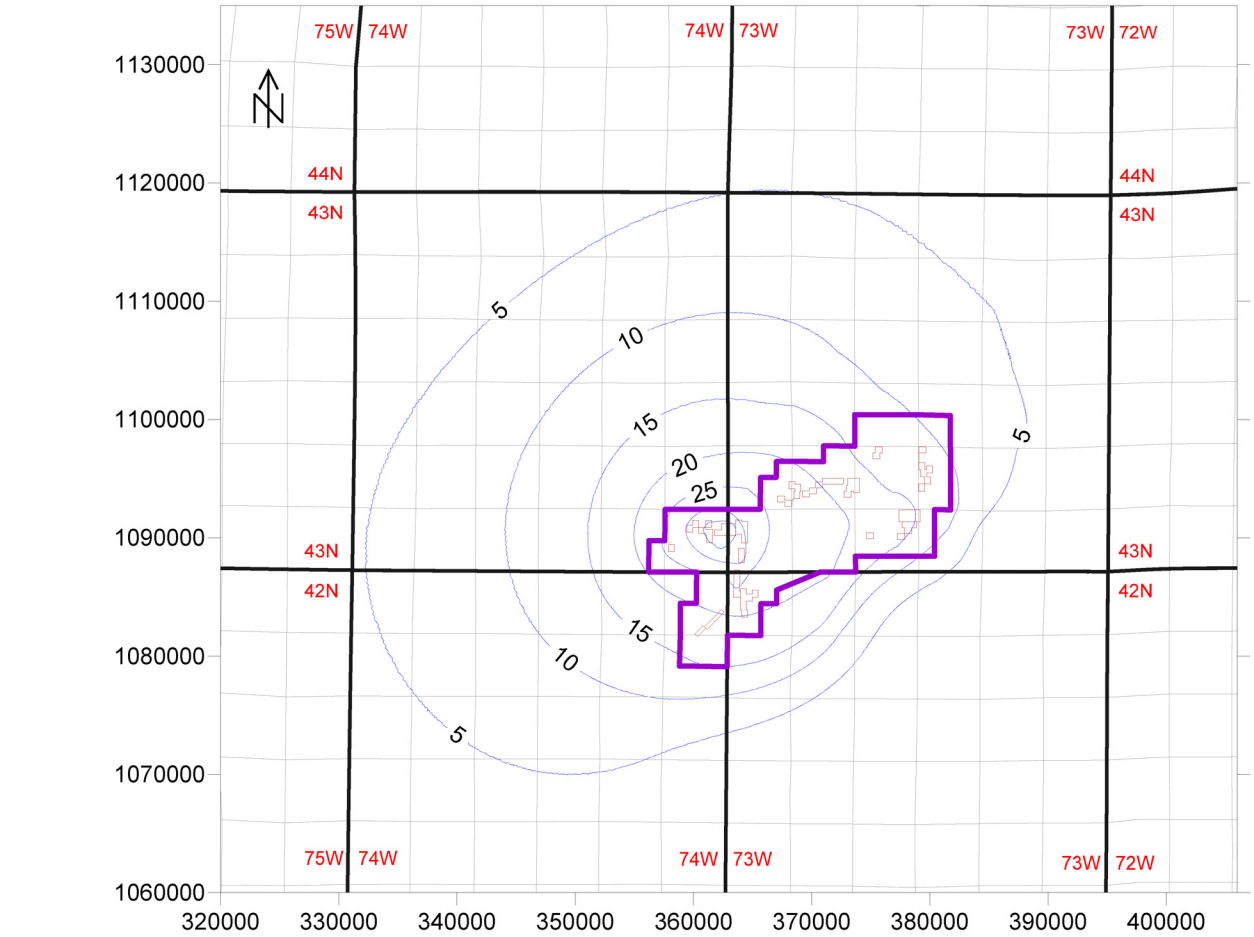
Petrotek

10288 W.Chatfield Ave, Ste 201
Littleton, CO 80127-4239

AUC LLC Reno Creek Project

Figure 4-4
Drawdown During Production Only

By: AP Checked: HD File ID:Fig_RCModel_31.srf Date: 8/15/12



10 Simulated Drawdown (ft amsl; 5 ft contour interval)

Production Units

Project Boundary

0mi 2mi 4mi

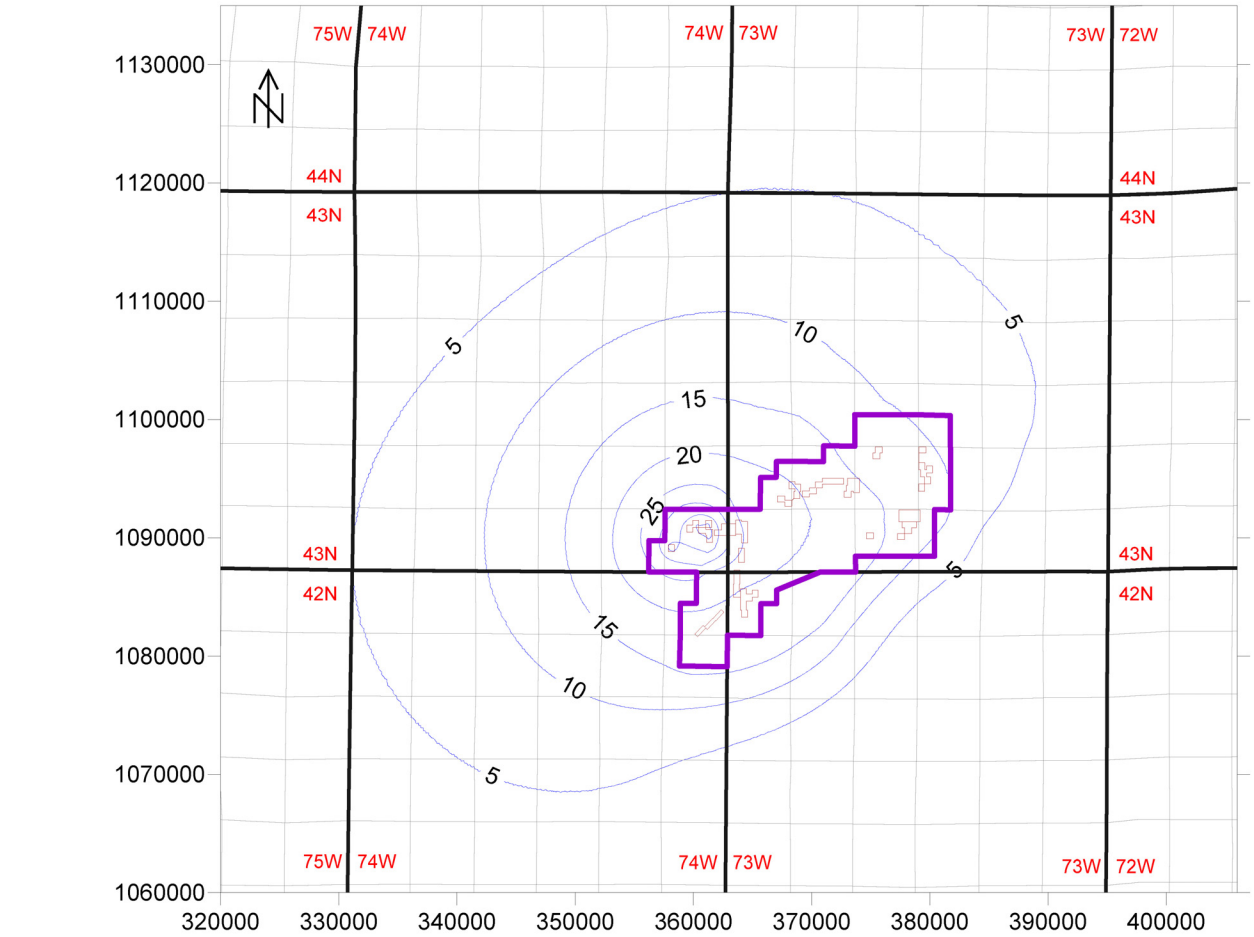
Petrotek

10288 W.Chatfield Ave, Ste 201
Littleton, CO 80127-4239

AUC LLC Reno Creek Project

Figure 4-5: Drawdown During Concurrent Production and Restoration

By: AP Checked: HD File ID:Fig_RCModel_31.srf Date: 8/15/12



10 Simulated Drawdown (ft amsl; 5 ft contour interval)

Production Units

Project Boundary

0mi 2mi 4mi

Petrotek

10288 W.Chatfield Ave, Ste 201
Littleton, CO 80127-4239

AUC LLC Reno Creek Project

Figure 4-6: Drawdown During Restoration Only

By: AP Checked: HD File ID:Fig_RCModel_31.srf Date: 8/15/12

4.5 Potential Ecological Resource Impacts

4.5.1 Proposed Action

The Proposed Action will consist of significant features associated with ISR recovery operations including a CPP and ancillary structures, Production Units, pipelines, and other supporting operations infrastructure. The Proposed Project will not control or disturb large expanses of habitat compared to that of conventional uranium recovery methods. Controlled areas located within the Proposed Project area will be minimal at approximately 481 acres or about 8 percent of the total Proposed Project area. Similarly, disturbed areas will be insignificant at approximately 154 acres or about 2.5 percent of the Proposed Project area. All disturbed areas will be reclaimed either at the completion of construction or during decommissioning. Once construction is complete, the disturbance area will be reduced to only what is needed to maintain operations. Limited habitat disturbance also results in fewer displaced animals from existing territories into other, potentially occupied areas, which reduces competition and stress on animals in both locations. There is potential for impacts to terrestrial and avian wildlife from process water and sediment in the lined backup storage pond. As noted in NUREG-1910 (GEIS Section 4.2.5.2), past experience at NRC-licensed ISR facilities has not identified potentially significant adverse impacts to wildlife from lined ponds. Therefore, the lined backup storage pond will be fenced to exclude wildlife and if significant avian wildlife injuries or deaths are noted then an avian deterrent system will be installed for the pond, consistent with other licensed ISR operations.

Given the factors outlined above, and the limited use of the Proposed Project area by most vertebrate species of concern, impacts to those species from ISR operations are expected to be small as described below. Mitigation measures designed to prevent or reduce impacts to wildlife are discussed in Section 6.5 of this ER. A detailed description of vegetation, terrestrial wildlife, fisheries, and threatened and endangered species associated with the Proposed Project area is contained in Section 3.5 of this ER.

4.5.2 Potential Construction Impacts to Ecological Resources

4.5.2.1 Vegetation

The CPP, Production Units, pipelines, and supporting infrastructure will be constructed primarily within the Big Sagebrush Shrubland plant community. To a lesser extent, the Meadow Grassland, Upland Grassland, and Breaks Grassland vegetation communities, as

well as previously Disturbed lands will also be potentially impacted by the construction of these facilities.

Direct impacts to plant communities within the construction footprint include the short-term and long-term loss of vegetation cover; productivity and long-term modification of structure; species composition; and areal extent of cover types. Indirect impacts will include the short-term and long-term increased potential for non-native species invasion, establishment, and expansion; exposure of soils to accelerated erosion; shifts in species composition or changes in vegetative density; reduction in livestock forage; and changes in visual aesthetics.

Construction activities, increased soil disturbance, and higher traffic volumes could potentially stimulate the introduction and spread of undesirable and invasive, non-native species within the Proposed Project area. Non-native species invasion and establishment has become an increasingly important result of previous and current disturbance in Wyoming. These species often out-compete desirable plant species, including special-status plant species, rendering an area less productive as a source of forage for livestock and wildlife. Additionally, sites dominated by invasive, non-native species often have a different visual character that may negatively contrast with surrounding undisturbed vegetation. The presence of three Wyoming State Designated Noxious Weeds, (Canada thistle, field bindweed, and Russian olive), was observed in the Proposed Project area during the baseline surveys along with other undesired annual grass species such as cheatgrass and Japanese brome. Therefore, potential impacts to vegetation will be Small, and generally short term.

Mitigation measures to lessen impacts on native vegetation and control Wyoming State Listed Noxious Weeds are discussed in Section 6.5.1.

4.5.2.2 Wetlands

A survey of potential wetlands was conducted within the entire Proposed Project area in accordance with the Regional Supplement to the USACE Wetland Delineation Manual: Great Plains Region (Version 2.0). Identification of potential wetlands was based on visual assessment of vegetation and hydrology indicators, as well as intrusive soil sampling to determine the presence of wetland criteria indicators. Hydrology and soils were evaluated whenever a plant community type met hydrophytic vegetation parameters based on the Dominance Test and Prevalence Index (as defined by the USACE Great Plains Regional Supplement), or whenever indicators suggested the potential presence of a seasonal wetland area under normal circumstances. Per the Great Plains Regional Supplement, for wetland delineation purposes, an area is considered to be vegetated if it has five percent or more total plant cover at the peak of the growing season.

Construction, operation, restoration, or decommissioning activities, which cause disturbance or potential impacts to jurisdictional wetlands on the Proposed Project site, will be performed in accordance with appropriate NWP, if applicable:

- NWP 44 non-coal recovery activities, which requires a PCN for all activities;
- NWP 12 utility line activities, which requires a PCN for an area where a Section 10 permit is required (utility installation in navigable waters), when a utility line in WoUS exceeds 500 feet, when a utility line is placed within a jurisdictional area and it runs parallel to a stream bed that is within that jurisdictional area, when more than 0.1 acre will be impacted, or when permanent access roads are constructed in WoUS with impervious materials; and
- NWP 14 (linear transportation projects) which requires a PCN for 0.5 acre in non-tidal waters and 0.33 acre in tidal waters.

NWP 44, NWP 12, and NWP 14 have an acreage impact limit of one-half acre for WoUS (e.g. jurisdictional). Impacts to WoUS are not considered under the acreage limit.

As a result of the NWP processes, the potential impacts to wetland areas are predicted to be small during all phases of the Proposed Project.

4.5.2.3 Wildlife and Fisheries

ISR uranium operations differ from conventional surface recovery by using less intrusive recovery methods that are more efficient and have less impact on the surrounding area. ISR operations use a series of injection and production wells that extract the uranium from the ore body without physically removing the ore or overburden from the area. The process area consists of a series of wells within a systematic pattern with a single processing facility to remove the uranium from the lixiviant. ISR operations have a much smaller impact footprint than conventional surface recovery because topsoil stripping and habitat destruction are restricted to relatively small areas needed for the processing facilities and the access roads. Detailed potential impacts to land use are discussed in Section 4.1.

As indicated, most of the habitat disturbance will consist of scattered, confined drill sites for wells that will not result in large expanses of habitat being noticeably transformed from its original character, during construction, operation, restoration or decommissioning. The disturbance will be slightly greater during construction, but re-seeding will be conducted immediately after completion. The nature of ISR operations decreases the occurrence of large-scale habitat alterations and, thus, the need for reclamation efforts that can result in noticeable differences between pre-construction and post-construction vegetative communities. Therefore, most potential indirect impacts that may occur relate to the displacement of wildlife due to increased noise, traffic, or lighting

associated with the development and operation of the Proposed Project, as well as from small reductions in cover and forage due to habitat alteration, fragmentation, or loss. Potential indirect impacts typically persist longer than potential direct impacts.

ISR uranium processing could potentially have direct and indirect impacts on local wildlife populations. These impacts may be both short-term (lasting until successful reclamation is achieved) and long-term (persisting beyond successful completion of reclamation). However, long-term impacts are expected to be small due to the relatively limited habitat disturbance associated with the ISR operating method. The potential direct impacts of ISR operations on wildlife include injuries and mortalities caused by collisions with project-related traffic or fencing and habitat removal actions such as topsoil stripping (particularly, for smaller species with limited mobility like rodents and reptiles). The likelihood for the impacts resulting in injury or mortality is greatest during the construction phase due to increased levels of traffic and physical disturbance during that period. Traffic will persist during production, but should occur at a reduced, and more predictable level. Speed limits will be enforced during all construction and maintenance operations to reduce impacts to wildlife throughout the year, but particularly during the breeding season(s). Because of the absence of surface water, there will be no potential impact on fisheries.

4.5.2.3.1 Raptors

Prior to the 2011 breeding season, a search of all available agency raptor databases indicated three known nests in the Proposed Project area and an additional 10 nests within the one-mile raptor review area (Bureau of Land Management [BLM] 2010). All but one of the nests are ferruginous hawk (*Buteo regalis*) ground nests situated on creek banks, hilltops, and rock outcrops throughout the area. However, no nesting activity from ferruginous hawks has been recorded in the area for the last several years. Most of the nests surveyed during the baseline period were in dilapidated condition and showed no signs of recent activity. Individual ferruginous hawks have been observed occasionally during the baseline surveys while soaring and foraging over the general area, but no defensive or territorial behaviors have been observed. One nest, located in a cottonwood tree, was active in 2008 and 2011, and was occupied by red-tailed hawks (*Buteo jamaicensis*) in both years.

Aside from the active red-tailed hawk nest and the aforementioned ferruginous hawk observations, other incidental raptor sightings within the survey area include golden eagles (*Aquila chrysaetos*), Swainson's hawks (*Buteo swainsoni*), and northern harriers (*Circus cyaneus*). The lack of suitable nesting substrate (large trees, cliffs, etc.) within the survey area greatly limits the potential for most raptor species to nest in the area. Northern harriers are likely to be nesting in the dense grassland habitats within the Proposed Project area; however, no nests were located. Because northern harrier nests are

placed on the ground and often concealed by dense vegetation, their nests are seldom found. Despite additional vigilance for burrowing owls (*Athene cunicularia*), this species was not observed within the survey area, and no appropriate habitat was observed.

The final rule delisting the bald eagle *(Haliaeetus leucocephalus)* was published in the Federal Register on July 9, 2007 (U.S. Fish and Wildlife Service [USFWS] 2007). Delisting became effective 30 days after publication of this rule, on August 8, 2007. However, this species will continue to be protected under both the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. The bald eagle is considered a breeder in portions of Campbell County, Wyoming (Cerovski et al. 2004). Due to the paucity of trees, nesting and winter roosting habitat for this species is extremely limited. Furthermore, the available prey base for bald eagles in the area is limited and consists primarily of lagomorphs, prairie dogs, and sporadic carrion (wildlife and livestock). The area does not support a large big game herd, though some groups may winter in the area. Although these resources could provide a marginal year-round food supply, no consistent or significant food sources exist within the survey area that will attract or sustain large numbers of bald eagles.

ISR operations in the Proposed Project area will not impact regional raptor populations, though individual birds or pairs may be affected. Direct impacts to raptors could include injury or mortality due to collisions with facility-related vehicular traffic. If new overhead power lines are installed, mortalities can occur from raptor collisions with overhead lines and electrocution. However, the project will utilize existing power line infrastructure where possible to minimize the construction of new overhead power lines. Design of any new power lines will follow guidelines suggested by the Avian Power Line Interaction Committee (APLIC 2005), which applies to many projects, including other ISR operations.

ISR operations could cause raptors to abandon nests proximate to disturbance, particularly if the activity encroaches on active nests during a given breeding season. However, equipment yards associated with ISR facilities provide additional habitat for prey species such as cottontails (*Sylvilagus* spp.), and raptors have been documented voluntarily nesting in or near those areas. Long-term data from nearby surface coal mines suggest that nesting raptors are influenced primarily by natural factors, such as prey abundance and availability of nesting substrates, rather than mine-related disturbances (refer to coal mine annual wildlife reports, on file with the WDEQ-LQD and USFWS in Cheyenne, Wyoming). Due to the paucity of woody vegetation and other natural vertical structures (e.g., cliffs), breeding raptors in the Proposed Projected and associated buffer zone are generally limited to species that either nest on the ground or are adaptable to nesting on man-made structures (e.g., plant facilities, windmills, artificial platform nests, etc.). Additionally, most of the ISR related activities are limited to relatively small areas for limited periods of time. It is not anticipated that those activities will adversely affect

raptor nests due to the lack of documented nesting raptors and nesting substrates in and near the plant and production unit areas.

4.5.2.3.2 Upland Game Birds

Sage-Grouse

The Proposed Project area does not overlap with any of the core or connectivity areas for greater sage-grouse (*Centrocercus urophasianus*) as designated by the State of Wyoming (Wyoming EO 2011-5). The closest core area ("Thunder Basin") is over 20 miles to the east. The "Thunder Basin" greater sage-grouse core area is located in the Thunder Basin National Grasslands however, is not located within the Proposed Project area. According to current Wyoming Game and Fish Department records (WGFD 2010a), no known sage-grouse leks exist within the Proposed Project area. However, three occupied leks (160 Acre, Porcupine Creek, and Spring Creek) are present within four miles. Peak counts of 12 and one displaying male(s) were observed at the Porcupine Creek and Spring Creek leks, respectively, during ground counts conducted in 2011. No grouse have been observed at the 160 acre lek since 2008.

No new leks were found during the baseline surveys. Outside of the active leks, one sage-grouse was observed during the baseline survey period. In 2011, a female sage-grouse was foraging in moderately dense sagebrush approximately 0.8 mile southwest of the Porcupine Creek lek.

Habitats within most of the Proposed Project and associated buffer area have limited potential to support sage-grouse throughout the year. Sagebrush stands are relatively sparse, with the only patches of moderately tall and dense sagebrush noted in the east, primarily south of Highway 387 and north of Cosner Road. That area (approximately the eastern one-third of the survey area) has been designated as a Crucial Habitat Priority Area by the WGFD. This means that the WGFD has identified the area to have significant biological and ecological value, and the department will concentrate habitat protection and management activities in those areas. Those areas could provide adequate nesting and wintering habitat for sage-grouse, and the moist drainages in those areas could also provide adequate brood-rearing and late summer habitat. Otherwise, habitats throughout the remainder of the survey area are not likely to be utilized by sage-grouse during any portion of the year.

No known sage-grouse lek sites or nest sites will be physically disturbed by the Proposed Project activities (Figure 3.5-1). Although existing wildlife data suggest that sage-grouse do not frequent the majority of the survey area, suitable and occupied habitat is present within the easternmost portion (south of Highway 387 and north of Cosner Road: portions of Sections 26-28, 33, and 34 T43N:R73W). In those areas, direct impacts to

sage-grouse may include injury or mortality due to collisions with facility-related vehicular traffic. If the backup storage pond or temporary mud pits are created during the drilling activities, those areas may create a potential hazard for sage-grouse and cause mortality if they are not fenced.

Potential indirect impacts could include limited habitat loss or fragmentation and increased noise and activity that may deter use of the area. However, such impacts are not expected to occur over the majority of the Proposed Project area, as the species are low in this non-core area, and thus are unlikely to utilize the habitats outside of those Sections outlined above. Due to increased levels of human activity, the project area may experience an increase in the occurrence of scavenger species (e.g., crows and ravens [*Corvus* spp.], badgers [*Taxidea taxus*], etc.) that often prey on sage-grouse eggs and young. However, those impacts can be reduced by proper management of byproduct material, as well as providing barriers (e.g., fencing) around facilities to prevent burrowing mammals. Overall, the extent of project related disturbance is minimal, and it is unlikely that disturbance or alterations to existing habitats from the proposed activities will alter the landscape sufficiently enough to inhibit sage-grouse from occupying the project area in the future. Mitigation measures will be put in place to help minimize potential impacts, they are described in Section 6.

No core or connectivity areas (as defined by the State of Wyoming) exist or will be disturbed by the development of the project.

Sharp-Tailed Grouse

The most recent WGFD records (WGFD 2004) do not reveal any sharp-tailed grouse (*Tympanuchus phasianellus*) leks near the Proposed Project area. The nearest known lek is located greater than 30 miles from the project.

Habitats within the Proposed Project and associated buffer area are marginally suitable for sharp-tailed grouse during most of the year. The mosaic of sagebrush-grasslands could provide habitat from April through October. However, cottonwoods (*Populus* spp.) berry-producing shrubs (e.g., snowberry [*Symphoricarpos* spp.] and chokecherry [*Prunus virginiana*]), which provide winter forage for sharp-tailed grouse, were very limited or absent from the survey area.

No potential direct or indirect impacts on sharp-tailed grouse are likely to occur due to the documented absence of the species in the general area and the presence of only marginal habitat.

Other Upland Game Birds

The mourning dove (*Zenaida macroura*) was the only other upland game bird that was observed in the Proposed Project or associated buffer area during baseline surveys. The gray partridge (*Perdix perdix*) could potentially occur in the survey area, but the species was not documented during the baseline surveys.

Potential direct impacts to mourning doves could include injury or mortality due to encounters with vehicles or heavy equipment during construction or maintenance operations. Given the limited area expected to be disturbed by the Proposed Project, such impacts are not expected to result in major changes of potential foraging and nesting habitat for additional upland game species, or affect game bird populations.

4.5.2.3.3 Sensitive Species

Mountain Plover

On June 29, 2010, the USFWS reinstated its 2002 proposed rule to list the mountain plover (*Charadrius montanus*) as threatened under the Endangered Species Act (ESA). After a thorough review of all available information, the USFWS announced its decision to withdraw the proposed listing on May 12, 2011 (USFWS 2011). However, the mountain plover remains on multiple federal agency sensitive species lists (e.g., BLM and USFWS), as well as the WGFD list of Species of Concern.

Despite thorough searching in the limited appropriate habitats within the survey area, no mountain plovers were observed during baseline surveys in 2008, 2010, or 2011. Mountain plovers are typically associated with sparse, short grassland habitats and are often found within or in close proximity to prairie dog colonies. No active prairie dog colonies exist within the wildlife survey area. No potential direct or indirect impacts on mountain plovers are likely to occur due to the documented absence of the species in the general area and the lack of suitable habitat.

Migratory Bird Species of Management Concern in Wyoming (non-coal)

Twelve USFWS avian species of concern (non-coal list) were recorded within the Proposed Project and associated buffer area during the baseline surveys. Six of those 12 species are categorized as Level I, which indicates a need for conservation action (i.e., having a monitoring and mitigation plan): the McCown's longspur (*Rhyncophanes mccownii*), ferruginous hawk, Brewer's sparrow (*Spizella breweri*), Wilson's phalarope (*Phalaropus tricolor*), and Swainson's hawk. The remaining six species are considered Level II, for which continued monitoring is recommended: the lark bunting (*Calamospiza melanocorys*), sage thrasher (*Oreoscoptes montanus*), grasshopper sparrow

(*Ammodramus savannarum*), loggerhead shrike (*Lanius ludovicianus*), vesper sparrow (*Pooecetes gramineus*), and lark sparrow (*Chondestes grammacus*). Wildlife features pertinent to the project area are shown in Figure 3.5-1.

Wyoming Game and Fish Department, Species of Greatest Conservation Need

The State of Wyoming has identified 279 species of greatest conservation need (SGCN), including 54 mammals, 60 birds, 26 reptiles, 12 amphibians, 40 fishes, 19 crustaceans, and 68 mollusks (WGFD 2005). Of that list, ICF biologists have documented 10 of those species during the baseline surveys. Those include observations of the greater sage-grouse, ferruginous hawk, Swainson's hawk, boreal chorus frog (*Pseudacris triseriata*), Brewer's sparrow, grasshopper sparrow, lark bunting, McCown's longspur, northern pintail (*Anas acuta*), and sage thrasher within appropriate habitats in the Proposed Project and associated survey area.

Potential direct impacts to these species of concern could include injury or mortality due to encounters with vehicles or heavy equipment during construction or maintenance operations. Potential indirect impacts could include habitat loss or fragmentation and increased noise and activity that may deter use of the area by some species. However, surface disturbance will be relatively minimal and will be greatest during only the construction phase. Enforced speed limits during all phases of the project will reduce impacts to wildlife throughout the year, particularly during the breeding season.

4.5.2.3.4 Big Game Mammals

Specific surveys for big game were not conducted as part of the Proposed Project wildlife baseline inventory. However, WGFD big game range designations exist for the entire state to identify crucial seasonal big game use areas. Pronghorn (*Antilocapra americana*) and mule deer (*Odocoileus hemionus*) are the only two big game species that regularly occur in the Proposed Project area and associated survey area. No crucial big game habitat or migration corridors are recognized by the WGFD in this area. Crucial range is defined as any particular seasonal range or habitat component but describes that component which is the determining factor in a population's ability to maintain and reproduce itself over the long term (WGFC 2008).

Pronghorn are more abundant than mule deer in the Proposed Project and associated buffer area, but neither species is prevalent. The WGFD has classified the survey area as yearlong and winter/yearlong pronghorn range. This means a population or a portion of a pronghorn population makes general use of this habitat on a year-round basis, but may also increase in abundance during the winter months as individuals immigrate into the area from other surrounding ranges.

Mule deer are not abundant in the survey area, with most individuals recorded in eroded draws and bottomland habitats. The WGFD has classified the entire Proposed Project and associated buffer area as yearlong mule deer range. No crucial mule deer ranges or migration corridors occur in or within several miles of the Proposed Project.

The WGFD does not consider the general area to be within the "use range" of any other big game species (e.g., white-tailed deer [*Odocoileus virginianus*], moose [*Alces alces*] or elk [*Cervus elaphus*]). Sightings of those species in the vicinity are extremely rare or may not occur at all.

Under the Proposed Action, big game could be displaced from portions of the Proposed Project to adjacent areas, particularly during construction of the production units and associated facilities, when disturbance activities will be greatest. Disturbance levels will decrease during actual production and restoration operations and will consist primarily of vehicular traffic on improved and unimproved (two-track) roads throughout the project area. Pronghorn will be most affected, as they are more prevalent in the area. However, no areas classified as crucial pronghorn habitat occur on or within several miles of the Proposed Project area. Mule deer will not be substantially impacted given their infrequent use of these lands and the paucity of winter forage and security cover.

4.5.2.3.5 Small and Medium-Sized Mammals

No quantitative surveys targeting small mammals, lagomorphs (e.g., jackrabbits [*Lepus* spp.] and cottontails), mammalian predators, or furbearers were required or conducted for the Proposed Project wildlife baseline. However, a variety of small and medium-sized mammal species are likely to occur in the vicinity. Observed species during baseline surveys in 2008, 2010, and 2011 include: the badger, cottontail, white-tailed jackrabbit (*Lepus townsendii*), and muskrat (*Ondatra zibethicus*). It is probable that several species of smaller mammals (voles, ground squirrels, and mice) also exist in the area, although none were directly observed. No black-tailed prairie dog (*Cynomys ludovicianus*) colonies are present within a one-mile survey of the project area.

Although the black-footed ferret (*Mustela nigripes*) is listed as federally endangered under the ESA throughout portions of its range, it is no longer considered a federally listed species for Campbell County, Wyoming (USFWS 2010). Additionally, the USFWS issued a block clearance for this species in all black-tailed prairie dog colonies throughout Wyoming in early 2004 (USFWS 2004). Consequently, ferret surveys are no longer required or recommended in those colonies statewide.

The swift fox (*Vulpes velox*) was removed from the ESA Candidate List in 2001, in part due to the conservation efforts of several western states (USFWS 2001). The WGFD classifies it as a species of special concern because population status and trends are

largely unknown. Despite thorough searching in all appropriate habitats within the Proposed Project area and associated survey area, no swift fox, dens, or sign thereof were observed during the 2008, 2010, or 2011 surveys.

Medium-sized mammals (such as lagomorphs, coyotes, and foxes) may be displaced to other habitats during the initial uranium ISR activities. Direct losses of some small mammal species (e.g., voles, ground squirrels, mice) may be higher than for other wildlife during topsoil scraping or staging activities due to their limited mobility and the likelihood that many will retreat into burrows when disturbed. However, given the limited area expected to be disturbed by the Proposed Project, such impacts are not expected to result in major changes or reductions in these localized populations. Most of the species that could potentially occur in the survey area demonstrate an ability to adapt to human disturbance in varying degrees, as evidenced by their presence in CBM developments, and residential areas of similar, or greater, disturbance. Additionally, small mammal species typically have a high reproductive potential and tend to re-occupy and adapt to altered and/or reclaimed areas rather quickly.

4.5.2.3.6 Waterfowl and Shorebirds

Avian species recorded in the survey area included common waterfowl, wading birds, and shorebird species, including the mallard (*Anas platyrhynchos*), northern pintail, American wigeon (*A. americana*), green-winged teal (*A. crecca*), northern shoveler (*A. clypeata*), eared grebe (*Podiceps nigricollis*), killdeer (*Charadrius vociferous*), and Wilson's phalarope. These wetland birds were observed in ponds and reservoirs throughout the Proposed Project area and associated survey area, particularly those along the Belle Fourche River and Spring Creek.

Under natural conditions, the Proposed Project area and associated survey area provides limited, marginal habitat for waterfowl and shorebirds. Aquatic habitats are mainly present during spring migration. Many of those water features are reduced to small, isolated pools or are completely dry during late summer.

Construction and operation of the Proposed Project will have a negligible effect on migrating and breeding waterfowl and shorebirds. Little existing habitat is present in the area, so it does not currently support large groups or populations of these species.

4.5.2.3.7 Reptiles and Amphibians

No standardized surveys targeting reptiles or amphibians were required or conducted specifically for the Proposed Project wildlife baseline. Potential habitat for aquatic reptiles and amphibians is relatively limited within the Proposed Project area and occurs

primarily in ephemeral or intermittent habitat associated with small, scattered stock ponds or drainages in the area. However, suitable habitat for snakes and other terrestrial reptiles does exist within the rocky outcrops, especially along the Belle Fourche River drainage. The only amphibian encountered in the Proposed Project and associated survey area during baseline wildlife surveys was the boreal chorus frog, which was heard calling in several of the reservoirs throughout the survey area. A single short-horned lizard (*Phrynosoma douglassi*) was the only reptile observed. It was observed in sagebrush-grassland uplands within the project area.

Potential direct impacts to reptiles and amphibians may include injury or mortality due to encounters with project-related traffic or habitat removal actions such as topsoil stripping, particularly because these species have limited mobility. Potential indirect impacts could include habitat loss or fragmentation and increased noise and activity that may deter use of the area by some species. However, the diversity of reptile and amphibian species within the available habitats is expected to be relatively low, and development of the project is not expected to disturb any unique or important habitats for these species.

4.5.2.3.8 Fish and Microinvertebrates

No quantitative surveys for aquatic species were required or conducted specifically for the Proposed Project. Potential habitat for fish is absent and for microinvertebrates it is quite limited within the survey area and occurs primarily in the numerous CBM-discharge reservoirs and intermittent wetland habitat associated with small, scattered stock ponds or drainages in the area. Under natural conditions, aquatic habitat in and near the Proposed Project is limited by the ephemeral nature (precipitation events and subsequent run-off) of surface water in the survey area. Several small reservoirs were present that held water during the baseline survey period. However, the lack of deep-water habitat and extensive water sources precludes the presence of fish, and greatly limits the abundance and diversity of other aquatic species.

Activities associated with the Proposed Project are not expected to disturb existing sources of surface water or vastly alter the topography in the area. Furthermore, under natural conditions, such habitat is limited in the survey area and few observations of aquatic species have been recorded there over time. Impacts on surface water flow and channels are expected to be minimal, as no significant alterations to these features will result from construction and operations. Additionally, all disturbances will be restored, as much as possible, to the previous topographical state to minimize impacts to channels and surface water flow.

4.5.2.4 Threatened and Endangered Species

The USFWS has identified four federally listed species that could occur in Campbell County and require monitoring. Those include two plant species, the Ute ladies'-tresses (*Spiranthes diluvialis*) (threatened) and blowout penstemon (Penstemon *haydenii*) (endangered), and two vertebrate species, the greater sage-grouse (candidate) and mountain plover (proposed) (USFWS July 2010).

No threatened or endangered (T&E) plant species or their potential habitats were observed within the Proposed Project area during surveys in 2011, and available data sets do not indicate the occurrence of any T&E species within the Proposed Project area.

Other than a single female sage-grouse that was documented in 2011, no threatened, endangered, candidate, or proposed wildlife species have been documented in the Proposed Project area and associated buffer area during surveys in 2008, 2010, and 2011, and available data sets do not indicate the occurrence of any Threatened and Endangered (T&E) species in the survey area.

4.5.2.4.1 Greater Sage-Grouse (Candidate)

On March 5, 2010, the USFWS issued a decision that the greater sage-grouse was warranted for listing under the ESA, but that listing was precluded by higher priority species. As a result, the sage-grouse is currently considered a candidate species under the ESA, and will undergo an annual review of its status to determine if a change in that decision is warranted.

No core or connectivity areas for sage-grouse have been designated by the State of Wyoming in the Proposed Project area or one mile perimeter (WGFD EO 2011-5). The closest core area ("Thunder Basin") is over 20 miles to the east. Survey results, available habitat, and potential impacts on sage-grouse were thoroughly discussed in Section 4.5.2.2.2 of this report.

4.5.2.4.2 Ute's Ladies'-Tresses Orchid (Threatened)

Ute ladies'-tresses, a member of the orchid family, was listed as threatened in January 1992. This plant colonizes early-succession riparian habitats such as point bars, sand bars, and low-lying gravelly, sandy, or cobble edges, persisting in those areas where the hydrology provides continual moisture in the root zone through the growing season. Documented Ute ladies'-tresses populations, in Wyoming, are located in Goshen, Converse, Niobrara, and Laramie counties in the Horse, Antelope, and Niobrara Headwaters watersheds (Fertig 2005) No occurrences have been recorded in Campbell

County, and the nearest known population of Ute ladies'-tresses is located along Antelope Creek, approximately 16 miles southwest of the Proposed Project area. No individuals or populations of Ute ladies'-tresses were found during field surveys, and based on the lack of suitable habitat characteristics or sufficient combination of suitable habitat characteristics (i.e., late season perennial water source, sandy or loamy textured soils, and gradual transitions between uplands and water bodies), local habitat was confirmed unsuitable for Ute ladies'-tresses within the Proposed Project area.

4.5.2.4.3 Blowout Penstemon (Endangered)

Blowout penstemon was listed as endangered in September 1987, but was not added to the list of threatened and endangered species for Campbell County until 2008. This plant is a member of the snapdragon family and requires an early succession habitat in sand blowouts. The three documented blowout penstemon populations, in Wyoming, are comprised of several thousand individuals, and are located in the northeastern corner of the Great Divide Basin in Carbon County, near the Ferris and Seminoe Mountains (Heidel et al. 2007). These populations are restricted to two habitat types: steep, northwest-facing slopes of active sand dunes with less than five percent vegetative cover; and north-facing sandy slopes, on the lee side of active blowouts, with 25 percent to 40 percent vegetative cover (USFWS 2008). These populations are approximately 125 miles southwest of the Proposed Project area. No individuals or populations of blowout penstemon were found during field surveys, and based on the lack of suitable habitat characteristics (i.e., shifting, sparsely vegetated sand dunes or blowouts); local habitat was confirmed unsuitable for blowout penstemon within the Proposed Project area. Therefore there will be no potential impact.

4.5.3 Potential Operations Impacts to Ecological Resources

Operation activities may directly and indirectly impact ecological resources within the Proposed Project area. Activities related to the operation of the Proposed Project may impact ecological resources by altering the habitat, displacing wildlife through human activity, and through direct and indirect mortality.

Access to the CPP area and portions of Production Units will be controlled and limited by fencing. Collisions with wildlife may occur by employees on-site or off-site and by trucks making shipments to and from the facility. Since most potential ecological impacts are caused by surface disturbance, potential impacts from operation would be much less than potential construction impacts. During operation the soils within the Proposed Project area may become temporarily contaminated or altered due to unexpected operational leaks and spills. This could potentially impact vegetation in affected areas.

During the operation phase noise and vehicular activity will be reduced within the Proposed Project area. The majority of vehicular activity will be limited the primary access roads, Highway 387 and Clarkelen Road. The decreased vehicular traffic should decrease the risk of vehicular collisions and reduce noise, which will reduce disruptions to wildlife populations. In general these impacts will be small in nature beyond those from construction.

4.5.4 Potential Groundwater Restoration Impacts to Ecological Resources

Groundwater restoration activities could produce potential ecological impacts similar to the operational phase. Thus, potential groundwater restoration impacts are expected to be small since the infrastructure will be in place.

4.5.5 Potential Decommissioning Impacts to Ecological Resources

Potential ecological impacts during decommissioning will temporarily increase due to higher levels of surface disturbance, traffic, and use of heavy equipment compared to the operation and aquifer restoration project phases. Potential impacts are expected to be similar to those occurring during construction, but less than construction phase impacts due to a smaller workforce. These include short-term loss of vegetation and habitat in disturbed areas, non-native species invasion, wildlife displacement due to noise, dust, and human/mechanical presence, and vehicle collisions with wildlife. Potential impacts are expected to be small due to the relatively small total disturbance area and mitigation measures specific to decommissioning, including habitat restoration in all areas disturbed during construction, operation, aquifer restoration, and decommissioning of the Proposed Project.

4.5.6 No Action Alternative

There will be no impacts to ecological resources from the No Action Alternative since the Proposed Project will not be constructed.

4.6 Potential Air Quality Impacts

4.6.1 Proposed Action

Air quality near the Proposed Project area has been monitored extensively due to the 12 active surface coal mines within approximately 50 miles of the Proposed Project area and has continuously demonstrated compliance with NAAQS and WAAQS standards for PM_{10} and $PM_{2.5}$. The following sections provide a discussion of potential air quality impacts including impacts associated with combustion and fugitive dust emissions.

As noted in NUREG 1910 (GEIS Section 4.2.6), air quality impacts will be considered Small because the following three conditions will be met for all four phases of the project:

- Gaseous emissions are within regulatory limits and requirements;
- Air quality in the region of influence is in compliance with National Ambient Air Quality Standards (NAAQS); and
- The facility is not classified as a major source under the New Source Review or Federal Operating (Title V) permit programs described in Section 1.7.2 of the GEIS.

4.6.1.1 Potential Construction Impacts

The primary potential new emission source of non-radiological pollutants will be particulate matter with a diameter less than 10 micrometers (PM_{10}) resulting from vehicle traffic within the Proposed Project area. AUC estimated fugitive dust emissions from construction and operation of the Proposed Project based on projected activity levels and emission factors supplied by the WDEQ. Projected activities impacting dust emissions included ongoing wellfield construction activities, routine site traffic related to operations and maintenance, heavy truck traffic delivering chemicals and material and shipping product, and employee traffic to and from the site. Based on these activities, the projected total PM_{10} emissions is less than 200 tons per year. This level of emissions is small relative to surface mines and other industrial operations that generate dust from vehicles and disturbed areas. The larger surface mines in the Powder River Basin show PM_{10} emissions inventories in the thousands of tons per year. Sections of unpaved county roads can also exceed the 18.5 tons per year emission rate by an order of magnitude or more. Viewed another way, atmospheric dispersion modeling generally shows that fugitive PM_{10} emissions on the order of 200 tons per year result in insignificant impacts to ambient air beyond a distance of a few hundred yards from the sources. Significant impact for PM_{10} is defined as 1.0 μg/m3 or more. For reference purposes, the National

Ambient Air Quality Standard (NAAQS) for annual average PM_{10} is 50 µg/m3. All area within the 50 mile (80) km radius or the project are in attainment of NAAQS.

It is important to note that no control factors were assumed for the emission calculations. Periodic watering or chemical treatment of the unpaved roads will reduce emission factors by half or more.

Emissions Inventory

Significant sources of non- radiological air emissions at the Proposed Project will include fugitive dust from roads and disturbed areas, and emissions from combustion sources (engines, heaters, vacuum dryers). AUC calculated an emissions inventory from these sources for the life of the project, which includes construction, operation, restoration and decommissioning phases. The emissions inventory addresses the following parameters:

- Particulates (PM_{10});
- Fine Particulates ($PM_{2.5}$);
- Oxides of nitrogen (NO_x);
- Carbon monoxide (CO);
- Sulfur dioxide (SO_2);
- Total hydrocarbons (THC); and
- Carbon dioxide (CO_2).

Activity levels for each project phase assume a maximum annual production of 2 million pounds of yellowcake. Since emissions were calculated by project phase and these phases will overlap, annual emissions were developed by combining emissions from concurrent phases for each year in the project schedule.

Stationary equipment includes a 500-kW emergency generator, two vacuum dryers and several space heaters. The emergency generator is for backup only, assumed to operate 500 hours per year. Table 4-6 lists the gas-fired sources, sizes, expected years of operation and hours per year.

Table 4-7 shows the estimated maximum hours of operation for mobile equipment over the 16-year life of the project.

Based on the schedule in Tables 4-6 and 4-7, maximum annual emissions are summarized in Table 4-8. For all pollutants, the maximum emissions are projected to occur during the first year of construction/operation (Year1).

Following is a discussion of each category of emissions, relevant sources and methods used to inventory these emissions. These individual categories were summed over the appropriate time periods to produce the summary in Table 4-8.

Combustion Emissions

During construction, diesel emissions will be emitted from drill rigs, scrapers, water trucks and other heavy equipment. During operation and restoration, diesel emissions from onsite operations and maintenance traffic will be less than emissions during construction. Vehicle combustion emissions will increase again during the restoration and decommissioning phases due primarily to surface reclamation activities. The predominant source of combustion emissions will be industrial equipment tailpipes. Passenger vehicles and delivery trucks will travel less than 0.5 miles from the public highway to the proposed CPP facility. For these reasons, AUC did not calculate combustion emissions for transportation vehicles traveling to and from the site (note that fugitive dust emissions from these sources were considered significant and were therefore included in the emissions inventory).

The Wyoming Department of Environmental Quality, Air Quality Division (AQD) emission inventory guidance for minor sources (WDEQ/AQD, 2010) references EPA AP-42 guidance (EPA, 1995) for tailpipe emission factors associated with construction and heavy equipment. For this analysis, emission factors from AP-42 Table 3.3-1 were applied to engines less than 600 HP in capacity, while emission factors for larger engines were obtained from AP-42 Table 3.4-1. Emissions for each pollutant were calculated using the following equations:

$$E = A \times EF \times LF \times U$$

Where:

E = Emissions (tons/yr)
A = Activity (hrs/yr)
EF = Emission factor (lb/hp-hr)
LF = Load factor (fraction of available power)
U = Unit conversion (ton/2000 lb)

AUC estimated a 40 percent load factor for most of the mobile equipment (i.e., engines operating at an average of 40 percent of maximum capacity). Drill rigs and dozers were assigned a higher load factor of 59 percent (EPA, 2004) due to more continuous and high-duty operation. This estimate is believed to be conservatively high based on actual engine loads and idling times. The results of the combustion emissions estimates for mobile equipment are presented in Table 4-9.

PM_{10} emission calculations represent particles 10 microns in diameter and smaller. $PM_{2.5}$ emission calculations represent particles 2.5 microns in diameter and smaller. For diesel combustion sources, $PM_{2.5}$ emissions were calculated as 97 percent of tailpipe PM_{10} emissions (EPA, 2004). Note that for propane combustion, all particulate emissions were assumed to be $PM_{2.5}$.

Fugitive Dust Emissions

The Proposed Project will generate fugitive dust during construction, operation, restoration and decommissioning. Sources of fugitive dust include wind erosion on disturbed areas, earth moving activities, and on-site traffic over the unpaved roads. Table 4-10 summarizes the estimated maximum fugitive dust emissions over the project life, as represented by PM_{10} emissions.

AP-42 Table 11.9-4 establishes an emission factor of 0.38 tons/acre/yr of total suspended particulate (TSP). Since this exceeds the 0.25 tons/acre/yr assigned by AQD, the AP-42 factor was applied to exposed acres for each year. From AQD guidance (AQD, 1979) for surface mines, 30 percent of the TSP emissions were assumed to be smaller than 10 microns (PM_{10}).

Traffic on project roads will consist of construction and ISR equipment, utility and maintenance equipment, and small vehicles. Fugitive dust emissions from traffic, characterized as PM_{10}, were estimated for each phase of the project using AQD emission factors (AQD, 1979). For project-specific roads a 50 percent control factor was applied to the fugitive road dust emission factors to account for water application for dust suppression. Water spray and/or chemical dust suppressant will be applied to the access road used by vehicles traveling to and from the project area, in order to minimize fugitive emissions.

Fugitive $PM_{2.5}$ emissions were calculated as 15 percent of fugitive PM_{10} emissions, based on an assumed ratio of $PM_{2.5}$ emissions to PM_{10} emissions. Ratios compiled from EPA AP-42 and the Western Regional Air Partnership (WRAP) are typically 0.15 or lower (Midwest Research Institute, 2006).

In summary, construction activities at the Proposed Project site will cause small, short-term effects on local air quality. Increased suspended particulates from vehicular traffic on unpaved roads, fugitive dust caused by wind erosion of areas cleared of vegetation, and diesel emissions from construction equipment will be the primary potential air quality impacts. The application of water to unpaved roads will reduce the amount of fugitive dust to levels equal to or less than the existing condition. Diesel emissions from construction equipment are expected to be short term only (less than 12 months), significantly declining once the operational phase begins.

4.6.1.2 Potential Operations Impacts

ISR facilities are not major point source emitters and are not expected to be classified as major sources under the operation (Title V) permitting program. Other potential emissions during operations include fugitive road dust and diesel combustion engine emissions from equipment, transport trucks, and other vehicles. For NAAQS attainment areas, it is expected that air quality impacts would be small.

During operations of the Proposed Project, impacts to air quality will be less than the impacts from construction because the use of diesel-powered construction equipment would be reduced and therefore pollutant levels will remain low. It is anticipated that the site-specific conditions at the Proposed Project are comparable to those described in the GEIS for air quality and incorporates by reference the GEIS conclusions that the impacts to air quality during operations will be Small.

Site specific operational potential air quality impact values, culminated along with the potential construction impacts, are discussed further in Section 4.6.2. Impacts that are more directly tied to operations are further outlined below.

Non-Radiological Gaseous Emissions

Apart from mobile equipment tailpipe emissions discussed above, the primary sources of non-radiological gaseous effluents will include yellowcake dryers, space heaters, and the emergency generator. Most of these sources will emit CO_2, the principal greenhouse gas (GHG) to be emitted by the Reno Creek ISR Project. GHG emissions are discussed in Section 4.6.3.2 below.

An emergency generator will be required to supply power to critical CPP equipment in the event of a utility power failure. The emergency generator will be limited to 500 hours of operation per year. It will be powered by a Tier 3 diesel engine in accordance with NSPS and BACT requirements (EPA, 2006).

The vacuum dryers and space heaters in the CPP (Table 4-6) will be fueled by propane. Dryers will run year-round while heaters will only be needed during the winter months. All pollutant emission factors for propane combustion were taken from AP-42 Table 1.5-1 (EPA, 1995).

Greenhouse Gas Emissions

The primary source of GHG will be CO_2 from the diesel-powered engines, gas-fired combustion sources, and the uranium recovery process itself. CO_2 will be released from uranyl tricarbonate breakdown in the precipitation circuit. CO_2 will also be released

during elution. Minor amounts of methane and nitrous oxides, both of which are considered greenhouse gases, will be emitted from propane combustion. The GHG potential or CO_2 equivalent of these emissions is a fraction of one percent of the total CO_2 emissions. Therefore, the above calculations for CO_2 emissions are representative of GHG emissions.

In order to calculate the CO_2 released when acidifying pregnant eluate prior to precipitation of uranyl peroxide, three lb. of U_3O_8 per cubic foot of loaded resin was assumed. At two million lbs/year of yellowcake production, this resulted in 570 short tons/year of CO_2 released. The breakdown of $UO_2(CO_3)_3$ was calculated to release an additional 470 short tons/year for a total process emissions rate of 1,040 tons/year.

Potential Non-Radiological Emissions

AUC estimates fugitive dust emissions from operations in the Proposed Project area based on projected activity levels and using emission factors supplied by the WDEQ. Projected activities impacting dust emissions included ongoing production unit construction activities, routine site traffic related to operations and maintenance, heavy truck traffic delivering chemicals and material and shipping product, and employee traffic to and from the site. Based on these activities, the projected total particulate matter (PM_{10}) emissions will be less than 200 tons per year. This level of emissions is small relative to surface mines and other industrial operations that generate dust from vehicles and disturbed areas. The larger surface mines in the PRB show PM_{10} emissions inventories in the thousands of tons per year. Sections of unpaved county roads can also exceed 18.5 tons per year emission rate. Atmospheric dispersion modeling generally shows that fugitive PM_{10} emissions on the order of less than 200 tons per year result are an insignificant impact to ambient air beyond a distance of a few hundred yards from the sources. 40 CFR 51.165(b)(2) defines the Significant Impact Level (SIL) for PM_{10} as 1.0 $\mu g/m^3$ or more. For reference purposes, 40 CFR 50.6(a) defines the national ambient standard for annual average PM_{10} as 150 $\mu g /m^3$.

It is important to note that no control factors were assumed for the emission calculations. This is a conservative effect resulting in overestimation of dust generation as periodic watering or chemical treatment of the unpaved roads will reduce emission factors by half or more.

Potential Radiological Emissions

As a result of employing pressurized, down-flow ion exchange columns, the primary source of radiological gaseous emissions will be ^{222}Rn gas from occasional venting of injection wells, small unavoidable leaks in production units and ion exchange equipment, resin transfer operations, water discharge to the lined backup storage pond, and

maintenance of production unit and ion exchange equipment. Radon, a decay product of ^{226}Ra, is dissolved in the lixiviant as it travels through the ore to a recovery well where it is brought to the surface. Since the project will use fixed bed pressurized down flow ion exchange columns to recover uranium from the pregnant lixiviant and to treat restoration solutions and since production units will be closed and operated under pressure, the majority of ^{222}Rn contained in the recovery solution will stay in solution and will not be released to the atmosphere. The concentration of ^{222}Rn in the production solution and estimated releases are calculated using the methods found in NRC NUREG 1569 Appendix D. The only expected routine emission at the facility will be ^{222}Rn gas.

It is not anticipated that there will be potentially significant impacts from radiological particulate emissions from the CPP and facility operations. The components to be used in yellowcake systems operations emit zero particulates in the drying and packaging. All other aspects of the operation are fluid based, with little chance of radiological particulate emissions.

4.6.1.3 Potential Groundwater Restoration Impacts

Potential air quality impacts during the groundwater restoration phase will resemble those of the operation phase of the Proposed Project. The decrease in emissions compared to the operational phase can be attributed to fewer employees and activities as groundwater restoration proceeds.

4.6.1.4 Potential Decommissioning Impacts

Additional heavy equipment will be utilized during the decommissioning phase of the Proposed Project, especially at the CPP, but will be mitigated by AUC conducting thorough decontamination prior to any demolition or other dust generating activity. As a consequence, the potential impacts are anticipated to be Small and temporary. Detailed potential air quality impacts from decommissioning will be similar to those during construction as previously in Section 4.6.2.

4.6.1.5 No Action Alternative

There will be no potential impacts to air quality from the No Action Alternative since the Proposed Project will not be constructed.

Table 4-6: Gas Fired Equipment

Item	Vacuum Dryer	Main Heater	Furnace	Radiant Heaters
Number of Units	2	1	1	7
Operating hours/yr	3,650	4,380	4,380	4,380
Maximum duty (MMBtu/hr)	1.30	1.20	0.11	0.14
Heating value (MMbtu/gal)	91.5	91.5	91.5	91.5
Years in operation	13	16	16	16

Source: IML emissions computation, 2012

Table 4-7: Mobile Equipment Schedule

RENO CREEK ISR HOURS PER YEAR															
Equipment	**Year1**	**Year2**	**Year3**	**Year4**	**Year5**	**Year6**	**Year7**	**Year8**	**Year9**	**Year10**	**Year11**	**Year12**	**Year13**	**Year14**	**Year15**
Scraper	3,500	2,500	2,500	4,000	2,500	6,200	2,500	2,500	1,250	1,250	2,500	2,500	2,500	1,250	2,000
Grader	3,500	2,500	2,500	4,000	2,500	6,200	2,500	2,500	1,250	1,250	2,500	2,500	2,500	1,250	2,000
Water Truck	12,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Front End Loader	4,000	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	1,500	1,500	1,500	1,500	1,500	1,500
Track Dozer	4,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Backhoe	5,840	5,840	5,840	5,840	5,840	5,840	5,840	5,840	5,840	1,500	1,500	1,500	1,500	1,500	1,500
Drill Rig	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	10,000	10,000	10,000	10,000	10,000	10,000
Heavy Drill Rig	3,000	3,000													
Other Mobile Equip.	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Pickup Truck 3/4 Ton	16,000	16,000	16,000	16,000	16,000	16,000	16,000	16,000	16,000	16,000	16,000	16,000	16,000	16,000	16,000
Fork Lift	4,000	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500

Source: IML emissions computation, 2012

Table 4-8: Emissions Summary

Reno Creek ISR Projected Emissions (tons/year)															
Parameter	**Year1**	**Year2**	**Year3**	**Year4**	**Year5**	**Year6**	**Year7**	**Year8**	**Year9**	**Year10**	**Year11**	**Year12**	**Year13**	**Year14**	**Year15**
THC	16.8	15.8	14.9	15.3	14.9	15.8	14.9	14.9	14.6	9.0	9.3	9.3	9.3	9.0	9.2
NO_x	225.6	212.7	182.9	187.7	182.9	194.7	182.9	182.9	178.9	109.2	113.2	113.2	113.2	109.2	110.9
CO	50.2	47.5	40.6	41.7	40.6	43.2	40.6	40.6	39.8	24.8	25.6	25.6	25.6	24.8	24.9
SO_2	23.2	22.3	12.3	12.6	12.3	13.1	12.3	12.3	12.0	7.4	7.7	7.7	7.7	7.4	7.6
CO_2	10,890	10,411	8,973	9,150	8,973	9,410	8,973	8,973	8,826	6,238	6,385	6,385	6,385	6,238	4,923
PM_{10}	107.4	93.8	99.9	125.2	117.4	157.3	121.0	114.0	98.1	83.2	88.4	81.5	74.4	58.7	62.5
$PM_{2.5}$	28.2	25.4	25.6	29.7	28.2	34.9	28.8	27.7	25.1	18.8	19.8	18.8	17.7	15.1	15.8

Source: IML emissions computation, 2012

Table 4-9: Combustion Emissions Inventory

RENO CREEK ISR COMBUSTION EMISSIONS PER YEAR															
Pollutant	**Year1**	**Year2**	**Year3**	**Year4**	**Year5**	**Year6**	**Year7**	**Year8**	**Year9**	**Year10**	**Year11**	**Year12**	**Year13**	**Year14**	**Year15**
THC	16.3	15.3	14.4	14.8	14.4	15.3	14.4	14.4	14.1	8.5	8.8	8.8	8.8	8.5	8.7
NO_x	223.1	210.2	180.4	185.2	180.4	192.2	180.4	180.4	176.5	106.7	110.7	110.7	110.7	106.7	109.1
CO	48.5	45.7	38.9	39.9	38.9	41.4	38.9	38.9	38.0	23.0	23.8	23.8	23.8	23.0	23.5
SO_2	22.8	22.0	11.9	12.2	11.9	12.7	11.9	11.9	11.7	7.1	7.3	7.3	7.3	7.1	7.2
CO_2	8,610	8,131	6,694	6,871	6,694	7,130	6,694	6,694	6,546	3,958	4,106	4,106	4,106	3,958	4,047
PM_{10}	14.6	13.7	12.8	13.1	12.8	13.6	12.8	12.8	12.5	7.6	7.9	7.9	7.9	7.6	7.7
$PM_{2.5}$	14.2	13.3	12.4	12.7	12.4	13.2	12.4	12.4	12.1	7.3	7.6	7.6	7.6	7.3	7.5

Source: IML emissions computation, 2012

Table 4-10: Fugitive Emissions Summary

PM_{10} Emissions (tons/yr)															
Equipment Item	**Year1**	**Year2**	**Year3**	**Year4**	**Year5**	**Year6**	**Year7**	**Year8**	**Year9**	**Year10**	**Year11**	**Year12**	**Year13**	**Year14**	**Year15**
Scraper	16.80	12.00	12.00	19.20	12.00	29.76	12.00	12.00	6.00	6.00	12.00	12.00	12.00	6.00	9.60
Grader	16.80	12.00	12.00	19.20	12.00	29.76	12.00	12.00	6.00	6.00	12.00	12.00	12.00	6.00	9.60
Water Truck	8.74	7.28	7.28	7.28	7.28	7.28	7.28	7.28	7.28	7.28	7.28	7.28	7.28	7.28	7.28
Front End Loader	4.80	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	1.80	1.80	1.80	1.80	1.80	1.80
Track Dozer	4.80	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40
Backhoe	7.01	7.01	7.01	7.01	7.01	7.01	7.01	7.01	7.01	1.80	1.80	1.80	1.80	1.80	1.80
Drill Rig	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Heavy Drill Rig	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
Misc Mobile Equipment	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85
Pickup Truck 3/4 Ton	15.18	15.18	15.18	15.18	15.18	15.18	15.18	15.18	15.18	15.18	15.18	15.18	15.18	15.18	15.18
Wind Erosion	9.23	16.30	23.26	33.86	40.81	44.35	44.35	37.39	33.86	30.32	23.26	16.30	9.23	5.81	2.28
Delivery Truck	0.87	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52
Passenger Vehicle	5.54	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38
Total PM_{10} Emissions	92.7	80.0	87.0	111.9	104.5	143.6	108.0	101.1	85.5	75.5	80.5	73.5	66.4	51.0	54.7

Source: IML emissions computation, 2012

Table 4-11: Stationary Equipment Emissions

Parameter	Generator Emissions		Propane Equip. Emissions	
	lb/hp-hr	tons/yr	lb/10^3 gal	tons/yr
NO_x	0.00657	1.10	13	1.39
CO	0.00575	0.96	7.5	0.80
$PM_{10}/PM_{2.5}$	0.00033	0.06	0.7	0.07
SO_2	0.00205	0.34	0.016	0.00
TOC	0.00251	0.42	1	0.11
VOC	0.00000	0.00	0	0.00
CO_2	1.15	192.69	117,100	1,331.85

Source: IML emissions computation, 2012

4.7 Potential Noise Impacts

4.7.1 Proposed Action

Non-agricultural rangeland is the primary land use within the Proposed Project area and in the surrounding two mile area. Other land uses include natural gas pipeline facilities. The existing ambient noise in the vicinity of the Proposed Project area is dominated by the traffic noise from State Highway 387 and surrounding oil and gas operations.

The proposed CPP site is approximately 2.2 miles from the closest residence outside the Proposed Project boundary. A level of 85 dB is the Occupational Safety and Health Administration (OSHA) threshold at which a hearing conservation program at the plant will be required. Assuming that the noise level produced by unshielded machinery at the plant site is 85 decibels (dB) at 50 feet, the sound pressure level attained at the residence will be below the level identified by the USEPA as suitable for outdoor areas where human activity takes place (approximately 55 dB). Experience at operating ISR facilities verifies that this assumption is conservative and that the average sound pressure levels during construction will be less than 85 dB. After appropriate engineered controls (i.e. the protective enclosure for the equipment) are installed, noise levels will not impact the residences, and are unlikely to approach the levels attained from State Highway 387.

As a result of the remote location of the potential Proposed Project and the relatively low population density of the surrounding area, impact on noise or congestion above ambient background noise within the project area or in the surrounding two mile area are not anticipated. Additionally, given the maximum increase in population due to migrant workers is insignificant, noise and congestion impacts are not anticipated in Gillette, Wright, or other neighboring towns or counties.

4.7.1.1 Potential Construction Impacts

As discussed in Section 4.3.7.1 of the GEIS, potential noise impacts will be greatest during construction of the CPP because of the heavy equipment involved and given the likelihood that these facilities will be built in rural, previously undeveloped areas where background noises levels are lower. The use of drill rigs, heavy trucks, bulldozers, and other equipment used to construct and operate the production units, drill wells, construct access roads, and build the CPP will generate noise that will be audible above the undisturbed background noises. Noise will likely be higher during daylight hours when construction is more likely to occur and more noticeable in proximity to operating equipment. Administrative and engineering controls will maintain noise levels in work areas below OSHA regulatory limits and, if necessary, additional mitigation will be

provided by use of personnel hearing protection. For individuals living in the vicinity of the site, ambient noise levels will return to background levels at a distance greater than 300m (1,000ft) from the construction activities. Wildlife will be expected to avoid areas where noise-generating activities were occurring.

Additionally, as stated in the GEIS, the traffic noise during construction will be localized, limited to highways in the vicinity of the proposed project and access roads within the Proposed Project area. Relative short-term increases in noise levels associated with passing traffic will be small for the larger roads, but could be moderate for lightly traveled rural roads. AUC will enforce site speed limits to further mitigate traffic noise impacts.

Although there are no site-specific noise data for the Proposed Project site, noise information is available from the Lost Creek ISR project in Wyoming, in a license application approved by the NRC. The Lost Creek ISR project is located in a fairly remote part of Wyoming, with areal topographic similarities to the Proposed Project and is comparable in project scale, making Lost Creek an appropriate analog. During construction, ISR projects create noise due to heavy equipment use and wellfield drilling. Drill rigs, heavy trucks, and equipment will generate noise that will be audible on-site above the 30 to 40 dBA of the background noise levels. At Lost Creek ISR the maximum measure of sound pressure (noise) during exploration activities was from a cement mixer and a generator running concurrently, which was 102 dBA, four feet from the source. During construction, occasional instantaneous levels could be somewhat higher. Field observations for the Lost Creek ISR project indicated that drilling activities are inaudible to humans at distances greater that one mile due to topographic interference and other factors (Lost Creek ISR, LLC. 2009).

Table 3.7-2 of this ER compares various noise levels experienced during our daily lives to equivalent sounds. Noise levels at the project site boundary could be as high as 80 dB at times during construction. However this construction activity sound level is less than or similar to vehicle traffic noise along Highway 387, and will not be a significant potential impact in the area. No residences will be within approximately two miles of the CPP.

Overall, the potential noise impacts of these types of activities will be small given the distance to the nearest residence is approximately 1.5 miles from the center of the Proposed Project area and the proposed construction activities.

4.7.1.2 Potential Operations Impacts

The proposed CPP site will be located approximately 2.2 miles from the closest residence located near the Proposed Project area. The rest of the Proposed Project area is primarily

open rangeland. Other land uses include natural gas pipeline facilities, as well as pastureland located to the east, north and west of the project area.

Assuming that the noise level produced by unshielded machinery at the plant site is 85 dB at 50 feet, the sound pressure level attained at the project boundary will be below the level identified by the EPA as suitable for outdoor areas where human activity takes place (approximately 55 dB). A level of 85 dB is the OSHA threshold at which a hearing conservation program at the plant will be required. Experience at operating ISR facilities verifies that this assumption is conservative and that the average sound pressure levels during construction will be less than 85 dB. After appropriate engineered controls (i.e. the protective enclosure for the equipment) are installed, noise levels will not impact the residences, and are unlikely to approach the levels attained by State Highway 387.

The potential noise impacts during operation are expected to be less than those during construction due to the smaller work force, reduction of earthmoving and construction activities on site, and the reduced number of shipments of materials and equipment.

As a result of the remote location of the Proposed Project and the low population density of the surrounding area, potential impacts from noise or congestion within the Proposed Project area or in the surrounding two mile area are not anticipated. Additionally, given the maximum increase in population due to migrant workers is insignificant, noise and congestion impacts are not anticipated in Campbell County or other neighboring counties.

4.7.1.3 Potential Groundwater Restoration Impacts

Section 4.7.3.3 of the GEIS states that the general noise levels during aquifer restoration will be similar or less than noise levels during operations. Workplace noise exposure during groundwater restoration will use the same administrative and engineering controls used during operations. Existing operational infrastructure will be used and traffic levels are expected to be the less than during construction and operation phases of the Proposed Project. Vehicular traffic will be limited to delivery of supplies and staff travel to and from the site; therefore fewer trips will occur during groundwater restoration than operations. Taking into account the relatively small increase in traffic the potential noise impacts to the proposed project will be smaller than during earlier phases of the project.

Overall, the potential noise impacts from these types of activities will be small given the distance to the nearest residence.

4.7.1.4 Potential Decommissioning Impacts

Section 4.7.3.4 of the GEIS discusses the potential noise impact from decommissioning activities. Noise levels generated during decommissioning and reclamation will be similar to or less than, noise levels during the construction phase. Decommissioning activities will result in a substantial but temporary noise impact onsite and potentially just beyond the Proposed Project boundary. Like the construction phase, noise levels will be higher during daylight hours when decommissioning and reclamation will more than likely occur and will be more noticeable in proximity to the operating equipment. Workplace exposure will be managed using the same administrative and engineering controls implemented for the construction phase. The increase in truck traffic associated with the transfer of solid waste to the Gillette landfill and of 11e.(2) byproduct to a licensed disposal facility will result in a small potential impact above background noise levels.

Overall, the potential noise impacts of these types of activities will be small given the distance to the nearest residence.

4.7.2 No Action Alternative

There will be no impacts to geology or soils from the No Action Alternative since the Proposed Project will not be constructed.

4.8 Potential Historic and Cultural Resources Impacts

4.8.1 Proposed Action

As discussed in Section 3.8, a Class III cultural resource inventory of the Proposed Project area was conducted in 2010 by Greer Services of Casper Wyoming. Prior to fieldwork, files of the SHPO Records Division were checked for information on previous surveys and recorded cultural resources. Pre-1980 surveys are not accepted by SHPO as current Class III level inventory. Those database records indicate that of the 6,057 acres encompassing the project area, 2,463 acres had been previously surveyed to present-day Class III standards since 1980 in blocks of 40 acres or more. No on-site review of survey areas or recorded cultural sites is technically necessary in those areas, although three previously recorded sites extending into present survey areas were revisited and site information updated. Other areas and sites were additionally field-checked and were found to need no further action.

The remaining 3,596 acres were intensively surveyed between 8/15/10 and 12/11/10 to a Class III level cultural inventory by Drs. John and Mavis Greer. Ownership of the survey area consists of 640 acres of State surface and 2,956 acres of private surface. There is no federal surface ownership within the overall project area.

Seventy-nine cultural localities are known within the Proposed Project area. Of these, 41 were recorded previously, and 38 were found during the present inspection. Of the total localities, 33 have been assigned site numbers, and the others are considered isolated resources, or those with one to 15 prehistoric artifacts or one to 49 historic artifacts and no features. Due to a 2008 SHPO change in site number definition policy, 14 previously recorded localities with site numbers will not qualify now as sites under the present system. Cultural localities include 42 locations with prehistoric artifacts, and 27 with historic artifacts, and 10 with both prehistoric and historic artifacts. One prehistoric hearth has been found at each of three sites, but without buried content or intact deposits. No other prehistoric features were found, and prehistoric remains consist almost entirely of chipped-stone artifacts and a few pieces of scattered fire-cracked rock. Historic features associated with seven localities are depressions or foundations associated with homestead sites. One standing lambing shed was recorded. Other ranch facilities recorded as isolates include the remains of livestock windbreaks, abandoned watering stations with permanent foundations, and windmill locations.

All 41 previously recorded cultural resources had been evaluated as not eligible for the NRHP, and files indicate SHPO concurrence for all previously recorded sites. All 38 newly recorded localities are also evaluated as not eligible for the National Register. All cultural resources are described in detail in the Class III inventory report included as Addendum 3.8A.

Although specific potential impacts to cultural resources within the Proposed Project are presently not defined, none of the 78 known cultural resources is considered eligible for the National Register. Therefore, the current Proposed Project will not affect any known significant cultural resources (formally referred to as "*historic properties*"), and no additional archaeological work or special consideration is recommended.

As concluded in the Class III Inventory Report, provided in Addendum 3.8A, the currently Proposed Project will not affect any known significant cultural resources and additional archaeological work is not considered necessary.

The discovery of cultural artifacts in an operational area shall result in a work stoppage in the vicinity of the find until the resources can be evaluated by a professional archaeologist. Mitigation measures that will be implemented if future development expands near any eligible sites are discussed in ER Section 6.8.

4.8.1.1 Potential Construction Impacts

The Proposed Project, as described in Section 4.1, construction could impact up to 481 acres, approximately 8 percent, of the total 6,057 acre Proposed Project area. NRC's NUREG 1910 Vol. 2 (pg. 4.3-25) notes that most of the potential for adverse effects to potentially NRHP-eligible historic properties, TCPs, and paleontological material, both direct and indirect, will likely occur during land-disturbing activities. Buried cultural features and deposits and paleontological material that are not visible on the surface during the initial cultural resources inventories could be discovered during earth-moving activities. As described in Section 6.8 of this ER, AUC will implement an Unanticipated Discovery Plan to prevent the loss of undiscovered cultural artifacts. The discovery of cultural artifacts in an operational area shall result in a work stoppage in the vicinity of the find until the resources can be evaluated by a professional archaeologist.

Potential indirect impacts also can occur outside the Proposed Project area and related facilities and components. Visual intrusions, increased access to formerly remote or inaccessible resources, potential impacts to traditional cultural properties and culturally significant landscapes, as well as other ethnographically significant cultural landscapes may adversely affect these resources. As described in Section 3.8, no Native American heritage, special interest, or sacred sites have been formally identified and recorded to date by studies directly associated with the Proposed Project. Implementing a stop-work provision and other mitigation measures as described in Section 6.8 of this ER, will assure that potential impacts to historical and cultural resources will be minimized.

4.8.1.2 Potential Operations Impacts

Potential direct and indirect adverse effects on potentially NRHP-eligible historic properties, traditional cultural properties, and paleontological materials are possible during the operation phase of the Proposed Project. Potential impacts during operation will result primarily from maintenance and repair of existing facilities.

Potential inadvertent impacts to historic and cultural resources located within the Proposed Project area and other cultural landscapes that are identified before construction are expected to continue during operation. AUC's Unanticipated Discovery Plan (UDP) will prevent potential impacts to cultural resources. A stop-work provision will be implemented if any previously undiscovered cultural resources are encountered during construction and operations including site decommissioning. Overall, impacts to cultural and historical resources during operations will be expected to be less than those during construction, as operations are generally limited to previously disturbed areas (e.g., access roads, central plant area, and production unit). Implementing the mitigation measures mentioned above and discussed in detail in Section 6.8 of this ER will reduce potential impacts to cultural resources during the operations phase of the Proposed Project to Small.

4.8.1.3 Potential Groundwater Restoration Impacts

Potential impacts to potentially NRHP-eligible historic properties, traditional cultural properties, and paleontological material are similar to those expected during operation. These will result primarily from surface disturbing activities associated with maintenance and repair of existing facilities. A stop-work provision will be implemented if any previously undiscovered cultural resources are encountered during groundwater restoration activities. Implementing the mitigation measures mentioned above and discussed in detail in Section 6.8 of this ER will minimize potential impacts to cultural resources during the groundwater restoration phase of the Proposed Project. Thus potential cultural impacts will be very similar to those during operations.

4.8.1.4 Potential Decommissioning Impacts

Surface disturbing activities will temporarily increase during decommissioning; however, the disturbances will occur primarily in areas of the Proposed Project which had been first cleared and then disturbed previously during the construction, operation, and ground water restoration phases. Because of the existence and continued application of AUC's Unanticipated Discovery Plan, there should be no potential cultural impacts during decommissioning. Where small amounts of additional disturbance are required (e.g., to remove contaminated soil), archeological surveys will be conducted if the areas are

outside of previously surveyed areas. In addition, AUC will implement a stop-work provision should previously unidentified resources be encountered during decommissioning and surface reclamation.

4.8.2 No Action Alternative

There will be no impacts to historic or cultural resources from the No Action Alternative since the Proposed Project will not be constructed.

4.9 Potential Visual and Scenic Resources Impacts

4.9.1 Proposed Action

The Proposed Project site is located predominantly on private land with a small portion of the project area containing state-owned land. There is no federal surface ownership within the Proposed Project boundary. Privately owned land is not managed by any public agency to protect scenic quality. The BLM has inventoried the visual resources of all lands within the boundaries of the Buffalo Field Office, including private lands, with the VRM system, and rated the areas as VRM Class III. The key factors of landform, vegetation, water, color, influence of adjacent scenery, scarcity and cultural modifications were evaluated and scored according to the rating criteria. The Proposed Project VRM rating can be found in Section 3.9 and in Figure 3.9-1 of this ER.

Potential visual and scenic resource impacts may occur during construction, operations, groundwater restoration, and decommissioning. Most of the potential impacts will be associated with the construction of the Proposed Project area and are expected to be short term. New facilities would introduce new elements of form, line, color and texture into the landscape. Because of the small surface footprint and low profile of ISR uranium recovery facilities, no major visual impacts would be present.

4.9.1.1 Potential Construction Activities

Temporary and short-term visual effects during the construction period in each Production Unit will result from header house construction, well drilling, ground clearing, grading, vehicular and pedestrian traffic, construction of facilities, and construction of access roads and electric distribution lines. Following completion of any Production Unit installation, temporarily disturbed areas will be reclaimed. Only long-term effects associated with operations and maintenance will remain following post-construction reclamation. Construction debris will be removed from new construction areas as soon as possible and temporarily disturbed areas will be reclaimed as soon as possible following construction.

Potential long-term effects will result from the addition of structures to the landscape, such as the CPP and associated structures, header houses, wellhead covers, access roads, and electric distribution lines. Potential effects from long-term activities will occur over the life of the project, but will be removed at the end of the project lifecycle.

Heavy equipment and drill rigs brought in during construction activities may be visible from certain vantage points from Highway 387, Clarkelen/Turnercrest Road, and Cosner

Road and views from the one residence nearest to the Proposed Project. Dust generated may also impact visual resources. Visible dust particles will be released during activities such as the mechanical disturbance of rock and soil materials, bulldozing, and vehicles traveling on gravel roads. Particles are also transported by wind blowing over the surface of bare land and stockpiles. As described in Section 6.9, dust will be minimized by wetting disturbed areas during construction, promptly restoring and re-seeding disturbed soil, and enforcing speed limits for AUC employees and contractors.

In general, resource protection measures proposed for erosion control, road construction, rehabilitation and re-vegetation will mitigate effects to visual quality. Thus the potential visual impacts will be Small and temporary.

4.9.1.2 Potential Operations Activities

Potential impacts to the visual resources during operations will result from the presence of infrastructure associated with the Proposed Project operations including the CPP and ancillary structures, header houses, and associated infrastructure such as wellhead covers, access roads, and overhead utilities. Some of the facilities and Production Unit activities will be visible from the county roads within and near the Proposed Project area including the Highway 387 and Clarkelen Road.

Although the CPP and ancillary structures are located in one area, they will be more noticeable to the casual observer because of their size. The CPP will be the largest structure, at approximately 200 feet wide by 350 feet long by 50 feet tall (70,000 $ft^{2)}$. The total plant area will occupy a space of approximately 15.5 acres and enclosed with security fencing. In addition, one backup storage pond (approximately 0.5 acre) will be separately enclosed in a 1.2 acre area with fencing to exclude wildlife. These facilities will be prominent in the foreground and middle ground views and will be silhouetted in the background view from public access points. ER Figure 1-5 shows the proposed locations of the CPP, Production Units, and access roads.

Pipelines and electrical lines between the injection and recovery wells and header houses will be buried and disturbed areas restored and reseeded. Each header house is a small (360 square foot) single story metal building with a basement or sump. A disturbance area around each header house is necessary to provide an adequate area for operations and maintenance vehicles to turn around. There will be approximately 67 header houses within the Proposed Project area. Electrical distribution lines (typically overhead) will connect header houses to existing electric distribution lines. The distribution poles will be approximately 20 to 40 feet high and wooden so that the natural color harmonizes with the landscape. Injection and recovery wells will have a wellhead cover that typically consists of a weatherproof structure placed over the well. These covers are approximately

three feet high and two feet in diameter. The covers would present only a slight contrast with the existing landscape.

The CPP and other structures supporting operations will be noticeable from certain public vantages; however, they will not be the only prominent industrial features in the area. Within the Proposed Project area, there is currently one natural gas compressor station visible from Clarkelen Road. Portions of the compressor station are painted to blend with the surrounding environment are not as easily discerned as those painted white or dark brown. In addition, solid geometric features such as storage tanks, pump jacks, maintenance buildings, power lines, and meter houses are prominent in the immediate foreground and often are noticeable in the foreground views by the casual observer.

Despite existing visual impacts from existing development and the average scenic quality rating for the Proposed Project area, AUC intends to implement measures to lessen the visual impact from the project. Mitigation measures are meant to minimize adverse contrasts of project facilities with the existing landscape. The measures should be applied to all facilities, even those that meet VRM objectives. Mitigation will enable Proposed Project facilities to harmonize with the surrounding landscape to the extent practicable.

Mitigative measures for visual and scenic resource impacts during operation are discussed in ER Section 6.9. All installed structures will be painted with low reflectivity paint in colors that harmonize with the surrounding landscape. In addition, several design techniques will be implemented to minimize the visual contrasts. Those methods include reducing unnecessary disturbance by using the same trench for multiple utilities, reducing the area of temporary disturbance by designating equipment parking areas during construction, and following areas of existing disturbance when considering utility placement. To the extent possible, topographic features will be used to screen plant facilities and roads from public view. Roads may be aligned with the contours of the topography, although this measure may result in a greater area of disturbance. Thus, the potential visual impacts during operations will be small.

4.9.1.3 Potential Groundwater Restoration Impacts

The potential impacts will be similar to operations during this most of this phase due to simultaneous production and restoration. When the Proposed Project enters the restoration only phase, the potential impacts will decline. In addition, as AUC receives regulatory approval for successful groundwater restoration within the Production Units, decommissioning of those Production Units will occur, such that the total area occupied by structures and facilities will begin to decrease during the groundwater restoration phase. Potential visual and scenic resources impacts during groundwater restoration will be similar to those during operations. These will include altered landscape from

structures and facilities and the appearance of vehicles and dust traveling within the Proposed Project area and on county roads near the Proposed Project area.

4.9.1.4 Potential Decommissioning Impacts

Potential decommissioning impacts to visual and scenic resources will resemble those of the construction phase of the Proposed Project. Disturbed areas will be re-vegetated to be consistent with pre-construction conditions. Following decommissioning, no structures or facilities will remain thereby no alterations to visual and scenic resources will remain, unless they are transferred to local landowners.

4.9.2 No Action Alternative

There will be no impacts to visual or scenic resources from the No Action Alternative since the Proposed Project will not be constructed.

4.10 Potential Socioeconomic Impacts

4.10.1 Proposed Action

The work force for all phases of the Proposed Project is anticipated to come from the 50 mile (80 km) study area, which includes the city of Gillette. Gillette provides labor for a number of large scale energy related projects in the region. The Proposed Project is located in Campbell County, which most likely will experience small effects to housing, public and other community services, recreation, county and municipal finances, crime, and the local transportation network. Adjacent counties such as Natrona could also experience effects to housing a community services.

AUC anticipates that the city of Casper in Natrona County, located 63 miles southwest of the Proposed Project, might house some of the workforce and experience some of the associated impacts. Casper's population in 2010 was 55,316 (USCB, 2012). Casper is a regional economic hub that provides a variety of construction services and labor for projects located throughout Wyoming.

It is anticipated that the overall effect of the proposed facility operations on the local and regional economy will be beneficial. Purchases of goods and services by AUC and the Proposed Project employees will contribute directly to the economy. Local, state, and the federal governments will benefit from taxes paid by the Proposed Project and its employees. Indirect impacts, resulting from the circulation and recirculation of direct payments through the economy, will also be beneficial. These economic effects will further stimulate the economy, resulting in the creation of additional jobs. Beneficial impacts to the local and regional economy provided by the Proposed Project will continue for the 16 year life of the proposed facility. Economic impacts of the Proposed Project are discussed in detail in Section 8 of the ER.

4.10.1.1 Potential Construction Impacts

Anticipated employment during the construction phase will be most intensive during the first year of the Proposed Project, with approximately 146 direct jobs. During the second year, direct construction employment is expected to decline to about 50 direct jobs. Through year nine, the number tapers down from 50 to about 20 direct jobs. Direct construction jobs from year nine through 14 will average about five jobs annually. Direct construction jobs will then increase to approximately 28 during decommissioning.

The construction phase will cause a Moderate positive impact to the local economy, resulting from the purchases of goods and services directly related to construction

activities. Impacts to community services in Wright, Gillette, and rural Campbell County or the towns of Midwest and Edgerton in northern Natrona County, such as roads, housing, schools, and energy costs will be Small or non-existent and temporary.

Most construction work available to the local construction labor pool consists of temporary contract work that varies in duration, depending on the scope of each construction project. Further, the number of unemployed construction workers does not represent the number of workers that will be available to the Proposed Project from the local construction labor pool. The number is an annual average that does not take into account monthly variations in the available construction labor pool from construction start-ups and completions. Contractors for projects located throughout northeastern Wyoming typically hire from the local construction labor pool. The actual number of construction workers available for the Proposed Project will potentially draw from the entire construction labor pool of 4,600 in Campbell County (U.S. Bureau of Economic Analysis 2009), as construction activities from some active projects will conclude so that workers will be available for future projects.

Potential Impacts to Demographics

Due to the short duration of construction (1 year) and small size of the construction workforce, the impacts of construction on demographic conditions would be limited. It is assumed that AUC would employ workers from the surrounding area, which would reduce demands for public services. Also, due to the short duration of the construction phase, workers would not likely relocate their families to the region. Therefore, demographic impacts from the Proposed Action will be small.

Potential Impacts to Housing

Construction workers relocating to the area would cause a short-term increase in the demand for temporary (rental) housing units in Campbell and surrounding counties. Any changes in employment would have little to no noticeable effect on the availability of housing in Campbell and surrounding counties. Due to the short duration of the construction phase and the availability of housing in the region, there would be little or no employment-related housing impacts. In addition, AUC assumes workers will currently live in the surrounding area, thereby reducing some of the need for additional housing.

Potential Impacts on Schools and Public Services

Due to the short duration of construction (1 year; the GEIS assumed 12 to 18 months), workers would not be expected to bring families and school-aged children with them, and

therefore, there would be no impact on educational services during construction of the Proposed Project.

Potential Economic Impact

Construction of the Proposed Project would generate some tax revenue in the local economy through the purchase of goods and services as well as contributing to county and state tax revenues. Due to the short duration (1 year) and small size of the construction workforce, construction of the Proposed Project will have a small impact on local finances.

Potential Health and Social Services Impacts

The number of construction workers would cause a short-term increase in the demand for health and social services in Campbell and surrounding counties. However, due to the short duration of the ISR construction phase and the small size of the construction workforce, there would be little or no impact on health and social services.

4.10.1.2 Potential Operation Impacts

An estimated 38 to 44 people will be required for the operation of the Proposed Project. The exception will be the final year when operations staff will decline to approximately 20. It is assumed that the majority of these personnel will be generated from the 50 mile (80 km) study area, including Gillette and Wright, and to a limited extent, the Casper area. At this time, it is not known how many of the permanent required operations workforce will be hired from outside of the 50 mile (80 km) study area.

Potential Impacts to Demographics

ISR facility operations require a number of specialized workers, such as plant managers, technical professionals, and skilled tradespeople who may relocate from outside the area. Assuming the entire direct and indirect workforce comes from outside the region of influence, the combined effect of 38 to 44 new persons in the region would constitute less than one percent of the current civilian labor force in Campbell and Johnson Counties. Demographic conditions in Campbell and surrounding counties would not likely change. The impact on demographic conditions would be small.

Potential Impacts to Housing

The Proposed Project lies within commuting distance of Gillette and Wright, both located in Campbell County and within the 50 mile study area. In addition, Midwest, Edgerton, and Casper in Natrona County are within commuting distance. Such workers from these

locales will likely commute from their homes. There will be no impact to temporary housing located within commuting distance (an estimated one to two hours) of the Proposed Project.

It is anticipated that few of the work force during any phase of the Proposed Project will purchase or rent housing of any type. Therefore, there will be no effects on the costs of any type of housing in the counties. Because rental housing usually require a long-term lease (generally a minimum of six months), only operations employees will likely enter into this type of lease agreement. Under a hiring scenario that assumes all of the proposed operations workforce will need to relocate to the area, 38 to 44 housing units will be required over the life of the project. In 2010, there were 661 vacant rental units and 209 houses for sale in the seven communities located in the Proposed Project area. Those communities include Gillette, Wright, Sleepy Hollow, Antelope Valley, Kaycee, Edgerton and Midwest. Most of the available units were in Gillette. In addition, the Casper area, which is approximately 63 miles southwest from the Proposed Project site, has considerable housing available. In 2010, Natrona County (including Casper) had 921 vacant rental units and 370 houses for sale. Because the Proposed Project lies within commuting distance of Casper, the impact on the housing market in the area is expected to be minimal.

It appears there is sufficient available housing stock in the 50 mile study area and in nearby Casper to accommodate new residents taking jobs directly or indirectly related to the Proposed Project. Thus, impact to housing should be small.

Potential Impacts on Schools and Public Services

Based on 2010 U.S. Census Bureau statistics, the average household size in Wyoming is 2.42 persons. Thus the projected increase of 38 to 44 during the operations phase for the Proposed Project could result in a total population increase of 106 persons. This assumes all of the jobs are filled with persons not already living in Wyoming.

Assuming the average household size is 2.42 persons a conservative estimate for the number of school-aged children that would relocate would be 38 to 44 children. Comprising various ages and spread across schools and classrooms in surrounding counties (kindergarten and grades 1 through 12). This small number of children would not likely have a noticeable effect on student-to-teacher ratios.

Currently, each of the schools within the 50 mile study area has some capacity for additional students, with the exception of the Kaycee Schools and the elementary school in Wright. Though the Campbell County School district is experiencing significant growth in student numbers, district officials are working to accommodate the anticipated

influx of new students (Strahorn 2011). Schools and education-related service impacts during the ISR facility operations would be Small.

A total increase of 106 people to the total population of 50 mile study area is not likely to create a significant impact on other public services such as fire, police, water, and utilities. Actual population increases as a result of the Proposed Project are anticipated to be less than discussed here because not all jobs will result in new residents within the study area.

Potential Economic Impact

Campbell County would receive some tax revenue during ISR facility operations. Personal property tax would be applied to the value of all equipment used by the Proposed Project. In addition, a state mineral severance tax would be applied to the extracted uranium; however, this tax would not be directly returned to Campbell and County. A county *ad valorem* tax for production would also contribute to local government revenue. Indirectly, the counties would benefit from increased sales tax revenue from the increased number of workers relocating to the area and from increased demand for goods and services. The tax-revenuerelated impact from ISR facility operations on local taxing jurisdictions in Campbell County would be small.

4.10.1.3 Potential Groundwater Restoration Impacts

As discussed in GEIS Section 4.3.10.3, socioeconomic impacts from groundwater restoration were expected to be similar to impacts experienced during facility operations, because the number of workers at the ISR facility and demand for services in the region would not change. The conclusion in the GEIS was impacts would be small.

The workforce is expected to be reduced by one-half to two-thirds during groundwater restoration, so the socioeconomic impacts will be similarly small. Toward the end of the operations phase, revenues from production and severance taxes and any State royalties will decline and eventually cease.

4.10.1.4 Potential Decommissioning Impacts

During decommissioning, a similar workforce as that required for construction will be required. As described in the ISR GEIS (pg. 4.4-33), up to 200 workers with similar skills to those required for construction are needed at a typical ISR facility. AUC anticipates that around 90 workers will be required during this project phase. Decommissioning of the CPP and ancillary facilities, access roads, and associated infrastructure is expected to last for 12 months. However, due to phased development, decommissioning of individual

Production Units is anticipated after regulatory approval of successful groundwater restoration. Therefore, wellfield decommissioning will likely overlap with groundwater restoration. Decommissioning, whether done by a contractor or using operations staff after operations cease, will have similar socioeconomic impacts to those during construction.

4.10.2 No Action Alternative

There will be no impacts to socioeconomics from the No Action Alternative since the Proposed Project will not be constructed.

4.11 Environmental Justice

In compliance with Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, ethnicity and poverty status in the vicinity of the proposed actions have been examined and compared to city, regional, state, and national data to determine if any minority or low-income communities could potentially be disproportionately affected by implementation of the proposed action. Similarly, in compliance with Executive Order 13045 – *Protection of Children from Environmental Health Risks and Safety Risks,* the distribution of children and locations where numbers of children may be disproportionately high in the vicinity of the proposed actions was determined to ensure that potential environmental risks and safety risks to children are addressed.

Three criteria must be met for impacts to minority/low income communities to be considered significant. First, there must be one or more populations within the region of influence. Second, there must be disproportionately high and adverse (or significant) impacts from the Proposed Action. Finally, the population under investigation must bear a disproportionate burden of those adverse impacts. If any of these criteria are not met, then impacts with respect to environmental justice or protection of children are not significant.

According to the environmental justice guidance provided by the Nuclear Regulatory Commission, *"percentage differences greater than 20 percentage points may be considered significant, and if either the minority or low-income population percentage in the radius of influence exceeds 50 percent, environmental justice should be considered in greater detail"* (Nuclear Regulatory Commission 2008:6.3). An examination of the 2010 census blocks indicates that the percentage of residents under the poverty level and the percentage of minority population surrounding the Proposed Project area, are significantly below the threshold. Therefore, the application will not analyze data for the environmental justice information.

Socioeconomics and populations that may potentially be impacted by the Proposed Project are described in Sections 3.10 of this ER and Section 2.3 of the TR.

4.12 Potential Public and Occupational Health Impacts

The Proposed Project uses ISR technology to recover uranium from the ore zones. The uranium will be recovered by means of pressurized downflow ion exchange, elution, and precipitation to produce yellowcake. A description of operations is located in Section 1 of this ER and in Section 3 of the TR. Potential public and occupational health impacts are addressed in this section.

4.12.1 Proposed Action

AUC is required to protect public and occupational health by complying with the Radiation Protection Standards set forth in 10 CFR Part 20. NUREG-1748 and NUREG-1569 require that potential public and occupational health impacts are described in the application from both non-radiological and radiological sources. The radiation safety controls and monitoring programs to be implemented at the Proposed Project site are discussed in Section 5.7 of the TR.

The Proposed Project area is located primarily on land owned by private residents (89.4 percent) with a small amount (640 acres) located on state land. As discussed in Section 3.1 of the ER there is one occupied residence currently within the Proposed Project. AUC will acquire that residence prior to the commencement of operations so that there will be no occupied housing units within the Proposed Project during operations.

As discussed in ER Section 3.10, the area within a 50 mile (80 km) radius of the Proposed Project area includes portions of seven counties in northeastern Wyoming (Campbell, Converse, Crook, Johnson, Natrona, Weston Counties and a small portion of Niobrara County), as shown on ER Figure 3.10-1. The Proposed Project is located in southwest Campbell County. The nearest communities are Wright, a small Campbell County incorporated town located northeast on State Highway 387, and the towns of Edgerton and Midwest, which are located in Natrona County southwest of the Proposed Project on State Highway 387. ER Figure 3.10-1 provides the sectorial population for the 16 compass sectors in concentric rings of varying distances from 1 to 50 miles (80 km) from the center of the Proposed Project. The population within two miles of the Proposed Project area boundary is estimated by locating occupied residences within two miles using 2010 aerial photos and field reconnaissance in 2011. The nearest resident is approximately 2 miles from the proposed CPP location as shown in ER Figure 3.1-3 and ER Table 3.1-3.

4.12.1.1 Potential Construction Impacts

During the construction phase of the Proposed Project, potential impacts to public health include fugitive dust, combustion emissions, noise, and occupational hazards associated

with construction of the CPP, Production Units, and associated facilities. Potential air quality impacts are discussed in detail within Section 4.6. As described in NUREG 1910 Vol. 2 (GEIS Section 4.2.11.2), fugitive dust will not likely result in any significant radiological dose as long as soils show low levels of radionuclides. Therefore, inhalation of fugitive dust will not result in any significant radiological dose. Baseline radiological soil sampling and gamma surveys within the Proposed Project area are discussed in detail in Section 2.9 of the TR.

Section 4.7 of this document addresses potential noise impacts associated with the Proposed Project. The employees of AUC will practice a hearing conservation program to prevent occupational noise impacts during construction. Members of the general public will not be exposed to potentially damaging noise levels because they will not have access to areas where construction is occurring. Other potential hazards include those of standard operations during construction such as strains and sprains resulting from slips, trips, and falls. Potential injuries related to the occupation will be minimized by implementing worker safety procedure in conformance with the Wyoming Occupational Health and Safety Act, Title 27, Labor and Employment, Chapter 11, Occupational Health and Safety and applicable OSHA standards. None of these potential risks affect the general public.

4.12.1.2 Potential Operation Impacts

The potential for adverse effects to either workers or members of the public are minimal during normal operations of the Proposed Project. The GEIS (Section 4.2.11) identifies that both radiological and non-radiological risks are small to both workers and the general public. Radiological monitoring and safety programs are required to be implemented that comply with 10 CFR Part 20 requirements to protect the health and safety of the workers and the public. AUC will develop and implement these monitoring and safety programs and is aware that they may be periodically inspected by the NRC. While the risks are minimal, and AUC will implement every precaution practicable to ensure the safety of the workers and public, the potential effects of operations are described below.

4.12.1.2.1 Potential Non-Radiological Impacts from Normal Operations

NUREG-1569 requires that applicants provide estimates of concentrations of non-radiological constituents in effluents at the points of discharge and provide a comparison with natural ambient concentrations and applicable discharge standards.

4.12.1.2.1.1 Potential Exposures from Air Pathways

Non-radiological airborne effluents at the Proposed Project site will be limited to fugitive dust from access roads and production unit activities. Fugitive dust emissions will be minimal as demonstrated by air quality modeling discussed in Section 3.6. Dust suppressants will be used if conditions warrant their use, however, dust suppressants were not considered for the air emissions calculations. Air quality impacts of operation of the Proposed Project are discussed in detail in Section 4.6 of this document. Additionally, vehicle combustion emissions will be lower during operations than during construction since fewer materials will be delivered and fewer workers will be required.

4.12.1.2.1.2 Potential Exposures from Water Pathways

The liquid effluent will be managed in the deep disposal wells as discussed in Section 4.14. The deep disposal wells will permanently dispose of liquid 11e.(2) byproduct material and will be permitted under a Class I UIC Permit issued by the WDEQ. No routine liquid environmental discharges, other than 11e.(2) byproduct material disposal via deep well injection, are planned and as such, no definable water related pathways for routine operations exist. There are no potential non-radiological impacts to public health expected due to the liquid effluents in water at the Proposed Project.

As discussed earlier in Section 4.5.2.3, excursions of lixiviant at ISR facilities have the potential to impact adjacent non-exempt aquifers with trace elements and other constituents of ISR recovery fluids that have been mobilized by the ISR process. Early warning constituents, e.g., chloride and TDS, have been selected to provide the initial indication about the potential for an excursion at the monitoring wells, so that corrective actions will be undertaken before potentially hazardous or radiological constituents can reach the monitor well ring. Notwithstanding this, according to NUREG-1910 (SEIS, Supplement 3, Section 4.5.2.1.2.2), following analysis of 60 events by NRC staff, most excursions were controlled through pumping and extraction of nearby wells. In all cases, however, none of these excursions resulted in environmental impacts.

Rural residents of the area surrounding the Proposed Project area have private wells that provide drinking water for household use and livestock watering. A description of the domestic water supply wells near the Proposed Project area is included with the description of the baseline groundwater quality monitoring program in Section 3.4 of the ER. Water quality impacts from normal operation of the Proposed Project will be confined to the portions of the ore zone within the aquifer exemption boundary, and therefore there will be no public health impacts to nearby drinking water wells from operations.

4.12.1.2.2 Potential Non-Radiological Impacts from Accidents

Accidents involving human safety associated with the ISR process typically have far less severe consequences than accidents associated with underground and open pit recovery methods. ISR provides a higher level of safety for employees and neighboring communities when compared to conventional recovery methods or other energy related industries. Accidents that may occur are generally minor when compared to other industries. As stated in Section 4.10.1.2 of this ER, the Proposed Project expects to employ approximately 44 full-time workers during operation. Since the rates shown in Table 4-12 are based on numbers of injuries or illnesses per 100 full-time workers, the expected rates for the Propsoed Project would be expected to be less than those shown in the table. Furthermore, employees at ISR operations will not be exposed to the many hazards associated with conventional recovery such as high walls and extensive heavy equipment operation.

NRC has previously evaluated the effects of accidents at conventional uranium ISR facilities in NUREG–0706 and specifically at ISR facilities in NUREG/CR-6733. These analyses demonstrate that, for most credible potential accidents, consequences are minor so long as effective emergency procedures and properly trained personnel are used. The Proposed Project facilities are consistent with the operating assumptions, site features, and designs examined in the NRC analyses in NUREG/CR-6733.

NUREG-0706 considers the environmental effects of accidents at single and multiple uranium milling facilities. Analyses were performed on incidents involving radioactivity and classified these incidents as trivial, small, and large. NUREG-0706 also considered transportation accidents. Some of the analyses in NUREG-0706 are applicable to ISR facilities, such as transportation accidents. NUREG/CR-6733 specifically addresses risks at ISR facilities and identifies the “risk insights” that are discussed in the following sections.

4.12.1.2.2.1 Chemical Accidents

NUREG/CR-6733 noted that the scope of the NRC mission includes hazardous chemicals to the extent that mishaps with these chemicals could affect releases of radioactive materials. Industrial safety aspects associated with the use of hazardous chemicals at the Proposed Project site are regulated by the Wyoming Safety-OSHA. ISR facilities utilize chemicals during the extraction process and during restoration of groundwater quality. AUC will implement standard industrial safety, accident prevention, personnel training, and detailed oversight, including the development of SOPs for each area of operation, which will be available to NRC for inspection, following the receipt of license and prior to the commencement of operation of the Proposed Project. Additional detail concerning individual chemicals is provided below.

Most of the bulk hazardous chemicals and materials will be stored in specially designed tanks or containers located within secondary containment structures as appropriate outside of the CPP building. The exception is sodium hydroxide which will be stored in the CPP. The conceptual CPP layout which includes chemical storage areas can be found in TR Figure 3-8. Included are berms surrounding outside chemical tanks built to contain 110 percent of the tank contents plus a 25-year flood event occurring within 24 hours as required by 40 CFR 112. A tank sizing summary is provided in Table 3-2 of the TR. Industrial safety aspects associated with the use of chemicals will be regulated by Wyoming Safety-OSHA and the WDEQ will regulate environmental aspects.

Process-related chemicals stored on site will include some or all of the following: hydrogen peroxide, a strong mineral acid, sodium hydroxide, oxygen, carbon dioxide, sodium carbonate, sodium chloride, and sodium sulfide. AUC will have strict standards and operating procedures regarding receiving, storing, handling, inspecting and disposal of chemicals to ensure safety of employees and the public.

The storage, use, and handling of all chemicals will also be consistent with the terms described in NUREG-1910.

Hydrogen Peroxide

Hydrogen peroxide is a strong oxidizer and is a reactive, easily decomposable compound. Its hazardous decomposition products include oxygen and hydrogen gas, heat, and steam. Decomposition can be caused by mechanical shock, incompatible materials including alkalis, light, ignition sources, excess heat, combustible materials, strong oxidants, rust, dust, and materials with a pH above 4.0. When sealed in strong containers, the decomposition of hydrogen peroxide can cause excessive pressure to build up which may then cause the container to burst explosively. A 50 percent solution of hydrogen peroxide will be stored in a horizontal aluminum pressure vessel tank with a pressure actuated relief valve installed in the vent pipe for safety. The storage tank will be located outdoors and outside the CPP, thus venting will be directly to the atmosphere. Upon relief, the vapors dissociate to water and oxygen, therefore no vapor scrubbing system is required. A secondary containment berm will be constructed meeting 40 CFR §264.193 for spill mitigation. Proper valves will be installed at the tank exit and both sides of the redundant pumps. A programmable logic control system integrated to the plant automation system will control the pump starts, flow rates, and time as it relates to volume needed. Standard Operating Procedures (SOP's) will be developed and operators will be trained on using these systems, both automated and manual. Eye wash stations as well as deluge type emergency showers will be located in close proximity to the areas where hydrogen peroxide is used.

As noted in NUREG/CR-6733, a hydrogen peroxide piping system leak in a process building has the potential to result in localized vapor concentrations in excess of the IDLH value of 75 ppm within several minutes. A leak in a confined space has the potential to generate lethal concentrations of vapor at an even faster rate. AUC will incorporate recommendations concerning materials of construction for tanks and piping systems and the use of local ventilation with explosion-proof fans to control vapors in the event of a leak of hydrogen peroxide. The building HVAC system will be designed for three air changes per hour, with the capacity to expand to six air exchanges per hour if needed. In addition, local exhaust fans will be installed along the outer plant wall to sweep vapors and gases near the floor level.

The use of hydrogen peroxide at concentrations greater than 52 percent is subject to the following regulatory programs:

- Process Safety Management of Highly Hazardous Chemicals standard contained in 29 CFR §1910.119 for TQs in excess of 7,500 pounds; and
- Threshold Planning Quantities (TPQs) contained in 40 CFR Part 355, Emergency Response Plans for threshold quantities (TQs) in excess of 1,000 pounds.

As discussed in TR Section 3, the Proposed Project design includes the use of hydrogen peroxide at a concentration of 50 percent contained in a hydrogen peroxide tank with a capacity of 10,000 gallons. With the design hydrogen peroxide concentration and capacity, AUC will not be subject to the aforementioned regulatory programs.

Strong Mineral Acid

A strong mineral acid (hydrochloric, sulfuric, nitric, etc.) may be used to split the uranyl carbonate complex from pregnant eluant into carbon dioxide gas and uranyl ions in preparation for precipitation using hydrogen peroxide. A 35 percent acid solution will be stored outdoors and outside the processing plant in a cross-linked high-density polyethylene flat bottom tank. The tank will be founded in a secondary containment system that is sized to hold 110 percent of the tank's volume plus a 25-year precipitation episode for 24 hours. The surface of the containment area will be treated with an appropriate coating that could include but not be limited to an acid proof epoxy coating, as appropriate. No other chemicals will be stored in the acid secondary containment area. A vent pipe will be fitted to the storage tank and will route vapors to a water bath or circulating water system. Here, acid vapors quickly react with the water to form a dilute acid solution. The solution will then be treated with an appropriate base such as soda ash to neutralize the dilute acid solution. Alternately, the vent pipe will be fitted with a demister system to mitigate any acid vapors from releasing to the atmosphere.

CPVC (chlorinated PVC) schedule 80 piping with Latharge Viton or EDPM gaskets will be used to transport the hydrochloric acid from the storage tank to the elution tanks or

other points of application. Proper valving will be installed at the tank exit, both sides of the redundant pumps, and a re-routing piping arrangement downstream from the pumps will be installed to purge the exit lines to the pregnant eluant tanks and return any residual acid in the lines to the outdoor storage tank. A programmable logic control system integrated to the plant automation system will control the pump starts, flow rates, and time as it relates to volume needed. SOPs will be developed and operators will be trained on using these systems, both automated and manual.

The use of a strong mineral acid is subject to Reporting Quantities (RQs) contained in 40 CFR Part 302.4 for quantities in excess of 5,000 pounds. Based on the design capacity, AUC will be subject to the Reporting Quantities.

At a minimum, an acid-rated respirator, face shield, overall or apron and gloves will be required during the cleanup of any acid spill. Additionally, eye wash stations as well as deluge type emergency showers will be located in close proximity to any areas where such acid will be used.

Sodium Hydroxide

Sodium hydroxide is used for pH adjustment during the precipitation process. The sodium hydroxide will be stored in a flat bottom tank located in the processing plant for use in the precipitation circuit. The 50 percent sodium hydroxide solution will be stored in a fiberglass tank with a vent pipe routed through the roof to the atmosphere outside and above the CPP. A secondary containment berm will be constructed within the plant to contain spills to the immediate area. As noted in NUREG-1910 (GEIS Section 2.7.2), all ISR facilities have concrete curbed floors with drains and sumps to control and retain liquid from spills and wash-downs. The berm will be constructed to a height of six inches. The sodium hydroxide will be transported using conventional PVC piping from the fiberglass storage vessel into the CPP precipitation tanks. Sodium hydroxide reacts vigorously with hydrochloric acid, which will also be present in the precipitation circuit.

Oxygen

Oxygen presents a substantial fire and explosion hazard. The design and installation of the oxygen storage facility is typically performed by the oxygen supplier and meets applicable industry standards. The oxygen will be delivered to the Proposed Project site by truck and stored on site under pressure in a cryogenic tank in liquid form. The oxygen will be allowed to evaporate and will be added to the barren lixiviant within the Production Units.

The oxygen storage system will consist of 30-ton bulk liquid oxygen pressure vessel(s) which will be centrally located to service multiple production units. The tanks will be

supplied and maintained by the liquid oxygen supplier. All oxygen deliveries and tank fillings are performed by the tank supplier. Gaseous oxygen, formed by the air heated evaporators, is then routed via low carbon steel piping that has been properly degreased from the bulk storage tank to individual header houses. Oxygen will be added to the injection stream either upstream of the injection manifolds or at each individual injection well meter run within the header house. The oxygen saturated lixiviant is sent to the individual injection wells at specified flow rates. Oxygen saturation pressure is a function of the water head or pressure above the uranium bearing sands. Totally enclosed fan cooled (TEFC) motors, solenoids, valves, pressure gauges, exhaust ventilation systems and alarm safety devices are included in the design for accident mitigation.

Combustibles such as oil and grease will burn in oxygen if ignited. AUC will ensure that all oxygen service components are cleaned to remove all oil, grease, and other combustible material before putting them into service. Acceptable cleaning methods are described in CGA G-4.1.

Carbon Dioxide

The primary hazard associated with the use of carbon dioxide is concentration in confined spaces, presenting an asphyxiation hazard. Bulk carbon dioxide facilities typically are located outdoors and are subject to industry design standards. Floor level ventilation and carbon dioxide monitoring at low points will be performed to protect workers from undetected leaks of carbon dioxide within the CPP.

The carbon dioxide storage system will consist of one 50-ton bulk liquid carbon dioxide pressure vessel tank supplied and maintained by the carbon dioxide supplier. The tank will be located outdoors and outside the CPP. All carbon dioxide deliveries and tank fillings will be performed by the supplier. Gaseous carbon dioxide is routed via carbon steel piping from the bulk storage tank to both the production and injection main lines.

AUC will incorporate recommendations concerning materials of construction for tanks and piping systems and the use of ventilation to control vapors in the event of a leak of carbon dioxide. The building HVAC system is designed for three air changes per hour with the capacity to expand to six air exchanges per hour if needed. The CPP will have full time alpha radiation and oxygen level monitoring which will be part of an automated system that will initiate the air exchange system as needed. In addition, local exhaust fans will be installed along the outer plant wall to sweep vapors and gases near the floor level.

Sodium Carbonate and Sodium Chloride

Sodium carbonate and sodium chloride are primarily inhalation hazards. Soda ash and carbon dioxide will be used to prepare sodium carbonate for injection in the production

unit. Sodium carbonate and sodium chloride are also used for regeneration of ion exchange resin. Dry storage and handling systems will be designed to industry standards to control the discharge of dry material.

A 26 percent sodium chloride saturated solution will be created from pure salt solids transferred using aluminum piping into a 30° cone-bottom reinforced silo with a capacity of 10.361 gallons with a vent pipe vented through the roof to the atmosphere outside and above the main plant. Water is pumped into the storage tank using PVC piping and the salt dissolves until solution saturation is achieved.

A 32 percent soda ash saturated solution will be created from dense soda ash solids transferred into a flat bottom reinforced fiberglass tank with a capacity of 13,114 gallons with a vent pipe vented through the roof to the atmosphere outside and above the main plant. Hot water is pumped using copper or PVC pipe into the storage tank and the soda ash dissolves until solution saturation is achieved. Solution temperature is maintained at a minimum of 95°F to avoid solids precipitation of the soda ash solution.

Proper valves will be installed at the tank exits and both sides of the redundant pumps. A programmable logic control system integrated to the plant automation system will control the pump starts, flow rates, and time as it relates to volume needed. Standard Operating Procedures will be developed and operators will be trained on using these systems, both automated and manual.

Sodium Sulfide

Sodium sulfide may be used as a reductant during groundwater restoration. Sodium sulfide is corrosive and will cause severe eye and skin burns. Routes of entry into the body include inhalation, ingestion, and contact with the skin. Under low pH conditions, sodium sulfide can react with water to liberate hydrogen sulfide gas.

Proper valves will be installed at the tank exits and both sides of the pump. A programmable logic control system integrated to the plant automation system will control the pump starts, flow rates, and time as it relates to volume needed. Standard Operating Procedures will be developed and operators will be trained on using these systems, both automated and manual.

Facility Areas Where Fumes or Gases May Be Generated

Potential sources of non-radiological fumes or gases can result from use of process related chemicals. The potential sources of non-radiological fumes or gases are minimal in the ion exchange process area since the production solutions contained in the process equipment are maintained under a positive pressure.

Non-Process Related Chemicals

Non-process related chemicals that will be stored and used on-site will include diesel and propane. Due to the combustible and flammable nature of these chemicals, they will be stored outside of the plant building and away from hazardous material storage areas. Storage containers will be located above ground and with safety and environmental provisions according to federal, state and local regulations.

Domestic Sewage

Relatively small amounts of domestic effluent from an on-site septic system will be discharged to the environment. As described in Section 4.13, the septic system will discharge up to a maximum of 2,000 gpd of septic tank effluent to the subsurface in a drainfield based on the peak design flow rate during construction. Alternately, AUC may decide to design and permit a septic treatment system with surface discharge of treated effluent. The septic water disposal facility will be designed and constructed in accordance with WDEQ-WQD standards designed to protect public health and the environment. The drainfield, if used, will include monitor wells to ensure that the septic tank and drainfield adequately treat the domestic septic water if the peak flow to the septic tank warrants a monitor well system.

4.12.1.2.3 Potential Radiological Impacts from Normal Operations

AUC is proposing to develop an ISR facility with a production and restoration flow of approximately 11,000 and 1,050 gpm respectively. An assessment of the radiological effects of the Proposed Project must consider the types of emissions, the potential pathways present, and an evaluation of potential consequences of radiological emissions. The only expected routine emission at the facility will be ^{222}Rn. Radon, a decay product of ^{226}Ra, is dissolved in the lixiviant as it travels through the ore to a recovery well where it is brought to the surface. The concentration of ^{222}Rn in the production solution and estimated releases was calculated using the methods found in NRC NUREG 1569 Appendix D.

MILDOS-AREA, a computer code maintained by Argonne National Laboratory, is employed to model radiological impacts on human and environmental receptors using project-specific ^{222}Rn release estimates, meteorological and population data, and other parameters. The estimated radiological impacts resulting from routine site activities are compared to applicable public dose limits and naturally occurring background levels. Because EPA has concluded that ^{222}Rn progeny exposures are most likely inside structures with limited air exchanges, and that they are very unlikely outside, the MILDOS-AREA estimates are regarded as very conservative (GER, 2007).

Figure 4-7 presents exposure pathways from all potential sources at the facility. The predominant pathways for planned and unplanned releases are identified. Atmospheric ^{222}Rn is expected to be the predominant pathway for impacts on humans and environmental media. Radon air concentrations associated with plant releases are controlled by wind direction and atmospheric stability. As a noble gas, ^{222}Rn itself has very little radiological impact on human health, since no deposition in lung tissues occurs when it is inhaled. Health impacts are associated with ^{222}Rn decay products, which are particulates that can be retained in the lung and may move to other organs. Radon has a relatively short half-life of 3.82 days; its decay products are alpha and beta emitting, particulate radionuclides.

4.12.1.2.3.1 Exposure from Water Pathways

The recovery solutions in the ore zone will be controlled and adequately monitored to ensure that migration does not occur. During ISR operations, a slightly greater volume of water will be recovered from the PZA than is injected, to create an inward flow gradient into the Production Units. The difference between the amount of water recovered and injected is the wellfield "bleed". The bleed minimizes the possibility of an excursion.

The primary method of liquid 11e.(2) byproduct material disposal at the facility will be by deep well injection. Brine, spent eluant and other liquid 11e.(2) byproduct material will be disposed in deep disposal wells as described above. A high percentage of permeate generated through the use of RO units will be injected either into the barren lixiviant stream or into the groundwater restoration circuit. Permeate which is not recycled back to operation or restoration activities will be used as plant makeup water.

The deep well(s) will be completed at depths significantly deeper than zones planned for uranium recovery and current CBM operations and will be isolated geologically from underground sources of drinking water. The well(s) will be constructed under a permit from the WDEQ and all requirements of the UIC program for Class I wells will be satisfied.

The uranium ion exchange, precipitation, drying and packaging facilities will be located on curbed concrete pads or within a curbed facility to prevent any liquids from entering the environment. Solutions used to wash down equipment drain to a sump and are either pumped back into the processing circuit or to the disposal well. The curbed pads or curbed facility will be of sufficient size to contain the contents of the largest tank in the event of a rupture.

No routine liquid environmental discharges, other than liquid 11e.(2) byproduct material disposal via deep well injection, are planned and as such, no definable water related pathways for routine operations exist.

4.12.1.2.3.2 Exposures from Air Pathways

The potential for radiological exposure from all air pathways will be minimized at the Proposed Project site. The use of pressurized down-flow ion exchange columns will limit ^{222}Rn emissions in the CPP and the use of vacuum yellowcake dryer systems will reduce the potential for particulate emissions to near-zero.

The uranium recovery process will be a closed circuit. The CPP will be equipped with a general area ventilation system to remove small amounts of ^{222}Rn that may be released in areas without dedicated ventilation systems. Details of the plant ventilation system are discussed in Section 4.1 of the TR. As discussed in NUREG-1910, there are no significant radiological safety issues during ISR operations.

Source Term Estimates for MILDOS Analysis

Source term estimates and potential radiological impacts on human and environmental receptors are made using the most recent version of MILDOS-AREA, as recommended by NRC in NUREG-1569, Section 7.3.1.2.2. The code is designed as a primary licensing and evaluation tool to model airborne radiological effluent releases for ISR facilities, including ^{222}Rn released from production units and processing facilities. The MILDOS-AREA code provides capabilities to evaluate radiation from the exposure pathways identified in Addendum 7-A of the TR, including inhalation, ingestion of vegetables, meat and milk, and external exposure from ground shine and cloud immersion.

The source terms used to estimate ^{222}Rn releases from the facility during operational periods include well fields in production, restoration well fields, new well field development and operation of the CPP. The parameters used to characterize and estimate releases and the results of the MILDOS-AREA model used to assess the potential radiation dose to the public from uranium recovery operations at the Proposed Project are presented in TR Section 7.

Human Exposure

To determine compliance with the annual public dose limit (100 mrem/year) per 10 CFR 20.1301, the MILDOS-AREA model, utilizing AUC's source term estimates, is used to calculate TEDE to members of the public on or off-site. These hypothetical persons include:

- Residents: Two residents will be living at the nearest residential structure to the Proposed Project. This structure will be located approximately 2.2 miles north of the CPP. The estimated maximum duration during which a resident may be exposed is 8,400 hours per year (24 hours per day x 7 days per week x 50 weeks). These two residents are considered the maximally potentially exposed member of

the public, but only for a period of one year (Year 3 of the Proposed Project). The second highest will be the oilfield workers;

- Ranchers: Five individual ranchers conduct ranching activity within the Proposed Project area are evaluated. The ranchers graze cattle, horses, and sheep within the Proposed Project and within 2 miles of its boundary. The estimated maximum duration that a rancher will occupy the Proposed Project area is 100 hours per year, calculated as ten 10-hour days;
- Oilfield workers: Two oilfield workers are modeled, attending to the existing oil or CBM gas production wells within the Proposed Project area. The estimated maximum duration that each oilfield worker will occupy the Proposed Project area is 175 hours per year, calculated as 0.5 hour per day x 5 days per week x 50 weeks per year for normal operations plus 10 hours per day x 5 days per year for maintenance activities;
- Couriers: Couriers will deliver and pick up packages at the site, primarily from the administration building within the central plant area. A courier is assumed to occupy the Proposed Project area for 90 hours per year, calculated as 20 minutes per day x 5 days per week x 52 weeks per year; and
- Vendors: Vendors such as fuel and bulk oil delivery personnel will travel regularly to the Proposed Project area. A vendor is assumed to occupy the project area for 260 hours per year, calculated as 1 hour per day x 5 days per week x 52 weeks per year.

In addition to these members of the public, AUC also considered a commuter driving through the Proposed Project area, and a hunter spending time within the area. Dose to each will be small, since the annual exposure time for each is estimated to be less than 25 hours.

These results, presented in detail in Section 2.9 of the TR, indicate that the highest annual TEDE, 0.53 mrem/year, for members of the public living at actual locations outside the permit boundary will occur during year 3 of the operational phase, at the Proposed Ranch House location. This dose is less than one percent of the applicable limit of 100 mrem/yr. Inhalation is found to be the primary pathway (98.6 percent). Maximum estimated dose to a hypothetical individual located full-time at edge of the site was calculated to be 2.5 mrem, on the east boundary. No residence is currently located or planned at this location.

Population Dose

The annual population dose commitment to the population in the region within 80 km of the facility also is estimated by the MILDOS-AREA method. Detailed results are presented in the Technical Report. Facility-related dose to the population of 55,000 living within 50 mile (80 km) of the facility was calculated to be 0.1 person-rem. This may be

compared to a natural background dose to the same population, estimated to be approximately 17,000 person-rem.

The atmospheric release of ^{222}Rn from the proposed facility will also result in a tiny and unmeasureable increase in dose to the population on the North American continent. The effect of operations at the facility will be to increase the TEDE of this population by 0.0001 percent, using the results of previous studies performed for similar facilities.

4.12.1.2.3.3 Potential Exposure from Flora and Fauna

Since the only planned emission from the facility is ^{222}Rn to the atmosphere, the most important pathway for exposure to flora and fauna is inhalation, and deposition of ^{222}Rn decay products in surface water, and on surface soils, and vegetation. MILDOS-AREA estimates a ^{222}Rn decay product surface deposition rate as a function of distance from the source for the ^{222}Rn decay products, and calculates surface concentrations. Table 7-8 of the TR presents the surface concentrations of ^{222}Rn decay products predicted by MILDOS-AREA. The calculated values represent very small increases when compared to naturally-occurring concentrations.

There are no current dose standards for protection of biota, including native animals that graze on or travel across the site. It is unlikely that any individual animal will be exposed to facility-related ^{222}Rn emissions of any significance for a significant portion of the year.

U.S. Department of Energy Order 5400.5 proposed a limit of one rad per day (rad/d) for aquatic organisms (U.S. Department of Energy 2010). According to 10 CFR 834 (proposed), Subpart F, the proposed limits for terrestrial plants are one rad/d and 0.1 rad/d (100 mrad/d) for terrestrial animals. Those proposed values are far higher than the doses calculated to any human receptor (2.5 mrem/y). Accordingly, there will be no significant impact to biota associated with the Proposed Project.

4.12.1.2.4 Potential Radiological Impacts from Accidents

The following sections discuss potential accident scenarios that could have radiological impacts. Mitigation measures to minimize or eliminate these impacts are discussed in Section 6.2.2 of this document.

As noted in NUREG-1910 (GEIS, Sec. 4.2.11.2.2), ISR facilities are designed to contain controls to reduce the exposure to individuals in the event of an accident. It also states emergency response procedures would be in place in addition to respiratory protection programs for worker protection. AUC will have such procedures and programs in place.

Section 5.7 of the TR describes the radiation safety controls and monitoring programs that will be implemented at the Proposed Project site. These programs were developed to assure that operations criteria established in NUREG-1910 will be followed such that the occupational health impacts and accident risks described in that document will be applicable to the Proposed Project. Additional accident scenarios and details of each potential credible accident are discussed in Section 7.6 of the TR.

Radiological accidents that might occur typically will manifest themselves slowly and therefore are easily detected and mitigated. The remote location of the Proposed Project facility and the low level of radioactivity associated with the ISR process combine to decrease the potential hazard of an accident to the general public.

4.12.1.2.4.1 Tank Failure

A spill of the materials contained in the process tanks at the Proposed Project area will present a minimal radiological risk. Process fluids will be contained in vessels and piping circuits within the CPP. The tanks at the Proposed Project site will contain injection and production solutions, ion exchange resin and liquid 11e.(2) byproducts.

NUREG/1910 analyzes the potential impacts of a failure of a yellowcake thickener resulting in a release of 20 percent of the contents outside the plant structure. This postulated accident scenario is based on an event at the Irigaray ISR facility in 1994. The event in question was caused by the failure of an inadequate concrete pad supporting the thickener. The subsequent release from the building was a result of the proximity of the thickener to the plant wall. NUREG/CR-6733 concludes that, based on conservative calculations of this unlikely event, the dose to the public will be below the limits in 10 CFR 20. The calculations result in a dose to an unprotected worker in excess of the exposure limits from 10 CFR 20 (i.e., five rem). However, this dose estimate is based on a number of unlikely, conservative assumptions. The scenario makes the unrealistic assumption that no efforts will be made to clean up the spill, allowing the yellowcake to dry and become transportable. The dose is based on lung clearance class Y uranium ("insoluble," therefore stays in lung a long time), which produces the highest dose estimates. This is very conservative since modern yellowcake products are quite soluble and leave the lung much more quickly than the "Y" assumed, resulting in much smaller doses. No allowance in the dose calculation is made for the use of protective equipment, including protection factors from the use of respiratory protection equipment. In the event of an accident similar to this at the proposed facility, personnel will follow spill response procedures which will require the use of PPE. Following the issuance of the license and prior to commencement of operation, AUC will implement a set of SOPs available to NRC for inspection.

NUREG/CR-6733 also assesses the potential dose from a catastrophic spill from an ion exchange column resulting in the release of the entire contents of the vessel and the resultant release of ^{222}Rn. Based on a number of assumptions, the predicted dose is 1.3 rem in a 30 minute period to a worker in the area. Any change to the ^{222}Rn concentration or exposure time has a linear effect on dose. For example, if the room size is doubled or the exposure time is halved, then the dose will be halved. NUREG/CR-6733 recommends that the use of ventilation or atmosphere-supplying respirators designed to protect against gases will be sufficient to mitigate doses that unprotected personnel should evacuate spill areas near ion-exchange columns, and that ISR facilities maintain proper equipment, training, and procedures to respond to large lixiviant spills or ion exchange column failure.

Construction of tanks and vessels will be in accordance with ASME and ASTM codes. This construction will provide sufficient liquid containment for potential releases. In addition, standard operating procedures for CPP operations will be used by AUC to minimize the potential of releases escaping the CPP primary containment systems. Such SOPs will be made available to NRC for inspection after license issuance.

Instantaneous failure of a tank is unlikely. Tank failure is more likely to occur as a small leak in the tank. In this case, the tank will be emptied to a level below the leaking area and repairs or replacement made as necessary. Other prevention methods include shift inspections of plant areas including tanks. If a tank or process vessel has a major failure, such as a rupture, fluids will be captured in secondary containment structures (e.g. concrete berms) in the process building. As discussed in Section 7.5.1 of the TR, the containment areas will have a sump to pump the collected fluids to other process tanks, a lined backup storage pond, or a deep disposal well. Following fluid removal the area will be washed down and the water will be collected and properly disposed of.

The plant will be designed to control and confine liquid spills from tanks should they occur. The CPP building structure and concrete curb will contain the liquid spills from the leakage or rupture of a process vessel and will direct any spilled solution to a floor sump. The floor sump system will direct any spilled solutions back into the plant process circuit or to the liquid byproduct material disposal system. Bermed areas, tank containments, and/or double-walled tanks will perform a similar function for any chemical vessels located outside the CPP building.

4.12.1.2.4.2 Plant Pipe Failure

The rupture of a pipe within the CPP will be detected easily by operating staff and can be controlled quickly. Spilled solution will be contained and managed in the same fashion as with a tank failure.

4.12.1.2.4.3 Production Unit Spill/Pipeline Failure

The rupture of an injection or recovery feeder line or individual flow line in a wellfield header house, or a trunkline between a production unit and the Proposed Project CPP, will result in a release of injection or recovery solution which could contaminate the ground in the area of the break. If such a rupture occurs, AUC will comply with all notification requirements put forth in 10 CFR Part 20.2202 and Part 20.2203.

Occasionally, small leaks at pipe joints and fittings may occur. Until remedied, these leaks may drip injection or recovery solutions onto the underlying soil. AUC will monitor trunklines, and individual flow lines for changes in pressure or flow. Significant variation in these parameters will signal alarms at the CPP control room, which will prompt an investigation of the potential leak. Following repair of a leak, AUC will require that the affected soil be surveyed for contamination and the area of the spill documented. If contamination is detected, the soil is sampled and analyzed for the appropriate radionuclides. All soils and clean-up materials will be disposed off-site at a licensed 11e.(2) byproduct material disposal facility.

4.12.1.2.4.4 Potential Transportation Accidents

Transportation accidents are discussed in Section 4.2 in this ER and in greater detail in Section 7.5 of the TR. The following provides a summary of materials that may be transported to and from the Proposed Project and potential impacts to the public and workers.

AUC will implement an emergency response arrangement with appropriate local and State governmental agencies, as well as a set of SOPs that will be available to NRC for inspection after the issuance of the license. The arrangement will include a listing of materials, emergency handling and risks, and will involve training and monitoring of such activities on an ongoing basis. The arrangement will include both radiological and non-radiological substances.

Throughout operations the following materials may be transported to or from the Proposed Project:

- Shipment of solid 11e.(2) byproduct material;
- Shipment of dried yellowcake to a conversion facility;
- Shipment of process chemicals or fuel;
- Shipment of solid non-11e.(2 byproduct material to a municipal landfill;
- Shipment of hazardous waste to an appropriately licensed disposal or recycling facility; and

- Shipment of uranium-loaded resin pursuant to RIS 2012-06.

To minimize transportation accidents, all shipments of materials and supplies to and from the site will be transported by properly licensed and certified drivers and will be subject to federal and state transportation regulations. Emergency response programs will be in place along with environmental emergency response contractors for spill cleanup. AUC will provide training for local emergency personnel including firemen, police and EMTs in the hazards and emergency response procedures to ensure safe working practices in the presence of spilled materials.

Shipment of Solid 11e.(2) Byproduct Material

Solid 11e.(2) byproduct material including unusable contaminated equipment generated during operations and decommissioning will be transported to a licensed disposal site in accordance with NUREG-1910 (see GEIS Section 2.7.3). As discussed in Section 4.2, AUC has evaluated potential transportation routes to four disposal sites. These include one facility in Wyoming, two in Utah, and one in Texas. The distances of these facilities from the Proposed Project range from approximately 144 miles to more than 1,000 miles.

Before operations begin, AUC will finalize a disposal agreement with one licensed disposal facilities. Shipments will be handled as LSA material and generally are made bulk in sealed roll off containers in accordance with the applicable NRC (10 CFR Part 71) and DOT (49 CFR Part 173) hazardous materials shipping requirements. Because of the low volume of solid 11e.(2) byproduct material generated, these shipments will average about five per year during operation and groundwater restoration, increasing to as many as 200 shipments during decommissioning. The potential for radiological and environmental impacts in the case of an accident will be low due to the low concentration of radioactive material in the shipments. The solid material will be contained relatively easily in the event of an accident. In the event of an accident, AUC will commit to performing radiological surveys during and following remedial action, soil sampling, and analysis to confirm cleanup, and a report to NRC to verify that contaminants have been removed in accordance with 10 CFR Part 20.2202 and Part 20.2203.

AUC will provide training for local emergency personnel including firemen, police and EMTs in the hazards and emergency response procedures to ensure safe working practices in the presence of spilled materials, and to ensure that medical personnel in particular understand the low risk associated with potential exposure to low-concentration materials. AUC will also arrange, well prior to the first shipment, for emergency response radiation monitoring and remedial action capabilities to be provided by properly trained organizations at intervals along the shipment route.

Shipment of Dried Yellowcake

Transportation of dried yellowcake will be made in exclusive-use vehicles. In accordance with NUREG-1910 (GEIS, Section 3.3.2), AUC will adhere to the NRC packaging and transportation requirements put forth in 10 CFR Part 71 and USDOT hazardous material transportation regulations at 49 CFR Parts 171-189. The only currently permitted conversion facility in the United States is in Metropolis, Illinois. The proposed maximum annual yellowcake production rate for the Proposed Project is two million pounds. Based on weight limits for legal transport, each shipment will contain approximately 40,000 pounds of yellowcake, for a total of about 50 shipments per year.

As noted in NUREG-1910 (GEIS Section 2.8), yellowcake will be shipped in 55 gallon steel drums, each containing up to 860 pounds of product. Section 4.2 of this ER summarizes accident probability estimates from NUREG-0706. The probability of a transport accident involving yellowcake shipment resulting in a significant release of yellowcake to the environment is low. Section 4.2 discusses exposure potential and risks to the general public, concluding that the probability of a cancer death from a yellowcake transportation accident would be very small.

If a transport accident involving spilled yellowcake during transportation occurs, all material and contaminated soil will be removed, and either processed through a uranium mill, or disposed of in an NRC licensed disposal facility. The cleanup will be directed by qualified and trained staff working for the licensed transporter with assistance, as available, from the affected state's radiological emergency assistance team. Should the state's response capability be limited, NRC may be requested to assist (NRC 1980). In any event, AUC commits to providing a radiological survey and sampling information to NRC, detailing remedial actions performed over the affected area demonstrating that contaminants have been removed in accordance with 10 CFR Part 20.2202 and Part 20.2203.

Consequently, the potential impacts of an accident involving radiological materials are considered to be small during operations.

Shipment of Process Chemicals or Fuel

It is estimated that approximately four bulk chemical, fuel, and supply deliveries will be made per working day throughout the operational life of the project. Types of deliveries will include carbon dioxide, oxygen, sodium chloride, soda ash, hydrogen peroxide, hydrochloric acid, and fuel. All packaging and shipments will be made in accordance with the applicable DOT hazardous materials shipping provisions.

4.12.1.3 Potential Groundwater Restoration Impacts

Groundwater restoration activities are expected to have similar but generally smaller potential impacts to public and occupational health than during operation. The number of employees, chemical shipments, and dried yellowcake shipments will all be lower during the groundwater restoration only phase, and potential radiological and non-radiological public and occupational health impacts also will generally be lower.

4.12.1.4 Potential Decommissioning Impacts

Potential public and occupational health impacts during decommissioning are expected to be similar to those discussed in construction. There will be similar types of occupational hazards such as heavy equipment operation, and there will be an increase in the workforce, although the total number of employees and contractors is expected to be only about half of the peak construction workforce. During decommissioning generally there will not be yellowcake shipments from the site nor a significant number of chemical shipments to the site. However, there will be an increase in shipments of 11e.(2) byproduct material. During the 12 month decommissioning phase, a total of 200 shipments of solid 11e.(2) byproduct materials are anticipated from affected equipment and piping, pond liners, deep disposal well materials.

4.12.2 No Action Alternative

There will be no impacts to public and occupational health under the No Action Alternative since the Proposed Project will not be constructed.

Table 4-12 :Number and Rate of Nonfatal Occupational Injuries and Illnesses for the Mining Industry, Wyoming, 2010

(Numbers in thousands)

Characteristic	Mining (except oil and gas) (code 212)[1]	
	Number	Rate[2]
Injuries and Illnesses		
Total cases	0.2	1.8
Cases with days away from work, job transfer, or restriction	0.1	1.0
Cases with days away from work	0.1	0.6
Cases with job transfer or restriction	(3)	0.4
Other recordable cases	0.1	0.8
Injuries		
Total cases	0.2	1.7
Illnesses		
Total cases	(3)	(3)
Illness Categories		
Skin disorders	(3)	(3)
Respiratory conditions	(3)	(3)
Poisoning	(3)	(3)
Hearing loss	(3)	(3)
All other illness cases	(3)	(3)

Source: WY DOE, 2010, http://doe.state.wy.us/lmi/osh/OSH_10/tA.htm, accessed November 3, 2011.

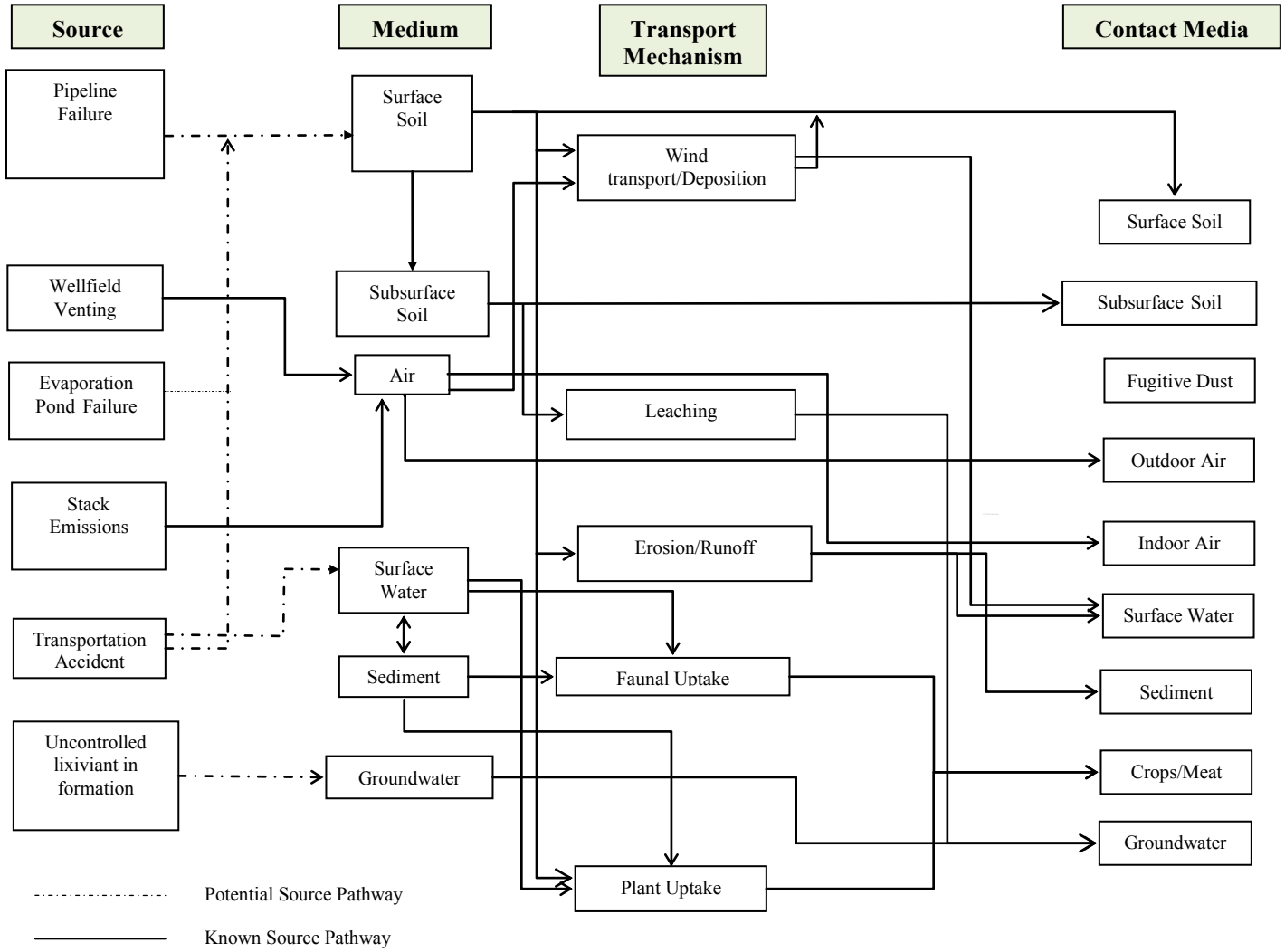
[1] The uranium mining NAICS code is 212291. No data exists solely for uranium mining.

[2] Incidence rates represent the number of injuries and/or illnesses per 100 full-time workers (10,000 full-time workers for illness rates) and were calculated as: (N / EH) X 200,000 (20,000,000 for illness rates) where,

N = number of injuries and/or illnesses
EH = total hours worked by all employees during the calendar year
200,000 = base for 100 full-time equivalent workers (working 40 hours per week, 50 weeks per year)
20,000,000 = base for 10,000 full-time equivalent workers (working 40 hours per week, 50 weeks per year).

[3] Values too small to display

Figure 4-7: Exposure Pathways



Pathway	Ingestion	Inhalation	Direct Exposure	Absorption
Surface Soil	x		x	
Subsurface Soil	x		x	
Fugitive Dust	x	x	x	x
Outdoor Air		x	x	
Indoor Air		x	x	
Surface Water	x			x
Sediment				
Crops/Meat	x			
Groundwater	x			

x	Predominant Path

4.13 Potential Byproduct Management Impacts

ISR uranium facilities produce airborne effluents, liquid byproducts, and solid byproduct materials that must be handled and disposed of properly. This section describes the anticipated quantities, proposed byproduct management systems, and potential impacts resulting from the management of liquid and solid byproduct material generated under the Proposed Action and No Action Alternative.

4.13.1 Proposed Action

4.13.1.1 Proposed Byproduct Management Systems

This section describes the proposed byproduct management system. Liquid and solid byproducts are divided into two general categories: 11e.(2) byproduct material and non-11e.(2) byproduct material:

- 11e.(2) Byproduct Material**:** material includes liquids and solids meeting the criteria as defined by 10 CFR Part 40.4: "The tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content." Liquid 11e.(2) byproduct materials produced in an ISR facility include brine, permeate, and process solutions. Process solutions are made up of CPP process liquids (e.g. spent eluant, etc.), and fluids generated in the wellfields such as from work over operations on production wells. Solid 11e.(2) byproduct materials include process solids (e.g., filter media, spent resin, etc.), contaminated soil, parts, equipment, debris, and PPE that cannot be decontaminated for unrestricted release including, but not limited to, pipe, fittings, and hardware (NMA 2007).
- Non-11e.(2) Byproduct Material: Non-11e.(2) liquid byproduct material include storm water runoff and domestic sewage. Non-11e.(2) solid byproducts include TENORM, hazardous byproducts, plus such other byproducts as oily rags and equipment, and uncontaminated solid byproduct material such as office refuse.

The following subsections describe the management of each byproduct stream anticipated under the proposed action. Section 4.13.1.2 describes the potential impacts during construction, operation, groundwater restoration, and decommissioning. For each byproduct material stream, the following information is provided, as required by NUREG-1748:

- The expected quantity of byproduct materials generated during construction, operation, groundwater restoration and decommissioning;
- Byproducts management systems designed for byproduct material collection, storage, and disposal;
- Material/byproduct disposal plan;

- Material/byproduct minimization plan; and
- Assessment of potential impacts, including potential cumulative impacts.

Refer to Table 4-13 for a summary of the anticipated 11e.(2) and non-11e.(2) solid and liquid byproduct material stream sources, storage locations, estimated typical quantities, and disposal methods.

4.13.1.1.1 Liquid 11e.(2) Byproduct Material

This Section describes the nature, potential volume, management and potential impacts of generating 11e.(2) byproduct materials at the Proposed Project.

4.13.1.1.1.1 Brine

Brine Quantity

Brine generated through the use of RO units will be sent to the CPP waste water tanks prior to disposal in the deep disposal wells (DDW). Occasionally RO brine will be temporarily discharged to the lined backup storage pond if DDW capacity is not sufficient due to maintenance or repair of a DDW. In the event it is necessary, AUC will apply for additional DDWs in order to maintain operating capacity. Anticipated brine generation rates during operation, concurrent operation and groundwater restoration, and groundwater restoration only are provided in Figures 4-8 through 4-10, which present the anticipated water balance for the Proposed Project. The highest flow rate of brine will be generated during concurrent operation and groundwater restoration phases.

Brine Management

Initially, prior to the start of active groundwater restoration, brine from the RO treatment of the barren lixiviant slip stream will be sent to the DDWs for disposal or to the lined backup storage pond if a deep disposal well is temporarily out of service. The DDWs and lined backup storage pond are described in Section 4.3.5 of the TR. One lined backup storage pond is planned to encompass 0.5 acres total and include dual liners and a leak detection system. Freeboard will be maintained for the 6-hour/25 year design storm event.

Brine Disposal

Brine generated by the proposed action will be disposed in Class I deep disposal wells. Deep well disposal is selected as the preferred method of brine disposal due to minimal potential impacts to human health and the environment compared to large evaporation ponds or off-site brine transport. AUC will construct up to four Class I deep disposal wells under WDEQ/WQD

UIC Permit 09-621. As described in TR Section 4.2.6.1, the anticipated injection capacity is expected to be 40 gpm per well, or up to 160 gpm total. A comparison between the maximum anticipated disposal well capacity and the maximum brine disposal rate shows that adequate disposal well capacity will be available.

The deep disposal well receiving formations will be the Cretaceous Teapot and Parkman sandstones at depths of approximately 7,450 to 8,390 feet BGS. Deep disposal wells will be constructed according to WDEQ/WQD Class I disposal well construction standards, including surface casing from the ground surface to a distance of at least 100 feet below the base of the lowermost potential USDW. The location, depth, and construction methods for deep disposal wells will be designed to isolate liquid 11e.(2) byproduct material from any USDW source. In order to permit the wells, AUC will demonstrate that there will be no migration of injected fluids into nearby wells or USDWs. AUC will also perform routine monitoring consisting of quantity and pressure recordation and perform internal and external MIT every five years. The deep disposal well permit application and WDEQ correspondence are included as Addendum 4A in the TR.

The use of up to four deep disposal wells will provide operational flexibility in case one of the disposal wells becomes inoperable either for the short or long term. Additional capacity also will be available in the lined backup storage pond without exceeding the freeboard capacity limits, which include space for rainfall and wave surges.

Brine Minimization

Once groundwater restoration begins, the quantity of brine generated during operation of the Proposed Project will be minimized primarily by employing two stages of RO. That is, the brine generated from the production and restoration RO units will be further treated in a secondary RO unit. This will reduce the brine quantity by an estimated 50 percent compared to single-phase RO treatment. AUC will further reduce the brine quantity by employing limited groundwater sweep which will also be treated by the secondary RO unit. As described in TR Section 6.1, a limited volume of groundwater sweep is proposed to minimize consumptive use of groundwater. AUC may also selectively apply groundwater sweep to specific portions of an affected Production Unit wellfield in order to maximize benefits with a minimal volume of water withdrawal and subsequent brine production.

Brine Management Potential Impacts

Potential impacts from brine management include potential leaking pipes in the effluent collection system, potential leaks from the lined backup storage pond, potential spills from transportation of production unit effluent (e.g., resulting from well work over) to the effluent collection system, and potential deep disposal well impacts, including potential pipeline leaks and potential groundwater impacts. These potential impacts are described as potential water

resource impacts (Section 4.4) and potential soil impacts (Section 4.3). Section 4.12 also addresses potential radiological impacts from the use of deep well injection for disposal of liquid 11e.(2) byproduct material. By implementing the monitoring systems and mitigation measures described, the potential impact of brine management will be small.

4.13.1.1.1.2 Other Liquid 11e.(2) Byproduct Material

Other liquid 11e.(2) byproduct material include permeate and process solutions. Process solutions include spent eluant, liquid from process drains in the CPP, fluids generated from work over operations on injection and recovery wells, resin transfer wash water, filter backwash water, plant wash down water, and decontamination water (e.g., employee showers).

A high percentage of permeate generated through the use of RO units will be injected either into the barren lixiviant stream or into the groundwater restoration circuit. Permeate which is not recycled back to operation or restoration activities will be used as plant makeup water. Any discharge of permeate will be under the auspices of a WYPDES discharge permit.

Prior to the startup of the secondary RO unit, liquid 11e.(2) byproducts generated in the CPP and wellfields will be discharged to the waste water tanks then to the DDWs. Once the secondary RO unit is online, these process solutions will be added to the feed stream of the secondary RO unit. The anticipated quantity of other liquid 11e.(2) byproduct material is shown in Table 4-13 and Figures 4-8 through 4-10.

4.13.1.1.2 Solid 11e.(2) Byproduct Material

Solid 11e.(2) Byproduct Material Quantity

Solid 11e.(2) byproduct material will be generated during all project phases except construction. During operation and groundwater restoration, AUC estimates that approximately 100 yd^3 of solid 11e.(2) byproduct material will be generated annually. This equates to about five 20 cubic yard shipments annually from the following sources, which is well within the typical range of 2.5 to 15 annual shipments provided in NRC NUREG 1910 Vol. 1 (Table 2.8-1, pg. 2-39):

- Filtrate and spent filter media from production and restoration circuits;
- General sludge, scale, etc. from maintenance operations;
- Affected soil collected from spill areas;
- Spent/damaged ion exchange resin;
- Well solids from injection/recovery well work over operations; and/or
- Contaminated PPE.

Estimated quantities generated during decommissioning are provided in the financial assurance calculations in the Restoration Action Plan (RAP) TR Addendum 6A). During decommissioning, up to an estimated 4,000 yd^3 of solid 11e.(2) byproduct material will be generated from the following areas:

- Injection, recovery, and restoration fluid trunklines;
- Injection and recovery well feeder pipelines;
- Downhole well piping (drop pipe);
- Manholes and sumps;
- Valves, pumps, and instrumentation and control equipment;
- Impacted soil;
- Affected concrete floors, sumps, and berms in the CPP;
- Equipment and piping in the CPP;
- Pond sludge, pond liners, and leak detection systems; and/or
- Disposal well piping and equipment.

The total quantity of solid 11e.(2) byproduct material that is expected to be generated from the Proposed Action is up to 5,300 yd^3, based on 13 years of operation and groundwater restoration at 100 yd^3 per year and an additional 4,000 yd^3during decommissioning.

Solid 11e.(2) Byproduct Material Management

Solid 11e.(2) byproduct material will be collected within the Proposed Project CPP in appropriate containers (e.g., 55 gallon drums with drum liners) and will be appropriately labeled and placarded for the class of material being stored. When these containers are full, they will be closed, sealed and stored within 20 yd^3 covered roll-off containers located in the designated solid 11e.(2) byproduct storage area outside of the CPP. The strong, tight containers will be capable of preventing the spread of contamination and contact with precipitation. Once full, these 20 yd^3 covered roll-off containers will be shipped for disposal to an 11e.(2) licensed byproduct disposal facility. Prior to beginning operations, AUC will have in place a signed contract for 11e.(2) byproduct disposal at such a facility. The designated solid 11e.(2) byproduct storage area will be restricted and access will be controlled through the use of security fencing, locked gates, and proper posting as a restricted area. Large items such as contaminated equipment that cannot be stored in a roll-off container will be stored in the designated solid 11e.(2) byproduct material storage area and will be covered/sealed in a manner that will prevent the spread of contamination.

Solid 11e.(2) Byproduct Material Disposal

Sealed 20 yd^3 roll-off containers containing solid 11e.(2) byproduct material will be transported by an appropriately licensed transporter to a disposal facility licensed by NRC or an agreement

state. AUC will develop an agreement with an off-site disposal facility prior to initiating any activity that will generate solid 11e.(2) byproduct material. AUC will notify NRC within seven days if the solid 11e.(2) byproduct material disposal agreement is terminated and will submit a new agreement for NRC approval within 90 days of expiration or termination. Potential disposal facilities evaluated in this application include the following:

- Pathfinder Mines Corporation, Shirley Basin Facility, Shirley Basin, Wyoming;
- Denison Mines Corporation, White Mesa Uranium Mill, Blanding, Utah;and
- Energy Solutions LLC, Clive Disposal Site, Clive, Utah.

Based on the anticipated solid 11e.(2) byproduct material generation rate of 100 yd^3 per year during operation and groundwater restoration, about five annual shipments of solid 11e.(2) byproduct material are anticipated during these project phases. During decommissioning, which is estimated to last 12-18 months, 100 to 200 shipments per year are expected.

Solid 11e.(2) Byproduct Material Minimization

The quantity of solid 11e.(2) byproduct material will be minimized through process design, decontamination, and volume reduction during decommissioning. Filter media for the production and restoration circuits will be selected based on filtration efficiency and on minimizing byproduct material. Where possible, equipment and building surfaces will be decontaminated and reclassified for unrestricted release. Decontamination procedures are discussed in TR Section 6.3 and may include high pressure washing, sand blasting, and acid rinsing.

Solid 11e.(2) Byproduct Material Management Potential Impacts

Potential impacts resulting from the management and disposal of solid 11e.(2) byproduct material include potential spills, addressed in Section 4.4, and potential transportation impacts, addressed in Section 4.2. In addition, AUC assessed the potential impacts on solid 11e.(2) byproduct material disposal on the capacity of the facilities potentially receiving the byproduct material. This assessment is provided below:

- Pathfinder Mines Corporation, Shirley Basin Facility: According to NRC materials license SUA-442, Amendment No. 59 (Adams Accession No. ML063480527), the Shirley Basin Facility is authorized to dispose of byproduct from ISR facilities without specific authorization from the NRC. There is a disposal limit of 10,000 yd^3 of byproduct material from generators other than ISR facilities. While there is potentially sufficient capacity to accept all of the solid 11e.(2) byproduct material from the Proposed Action at the Shirley Basin Facility, AUC might be required to find an alternate disposal facility in the event that the Shirley Basin Facility stops accepting solid 11e.(2) byproduct material and completes reclamation;

- Denison Mines Corporation, White Mesa Uranium Mill, Blanding, Utah: According to Utah Division of Radiation Control License UT 1900479 (Utah DEQ 2010a), disposal of byproduct material generated at licensed ISR facilities is limited to 5,000 yd^3 from a single source. Based on this limitation, AUC will be able to dispose most or all of the solid 11e.(2) byproduct material at this facility, but an agreement with an alternate facility could be needed at some point due to the uncertainty in final decommissioning volumes; and
- Energy Solutions LLC, Clive Disposal Site: According to Amendment 6 to Radioactive Material License UT 2300478 (Utah DEQ 2010b), the maximum quantity of solid 11e.(2) byproduct material that this facility may possess at any one time is 5.5 million yd^3. By comparison, the total estimated solid 11e.(2) byproduct material quantity from the proposed action (5,000 yd^3), is less than 0.1 percent of this volume.

By implementing the monitoring, testing, and management procedures outlined in this ER, the potential impact of solid 11e.(2) byproducts will be small.

4.13.1.1.3 Solid Non-11e.(2) Byproduct Material

This Section describes the nature, potential volume, management and potential impact of generating non-11e.(2) byproduct material at the Proposed Project.

4.13.1.1.3.1 Solid Waste

Solid Waste Quantity

Solid waste material will be generated during all phases of the Proposed Project and will include construction debris, office trash, and decontaminated material and equipment. Most of the solid waste will be generated during decommissioning. As described in Section 6 in the TR, AUC estimates that 2,000 yd^3 of solid waste will be generated during decommissioning. During the prior three project phases, only about 30 yd^3 per week (1,500 yd^3 per year) are expected.

Solid Waste Management

During construction and decommissioning, solid waste l will be stored in roll-off containers in designated areas prior to shipment off-site to a nearby landfill. During operation and groundwater restoration, solid waste will be collected daily from work areas and disposed in trash receptacles located within the site security fenced area near a primary access road for convenient access for a contract material disposal contractor.

Solid Waste Disposal

Non-hazardous solid waste will be disposed off-site in a municipal landfill permitted by WDEQ/SHWD. The nearest municipal solid material landfill is in Gillette, Wyoming (approximately 50 road miles north). The Campbell County landfill has a current capacity of 36 years for municipal solid waste and nine years for construction and debris material remaining (CC Gov, 2011).

Solid Waste Minimization

The quantity of solid waste will be minimized by recycling materials and process equipment during decommissioning. Recyclable materials currently accepted at the Campbell County landfill include newspaper, magazines, phone books, cardboard, aluminum and steel cans, and plastic (City of Gillette 2010).

Solid Waste Potential Impacts

The potential impact to area municipal landfills from disposing solid waste generated by the Proposed Action will be small.

Potential transportation impacts resulting from disposing solid byproducts are addressed in Section 4.2.

4.13.1.1.3.2 TENORM

TENORM (technologically enhanced naturally occurring radioactive materials) includes drilling fluids and drill cuttings from perimeter monitor wells and from the construction and development of recovery and injection wells prior to using the wells for ISR uranium recovery.

TENORM Quantity

Based on information gathered during installation of the regional baseline monitor wells for the Proposed Project, a typical injection, recovery, or monitor well is expected to use between 3,000 and 30,000 gallons of water during drilling and well development and average around 6,000 gallons. In addition, installation of each well is expected to yield approximately five to 15 yd^3 of drill cuttings.

TENORM Management

TENORM drilling fluids will be stored and disposed of on-site in mud pits, which will be constructed adjacent to the drilling pads. During the regional hydrologic baseline activities, groundwater was discharged during PZA pump tests at four of the baseline well clusters. These

discharges were authorized under temporary WYPDES permits issued by the WDEQ/WQD. In accordance with the permits, the discharge was monitored for flow, pH, ^{226}Ra, uranium, TDS, and TSS and reported to the WDEQ/WQD. AUC expects that similar surface discharges of TENORM generated groundwater during Production Unit PZA pump testing will be also be authorized by the WDEQ/WQD.

The temporary WYPDES permits issued for the baseline PZA pump tests are listed here: WYG720248, WYG720249, WYG720253, WYG720254, WYG720278, and WYG720289. Additional details regarding WYPDES discharge during regional baseline monitor well construction are found in Addendum 2.7A of the TR (Figure 2.7A-7 and Tables 2.7A-16 and 2.7A-17).

TENORM Disposal

Mud pits containing drilling fluids and cuttings will be backfilled and graded in accordance with WDEQ/LQD regulations.

TENORM Minimization

The quantity of drilling fluids will be minimized by using the minimum quantity of water that is technically practicable for well drilling and development.

Potential TENORM Management Impacts

Potential TENORM management impacts primarily are those associated with the surface disturbance required for mud pit construction and potential surface water impacts from discharge of native groundwater. Potential impacts include temporarily disturbing and changing existing land uses as described in Section 4.1, providing an increased risk for sediment transport due to soil disturbance and vegetation removal as described in Section 4.4. Mitigation measures that will minimize potential impacts from TENORM disposal include backfilling, restoring and re-seeding mud pits, typically within a single construction season, using sediment control BMPs, avoiding construction in areas with previously identified, potentially NRHP-eligible cultural sites, and stopping work if any previously undiscovered cultural resources are encountered during construction or reclamation of mud pits. As described by EPA (2008), “Some slight radioactivity may occur in accumulated solids in the pit bottoms.” The estimated average mass of ore material in the mud pits has been included in the MILDOS-AREA source term estimates for production units as described in Section 4.12. The ^{222}Rn release rate from mud pits is expected to be low, and the potential impacts to public health and safety from radioactive material in the mud pits will be Small.

4.13.1.1.3.3 Hazardous Waste

Hazardous Waste Quantity

Hazardous waste generated by the proposed action may include small quantities of used oil from CPP equipment and production unit vehicles, oil-contaminated soil, oily rags, used batteries, expired laboratory reagents, fluorescent light bulbs, solvents, cleaners, and degreasers. Small amounts of hazardous waste are expected to be generated during all four project phases in similar quantities. AUC anticipates that the Proposed Project will be classified as a conditionally exempt small quantity generator (CESQG) by WDEQ/SHWD. As such, the Proposed Project will generate less than 220 pounds (100 kg) of hazardous waste and less than 2.2 pounds (one kg) of acute hazardous waste in any calendar month and store less than 2,200 pounds (1,000 kg) of hazardous waste at any one time. If the facility does not meet the requirements for a CESQG, it will lose its CESQG status and be fully regulated as either a small-quantity generator (more than 100 but less than 1,000 kg hazardous waste per calendar month) or a large quantity generator (more than 1,000 kg per calendar month) (NUREG-1910, Supplement 1, NRC 2010).

Hazardous Waste Management

Hazardous waste will be stored in secure containers within the secure fenced area near the CPP. The containers will be compatible with the materials stored, visually inspected for leaks, rust, etc. and will be labeled with contents. The maintenance shop will have a specific area that is bermed and adequately vented for hazardous waste material storage.

Hazardous Waste Disposal

Hazardous waste will be transported to an off-site treatment, storage and disposal facility that is licensed by WDEQ/SHWD or a nearby state to manage hazardous byproducts. The Campbell County Landfill, located just north of Gillette, accepts used oil and batteries for recycling and certain other hazardous byproducts by contract (CC Gov 2011). If needed, small quantities of used reagents or other types of hazardous waste may occasionally be transported to more distant licensed disposal facilities by a licensed hazardous waste contractor.

Hazardous Waste Minimization

AUC will minimize the quantity of hazardous waste generated by the proposed action by generally servicing vehicles and equipment at off-site facilities and by limiting laboratory reagent orders to quantities that can be consumed within the reagent shelf lives. The quantity of hazardous waste generated and stored in the Proposed Project area will be kept small in order to comply with CESQG requirements.

Potential Hazardous Waste Management Impacts

Potential management impacts from hazardous waste management, storage and disposal include potential releases to surface and groundwater, addressed in Section 4.4, and potential transportation impacts, addressed in Section 4.2.

4.13.1.1.3.4 Domestic Sewage

Domestic Sewage Quantity

The quantity of domestic sewage generated by the proposed action will vary according to the number of workers during each project phase. The peak number of workers is estimated to be 100 during construction. During construction portable toilets will be used. The average daily septic water generation rate during operations will likely approach 1,300 gpd, based on the EPA (2002) domestic septic generation rate of 13 gpd for industrial building employees.

Domestic Sewage Management

Domestic septic water will be collected in a gravity sewer collection system serving the office/administration building, CPP, maintenance building, and any other buildings with restrooms. Raw septic water will be routed in gravity fed sewer pipes to one or more septic tanks for primary treatment.

Domestic Sewage Disposal

Domestic sewage will be disposed in an on-site septic system. The system will be designed according to WDEQ-WQD standards and will likely include one or more septic tanks for primary treatment. Septic tank effluent will either be disposed in a gravity or pressure-dosed drainfield. The anticipated peak daily flow rate is not anticipated to exceed 2,000 gpd. Therefore, permitting as a Class V UIC facility through WDEQ/WQD will not be required nor will the installation of monitor wells around the drainfield.

Every one to five years, the septic tank(s) will require sludge removal. This will be performed by a septic disposal contractor, who will pump the solids from the septic tanks into a tanker truck and transport the sludge to a nearby municipal septic water treatment system for disposal.

Domestic Sewage Minimization

Domestic sewage will also be minimized by using modern, low-flow restroom fixtures. As required by the 1992 U.S. Energy Policy Act, fixtures installed after January 1994 must meet modern low-flow requirements (e.g., toilets with flush capacities equal or less than 1.6 gallons per flush).

Domestic Sewage Potential Impacts

Construction of the domestic septic water system will result in soil disturbance. The size of the drainfield will depend on the design capacity, the drainfield configuration, and the site-specific percolation rate of the receiving soils. Two separate trench-style drainfields with gravel less drainfield chambers will require about 0.14 acres (6,000 ft^2) of surface area each in order to alternate between drain fields if needed, assuming a moderate percolation rate of 30 minutes per inch and a peak design flow rate of around 2,000 gpd. TR Figure 3-1 depicts the preliminary drainfield location. Effluent may be pumped from the septic tank(s) to the drainfield if needed; the drainfield will not need to be located down gradient from the septic tank(s).

Potential transportation impacts related to sludge hauling will be small and are addressed in Section 4.2.

Potential groundwater impacts resulting from effluent disposal will be small and are addressed in Section 4.4. The small quantity of effluent (about two gpm on average) spread over a large area will have very limited potential to impact groundwater quality, considering that a properly sized and maintained septic tank will remove most of the solids and significantly reduce total suspended solids, organic carbon, and ammonia, and a drainfield will provide further treatment, including a high level of bacteria reduction.

4.13.1.2 Potential Construction Impacts

During construction of the Proposed Project, solid waste will be generated. Waste will be limited to relatively small quantities of solid waste (est. 40 yd^3/week), potential hazardous waste (est. <220 lb/month), and domestic sewage (est. 400 gpd). Much of the TENORM (drilling fluids and drill cuttings) will also be generated during construction. Potential impacts will result from surface disturbance during construction of material management facilities, including the lined backup storage pond, deep disposal wells, deep disposal well pipelines, mud pits and the domestic septic water system. Potential impacts include restricting access around the drainfield and CPP area (discussed in Section 4.1), impacting surface water due to sediment transport (discussed in Section 4.4), and disturbing cultural resources (discussed in Section 4.8). The area required for material management facilities will be small, and potential surface disturbing impacts will be accordingly small. Mitigation measures include using sediment control BMPs, restoring and re-seeding disturbed areas, typically within a single construction season, avoiding construction in areas with previously identified, potentially NRHP-eligible cultural sites, and stopping work if any previously undiscovered cultural resources are encountered during construction.

Potential impacts to shallow groundwater or surface water from domestic effluent disposal are described in Section 4.4. The domestic disposal system will be designed according to WDEQ/WQD requirements. Potential impacts are therefore small.

Potential transportation impacts resulting from byproduct material management are discussed in Section 4.2. During construction, only a relatively small amount of additional traffic will be required to transport solid and hazardous byproducts from the Proposed Project area to nearby landfills. The potential impacts are therefore Small.

4.13.1.3 Potential Operation Impacts

11e.(2) Byproducts in Operations.

11e.(2) byproduct material generated during operation includes solid material (including but not limited to filtrate and spent filter media, scale and sludge from equipment maintenance, contaminated soil, damaged ion exchange resin, contaminated solids from injection/recovery well work over operations, and contaminated PPE) and liquids (permeate, brine, and other process liquid 11e.(2) byproduct materials such as spent eluant, process drain water, contaminated reagents, filter backwash water, wash down water, and water from decontamination showers).

A high percentage of permeate generated through the use of RO units will be injected either into the barren lixiviant stream or into the groundwater restoration circuit. Permeate which is not recycled back to operation or restoration activities will be used as plant makeup water. Potential impacts related to permeate disposal are described in Section 4.5 (potential surface and groundwater impacts from excess permeate disposal).

Prior to the startup of the secondary RO unit, liquid 11e.(2) byproducts generated in the CPP and wellfields along with brine from the production RO unit will be discharged to the waste water tanks then to the DDWs in buried pipelines. Once the secondary RO unit is online, these process solutions will be added to the feed stream of the secondary RO unit. The brine from the secondary RO unit will be pumped to the Class I deep disposal wells in buried pipelines. In the event of a Class I well is under repair or during testing, liquid 11e.(2) water will be temporarily store in the lined backup storage pond. Potential impacts related to disposal of these liquid byproduct materials include potential surface and groundwater impacts from spills, leaks, or deep well disposal (discussed in Section 4.4). The potential for surface and groundwater impacts will be reduced by implementing mitigation measures including special construction measures for pipeline stream crossings, dual liners with leak detection systems for the lined backup storage pond, and protection of potential USDWs during deep disposal well construction and operation.

Solid 11e.(2) byproduct material will be stored in lined drums and roll-off containers in the designated solid 11e.(2) byproduct storage area. Solid 11e.(2) byproduct material will be transported in the sealed roll-off containers by an appropriately licensed transporter to a disposal facility licensed by NRC or an agreement state. Potential transportation impacts are addressed in

Section 4.2 and are expected to be small due to the low traffic volume and low risk of contamination in the event of an accident involving transport of solid 11e.(2) byproduct material.

Non 11e.(2) Byproducts in Operations.

Solid waste material and hazardous waste quantities will be similar to those generated during construction, and the potential impacts will be accordingly small. The quantity of domestic sewage will likely decrease due to a smaller operating work force. There will still be some TENORM generated from delineation drilling and production well installation for later Production Units .

4.13.1.4 Potential Groundwater Restoration Impacts

Potential byproduct material management impacts during groundwater restoration activities are similar to those anticipated during operation. The quantity of non-11e.(2) byproduct material will typically be trending lower during groundwater restoration due to a lesser workforce. The quantity of 11e.(2) byproduct material will typically be similar to or less than that during operation.

4.13.1.5 Potential Decommissioning Impacts

Potential byproduct material management impacts during decommissioning are anticipated to be similar to those during construction for most 11e.(2) and non-11e.(2) byproduct material. Three distinctions are TENORM, which will be generated during construction but not decommissioning, solid byproducts, which will be generated at higher quantities during decommissioning than construction, and solid 11e.(2) byproduct material, which will be generated during decommissioning but not construction.

The quantity of solid non-11e.(2) byproduct material will increase from an estimated 30 yd^3 per week of relatively light-weight trash during construction, operation, and groundwater restoration (1,500 yd^3 per year) to 2,000 yd^3 over 12 to 18 months of dense construction debris and decontaminated piping, materials, and equipment during decommissioning. While the relatively small mass of solid byproduct material during the previous three project phases will have minimal impact to the nearest municipal landfill (Gillette), the increased mass and volume during decommissioning could have a significant impact on the capacity of the Campbell County landfill. This will be mitigated by coordinating with the landfill well in advance of decommissioning to ensure that sufficient capacity will be available or by transporting solid non-11e.(2) byproduct material generated during decommissioning to an alternate landfill.

The quantity of solid 11e.(2) byproduct material requiring transport and off-site disposal will be significantly higher during decommissioning than during any of the other project phases. During

decommissioning, an estimated 4,000 yd^3 of solid 11e.(2) byproduct material will be generated from Production Units and the CPP area, including affected concrete, equipment and piping in the CPP; lined backup storage pond sludge, liners, and leak detection systems; and disposal well piping and equipment. There is currently sufficient capacity at each of the four potential disposal facilities evaluated in this ER. The primary potential impacts associated with solid 11e.(2) byproduct material disposal are transportation-related impacts discussed in Section 4.2. Although the number of shipments per year will increase during decommissioning, the potential impacts are expected to be small due to the frequency of shipments (100 to 200 per year) and the low risk of contamination in the event of an accident involving transport of 11e.(2) byproduct material.

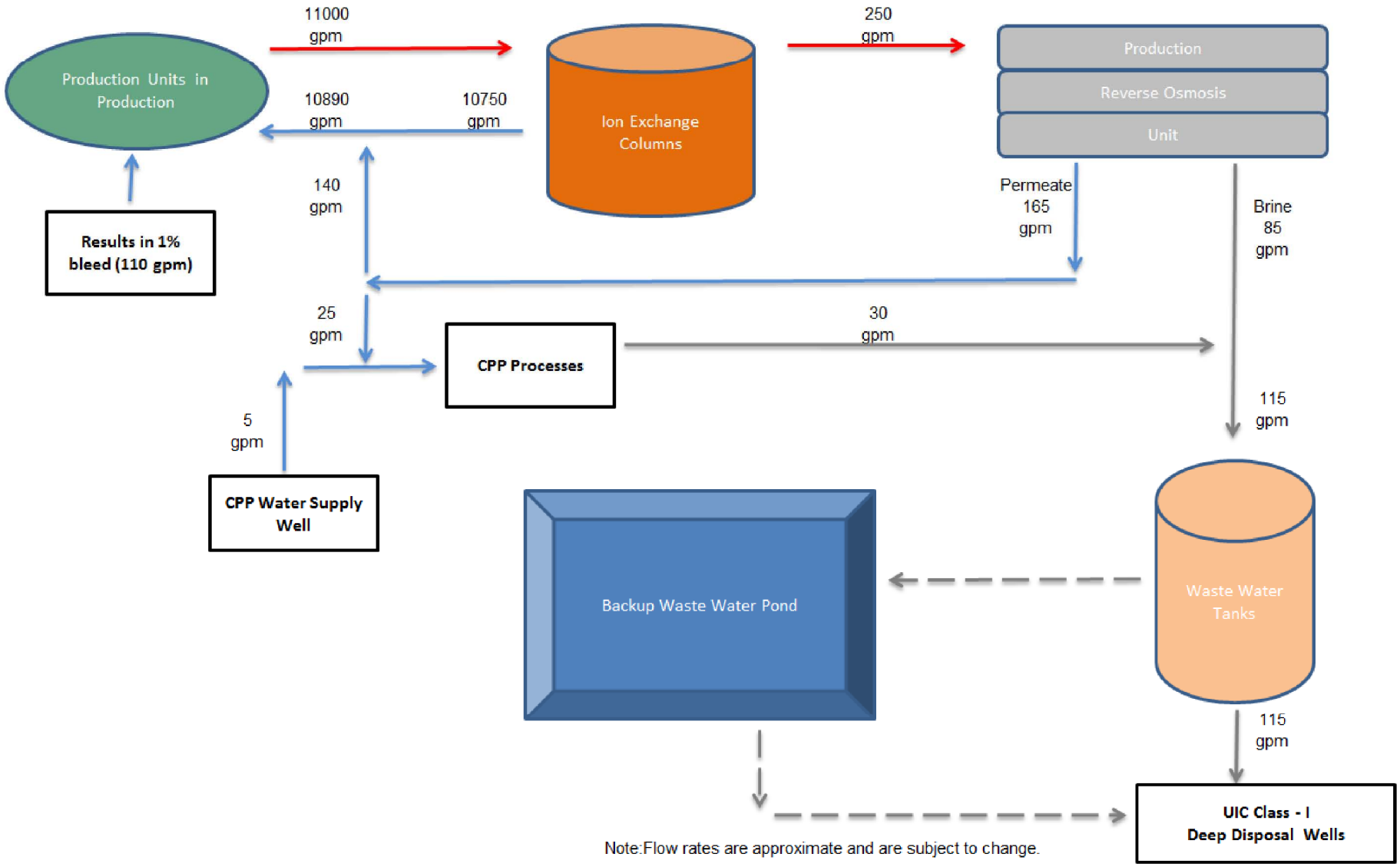
4.13.2 No Action Alternative

There will be no impacts to public and occupational health under the No Action Alternative since the Proposed Project will not be constructed.

Table 4-13: Byproduct Material Management Systems and Anticipated Quantities

Stream	Source	Storage Location	Disposal Method(s)	Estimated Typical Quantity
11e.(2) Byproduct Material				
Liquid 11e.(2) Byproduct Material (Brine, permeate and other process)	Production and restoration RO circuits, CPP, well work over, spent eluant, process drains, filter backwash, wash down water and decontamination showers	Waste water tanks.	Deep disposal wells and temporary storage in the lined backup storage pond	C: 0 gpm O: 115 gpm O&R: 146 gpm R: 104 gpm D: <10 gpm
Solid 11e.(2) Byproduct Material	Filtrate and spent filter media; scale and sludge from equipment maintenance, contaminated soil, damaged ion exchange resin, contaminated solids from injection/recovery wells, contaminated PPE and contaminated materials and equipment from decommissioning	Designated and restricted solid 11e.(2) byproduct storage area within the CPP area	Shipment to NRC or agreement state licensed disposal facility	C: 0 C O: 100 yd^3/yr R: 100 yd^3/yr D: 4,000 yd^3
Non-11e.(2) Byproduct Material				
TENORM	Drilling fluids and drill cuttings	Mud pits	On-site disposal in mud pits	C (per well): drilling fluid; 6,000 gal drill cuttings: 15 yd^3 O, R, D: 0 gal 0 yd^3
Solid Waste	Construction debris, decontaminated materials and equipment, and general office trash	Designed byproduct receptacles	Shipment to municipal landfill	C: 40 yd^3/wk O: 30 yd^3/wk R: 20 yd^3/wk D: 2,000 yd^3
Hazardous Waste	Used oil, oily rags, used batteries, expired laboratory reagents, fluorescent light bulbs, solvent, cleaners and degreasers	Designated hazardous material storage area	Shipment to WDEQ/SHWD licensed recycling or disposal facility	<220 lb/mo (<100 kg/mo) (C, O, R, D)
Domestic Sewage	Restrooms	Septic tank(s) near CPP and office/admin building	On-site septic water disposal or treatment system plus holding tanks/portable toilets during construction and decommissioning	C: 400 gpd O: 2,000 gpd R: 300 gpd D: 400 gpd

Abbreviations: C - Construction O - Operation R - Groundwater restoration D – Decommissioning



Path: O:\WY_Projects\2010-100_AUC_Reno_Creek\Project_MXD\Submittal\Water Balance Production Phase Only.mxd

TREC, Inc.
Engineering & Environmental Management
900 Werner Court
Suite 150
Casper, WY 82601
Phone (307) 265-0696
Fax (307) 265-2498
www.treccorp.com

PROPOSED RENO CREEK PROJECT
CAMPBELL COUNTY, WY

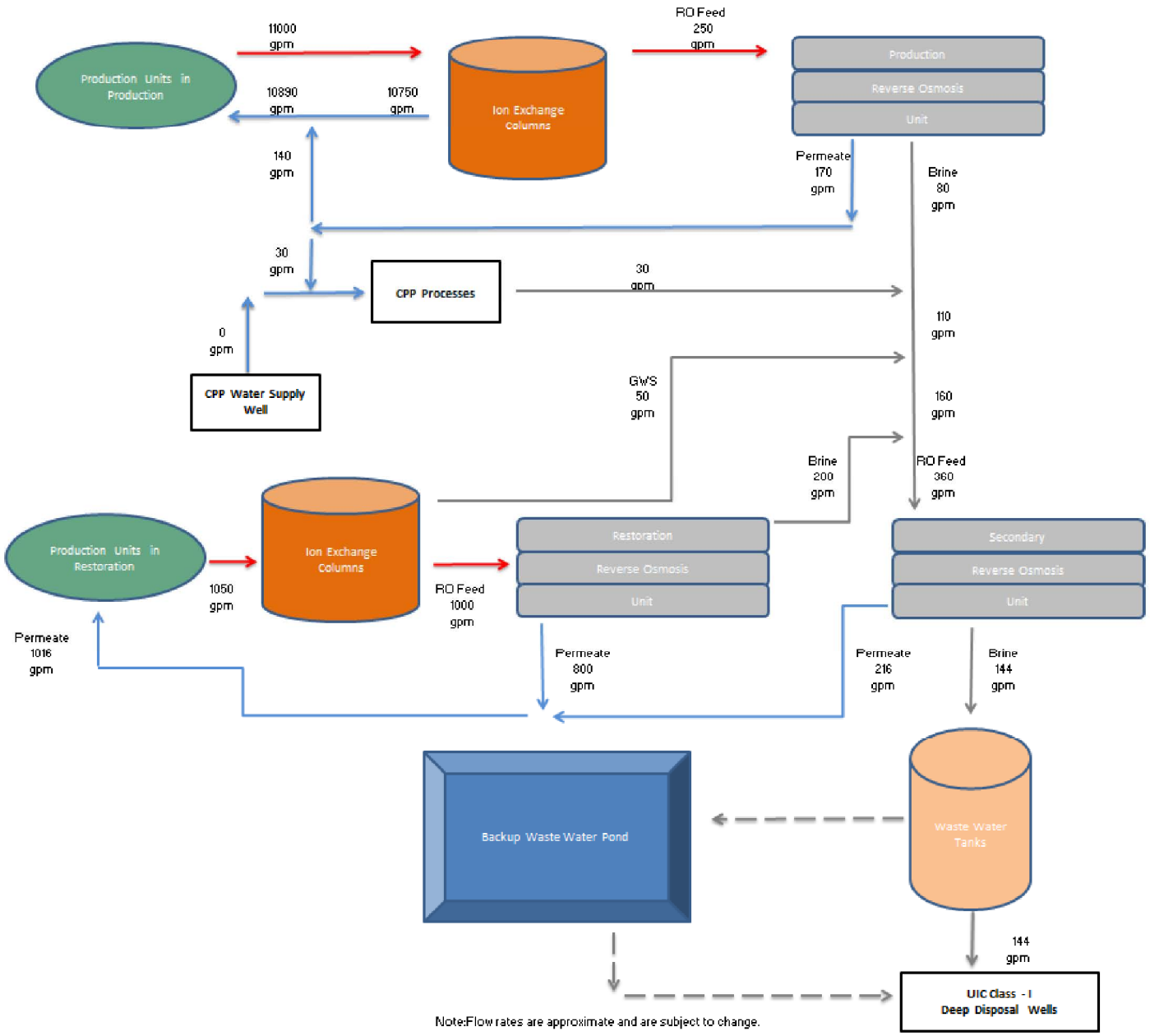
PREPARED FOR: AUC LLC
LAKEWOOD, CO

Water Balance
Production Phase Only

Drawn: RHK
Checked: RMD
Approved: JEY

Figure 4-8

Rev. #	Description	Date
0	Draft	09/08/2011
1	Final	11/12/2011
2	Revisions made per Client Request	02/21/2012



Path: O:\WY_Projects\2010-100_AUC_Reno_Creek\Project_MXD\Submittal\Water Balance Production and Restoration Phases.mxd

TREC, Inc.
Engineering & Environmental Management
900 Werner Court
Suite 150
Casper, WY 82601
Phone (307) 265-0696
Fax (307) 265-2498
www.trecorp.com

PROPOSED RENO CREEK PROJECT
CAMPBELL COUNTY, WY

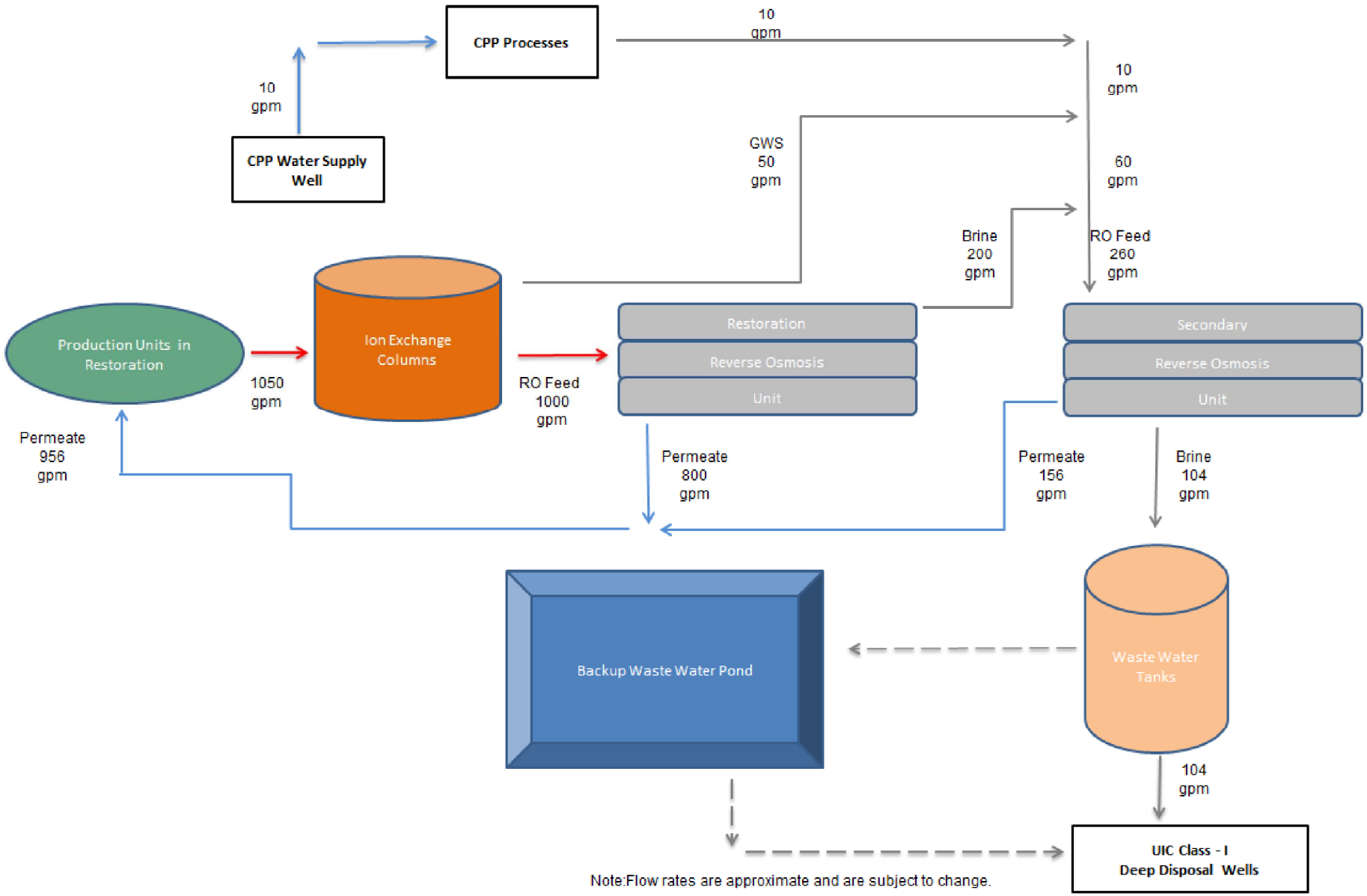
PREPARED FOR: AUC LLC
LAKEWOOD, CO

Water Balance
Production and Groundwater Restoration Phases

Drawn: RHK
Checked: RMD
Approved: JEY

Figure 4-9

Rev. #	Description	Date
0	Draft	09/08/2011
1	Final	11/12/2011
2	Revisions made per Client Request	02/21/2012



Path: O:\WY_Projects\2010-100_AUC_Reno_Creek\Project_MXD\Submittal\Water Balance Restoration Phase Only.mxd

TREC, Inc.
Engineering & Environmental Management
900 Werner Court
Suite 150
Casper, WY 82601
Phone (307) 265-0696
Fax (307) 265-2498
www.treccorp.com

PROPOSED RENO CREEK PROJECT
CAMPBELL COUNTY, WY

PREPARED FOR: AUC LLC
LAKEWOOD, CO

Water Balance
Groundwater Restoration Phase Only

Drawn: RHK
Checked: RMD
Approved: JEY

Figure 4-10

Rev. #	Description	Date
0	Draft	09/08/2011
1	Final	11/12/2011
2	Revisions made per Client Request	02/21/2012

TABLE OF CONTENTS

5 CUMULATIVE IMPACTS 5-1
5.1 Introduction 5-1
5.1.1 Other Past, Present, and Reasonably Foreseeable Future Actions 5-2
5.1.1.1 Uranium Recovery Sites 5-2
5.1.1.2 Coal Mining 5-3
5.1.1.3 Conventional Oil and Gas Production 5-4
5.1.1.4 Coal Bed Methane Development 5-4
5.1.1.5 Wind Power 5-5
5.1.1.6 Other Mining 5-6
5.2 Land Use 5-7
5.3 Transporation 5-7
5.4 Air Quality 5-9
5.5 Geology and Soils 5-13
5.6 Water Resources 5-14
5.6.1 Surface Waters and Wetlands 5-14
5.6.2 Groundwater 5-15
5.7 Ecological Resources 5-17
5.7.1 Terrestrial Ecology 5-17
5.7.2 Aquatic Ecology 5-17
5.7.3 Threatened and Endangered Species 5-18
5.8 Noise 5-19
5.9 Historical and Cultural Resources 5-20
5.10 Visual and Scenic Resources 5-21
5.11 Socioeconomics 5-22
5.12 Environmental Justice 5-23
5.13 Public and Occupational Health and Safety 5-23
5.14 Byproduct Material Management 5-24

List of Tables

Table 5-1: Powder River Basin EISs 5-27
Table 5-2: Past, Existing, and Potential Uranium Recovery Sites Within 50-miles of the Proposed Project 5-28
Table 5-3: Wyoming Coal Mines Near the Proposed Project 5-29

List of Figures

Figure 5-1: Energy Development 5-30
Figure 5-2: Regional Wells and Surface Ownership..... 5-31

5 CUMULATIVE IMPACTS

Cumulative impacts result from the incremental impacts of an action added to other past, present, and reasonably foreseeable future actions, regardless of who is responsible for such actions. Cumulative impacts can result from individually minor, but collectively significant, actions occurring over time. Thus, the proposed Reno Creek Project (Proposed Project) could contribute to cumulative impacts when its impacts overlap with those of other past, present, or reasonably foreseeable future actions. This section summarizes the cumulative impacts that are occurring as a result of existing development in the Powder River Basin (PRB) and considers how those impacts may change if the Proposed Project and other projected development in the area occurs.

5.1 Introduction

The BLM released a regional technical study, called the PRB Coal Review (BLM, 2005a,b,c), to help evaluate the cumulative impacts of coal and other mineral development in the PRB. This Coal Review was reviewed to evaluate whether the cumulative impacts of existing and reasonably foreseeable development evaluated by BLM will occur within the Proposed Project area of influence. The PRB Coal Review consisted of three tasks:

- Identify existing resource conditions in the PRB for the baseline year (2003) and, for applicable resources, update the BLM's 1996 status check for coal development in the PRB;
- Define past and present development activities in the PRB and their associated development levels as of 2003, and develop a forecast of reasonably foreseeable development in the PRB through 2020. The reasonably foreseeable activities fall into three broad categories: coal development; oil and gas development, including major transportation pipelines; and other development, which includes development that is not energy-related as well as other energy-related development; and
- Predict cumulative impacts that could be expected to occur to air, water, socioeconomics, and other resources if the development occurs as projected in the forecast developed under the second task.

Results of the PRB Coal Review task study were presented in a series of reports. The Task 1, 2, and 3 reports represent components of a technical study of cumulative development in the PRB; they do not evaluate specific Proposed Projects, but they provide information that BLM is using to evaluate the cumulative impacts that will be expected to occur if specific projects or applications are approved. The following discussion presents summarized information from this Coal Review where such

information indicates that the cumulative impacts identified by BLM might affect the Proposed Project region of influence or might act with the Proposed Project to increase the severity or duration of any identified impacts.

The Wyoming portion of the PRB is the primary focus of the PRB Coal Review and encompasses all of Campbell, Sheridan, and Johnson counties (outside of the Bighorn National Forest), and the northern portion of Converse County. The review study area incorporates the four counties surrounding the Proposed Project and is utilized for the cumulative analysis of resources.

5.1.1 Other Past, Present, and Reasonably Foreseeable Future Actions

The Proposed Project area is located in the middle of the PRB, which covers an approximately 10,000-mi^2 area and spans large portions of northeastern Wyoming and southeast Montana. In comparison, the proposed activities at the Proposed Project will potentially affect less than 0.001 percent of the area within the PRB. This area holds the largest deposits of coal in the United States, as well as significant reserves of uranium and other natural resources such as oil and gas. As such, there has been, and continues to be, substantial extraction activities throughout the PRB. CBM extraction continues to be the most prolific mining activity in the region and is a form of natural gas extraction from coal beds.

Another indicator of present and reasonably foreseeable future actions is the number of draft and final EISs Federal agencies have prepared within the past five years. Using information in NUREG–1910 (GEIS, Section 5.2.2) and the EPA EIS database (EPA, 2012), several EISs were identified for the PRB (see Table 5-1). These projects potentially could contribute to both local and regional cumulative impacts on several resources.

The various past, present, and reasonably foreseeable future actions in the vicinity of the Proposed Project are discussed separately, as follows.

5.1.1.1 Uranium Recovery Sites

Wyoming has been the nation's leading producer of uranium since 1995, and also hosts the nation's largest uranium reserves (WSGS 2010). The ISR GEIS identifies four uranium milling regions: the Wyoming West Region, Wyoming East Region, Nebraska-South Dakota-Wyoming Region, and Northwestern New Mexico. Numerous uranium recovery sites, both potential and existing, are present in these regions. These projects are in various stages of development, and are discussed within the context of cumulative impacts based on available information.

Currently, there are other NRC licensed ISR facilities located within 50 miles of the Proposed Project (Figure 3.1-6). Wyoming currently has two producing uranium ISR operations, the Smith Ranch-Highland Project and the Willow Creek Project operated by Power Resources Inc. and Uranium One, respectively. In addition, several other ISR operations are in various stages of licensing and construction and are anticipated to go into operation within the next ten years, as shown in Table 5-2. Table 5-2 lists known past, existing, and potential uranium recovery sites within 50 miles of the Proposed Project including their current status and distance from the Proposed Project area.

As indicated in Figure 5-1 and Table 5-2, there are two conventional uranium milling sites that are in the decommissioning process, Bear Creek and Highlands, and a Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I (reclamation work at inactive tailings site) site, the Spook site. The Bear Creek Uranium Recovery Project (Bear Creek) is owned by Bear Creek Uranium Company and is located approximately 24 miles south of the proposed facility. Highlands (Highlands) Uranium Recovery Facility is owned by Exxon Mobil Corporation and is located in Converse County, Wyoming, approximately 39 miles south of the Proposed Project site. Both the Bear Creek and Highlands site decommissioning activities have been performed under NRC license.

The UMTRCA Title I program established a joint Federal/State-funded program for remedial action at abandoned mill tailings sites where tailings resulted largely from production of uranium for the weapons program. Under Title I, the U.S. Department of Energy (DOE) is responsible for cleanup and remediation of these abandoned sites. NRC is required to evaluate DOE's design and implementation and, after remediation, concur that the sites meet the EPA standards. In 1993, DOE became a licensee of NRC under the general license provisions of 10 CFR 40.28. This occurred after NRC concurred in the completion of construction and surface cleanup at the Spook, Wyoming inactive tailings site and accepted DOE's plan for long-term surveillance and maintenance at the Spook site. The Spook facility is located in Johnson County, Wyoming, and is approximately 27 miles south/southeast of the Proposed Project.

5.1.1.2 Coal Mining

The Powder River Regional Coal Team (PRRCT) decertified the Powder River Federal Coal Region as a Federal coal production region in 1990, which allowed leasing to occur in the region on an application basis. Because of decertification, U.S. coal production increased 11 percent, from 1.14 billion tons in 1990 to 1.27 billion tons in 2007 (BLM, 2009e). Between 1990 and 2008, the BLM Wyoming State Office held 25 competitive lease sales and issued 19 new Federal coal leases containing more than 5.7 billion tons of coal using the “lease by application” process (BLM, 2005a,b,c). In 2003, PRB coal mines produced 363 million tons of coal. These mines make up more than 96 percent of the coal produced in Wyoming each year (BLM, 2005a,b,c). In 2003, the cumulative disturbed

land area of the PRB attributable to coal mines totaled nearly 70,000 acres. Reasonably foreseeable future development projects for cumulative disturbed land area range from 47,400 to 117,000 to 125,000 acres in the year 2015, under estimated low and high production scenarios, respectively. Other development related to coal includes railroads, coal-fired power plants, major (230 kV) transmission lines, and coal technology projects. The total land area of other coal-related disturbance in the PRB in 2003 was nearly 5,000 acres.

Table 5-3 lists coal mines near the Proposed Project in Wyoming. The Wyoming East Uranium Milling Region has 14 surface mines. Surface mining of coal can potentially cause adverse impacts to land use, geology and soils, water resources, ecology, air quality, noise, historic and cultural resources, visual and scenic resources, socioeconomics, and byproduct material management.

5.1.1.3 Conventional Oil and Gas Production

By the end of 2007, there were approximately 3,857 producing conventional oil and gas wells in the Wyoming PRB study area plus an estimated 1,500 seasonally active wells (IHS 2008). These are evenly dispersed throughout the entire PRB. WOGCC reported that these wells produced approximately 11.4 million barrels of oil and 22 billion ft^3 of conventional gas in 2007 (WOGCC 2008).

Most of Wyoming's current oil production is from old oil fields with declining production. The level of exploration drilling to discover new fields has been low (BLM, 2008a). From 1992 to 2002, oil production from conventional oil and gas wells in Campbell and Converse Counties within the PRB decreased approximately 60.4 percent. Oil- and gas-related development includes major transportation pipelines and refineries.

In 2003, the cumulative disturbed land area in the PRB from oil and gas, CBM, and related development was nearly 188,000 acres. Increasing development associated with extraction of these energy resources will result in a total of 305,000 acres under development by 2015 (BLM, 2005a, b, c). The depth to producing gas and oil-bearing horizons generally ranges from 4,000 to 13,500 feet, but some wells are as shallow as 250 feet (BLM, 2005a, b, c).

5.1.1.4 Coal Bed Methane Development

Natural gas production has been increasing in Wyoming. In the PRB, this is from the development of shallow CBM resources. Annual CBM production in the PRB increased rapidly between 1999 and 2003, with nearly 15,000 producing CBM wells in the PRB in 2003 and a total production volume of 364 billion ft^3 (BLM, 2005 a, b, c). In 2007, CBM

production within Campbell County was 167,000 million ft^3 (BLM, 2009h). The BLM Buffalo Field Office, which administers the area where the Proposed Project is located, has processed approximately 3,000 applications for permits to drill since 2003; more than 98 percent of these applications are for CBM recovery (BLM, 2009i).

The recovery of CBM involves the installation of facilities that include access roads; pipelines for gathering gas and produced water; electrical utilities; facilities for measuring and compressing recovered gas; facilities for treating, discharging, disposing of, containing, or injecting produced water; and pipelines to transport gas high-pressure transmission pipelines. The wells are located on a well pad installed in an 80 acres spacing pattern (eight pads per square mile). The overall life of each well is approximately seven to 10 years after which pipes are abandoned in place and well sites are reclaimed (NRC, 2010).

As shown in TR Table 2.7B-19 in Addendum 2.7-B in the TR, there are numerous permitted or completed CBM wells within two miles of the Proposed Project (324 wells). Three CBM operators began working in or near the Proposed Project area in 2007. The target coal seam occurs between approximately 631 feet and 1,424 feet below ground surface (bgs) at the Proposed Project. The formation is separated vertically from the Proposed Project site by approximately 200 feet.

5.1.1.5 Wind Power

There is strong interest from consumers, investor-owned utilities, and environmental and economic sustainability interests in wind energy generating projects and other forms of renewable energy projects. The current development interest in wind energy generation is driven in part by mandates for many utilities to increase the use of renewables in their overall energy portfolio, decisions by environmentally conscious firms to use renewable energy sources, and also due to the development of wind energy manufacturing infrastructure in the region.

Wind power facilities have been proposed, are being constructed, and are providing energy at various sites in Wyoming, including the PRB region. There is good potential for wind power, and these facilities can contribute to meeting forecasted electric power demands; however, they are dependent on available transmission capacity to send power to users. Although many Wyoming locations having the highest potential are in the southern portion of the state, areas in both Campbell and Converse counties offer sufficient potential to support commercial-scale wind generation projects including:

- Glenrock Wind Farm, is currently providing power in the Wyoming PRB. PacifiCorp completed construction of the three phase project in 2009. The wind farm is located approximately 40 miles south on and near the reclaimed Dave

Johnston Coal Mine and consists of 92- 15 MW wind turbines (Pacific Corp 2011);

- Duke Energy (dba Three Buttes Windpower, LLC) completed the Campbell Hill Windpower Project and began commercial operations in December 2009. The Campbell Hill Windpower Project is located approximately 15 miles northeast of Casper in Converse County and consists of 66 wind turbines generating 99 MW; and
- Duke Energy built the Top of the World Wind Energy Project, a 200-MW wind farm consisting of 110 turbines located approximately 45 miles south of the Proposed Project area (Duke Energy 2011).

Land use disturbance for wind energy projects is associated with development of access roads, a turbine assembly pad, and foundation pad for each wind turbine tower. Additional land disturbance results from installation of transformers and substations, underground electric and fiber optic communications cables, one or more operations and maintenance facilities, meteorological towers, and a transmission line connecting the project to the regional grid. Much of the disturbance area is reclaimed immediately following construction, with long-term disturbance associated with permanent facilities (i.e., access roads, support facilities, and tower foundations).

5.1.1.6 Other Mining

Sand, gravel, bentonite, and clinker (or scoria) have been and are being mined in the PRB. There is also potential for rare earth elements near Sundance, Wyoming.

Bentonite is weathered volcanic ash that is used in a variety of products, including drilling mud and cat litter, because of its absorbent properties. There are three major bentonite-producing districts in and around the PRB: the Colony District in the Northern Black Hills, the Clay Spur District in the Southern Black Hills, and the Kaycee District west of Kaycee, Wyoming.

Aggregate, which consists of sand, gravel, and stone, is used in the construction purposes. In the PRB, the largest identified aggregate operation is located in northern Converse County. It has an associated total disturbance area of approximately 67 acres, of which four acres have been reclaimed.

Scoria, or clinker, is used as aggregate where alluvial terrace gravel or in-place granite/igneous rock is not available. Scoria generally is mined in Converse and Campbell Counties in the PRB (BLM, 2005a, b, c).

Rare Earth Elements, Ltd has delineated rare earth elements-thorium deposits in the southern Bear Lodge Mountains about five-miles northwest of Sundance in Crook County. There are no recognized cumulative impacts associated with a potential rare earth elements mine due to the distance from the Proposed Project area.

5.2 Land Use

The PRB is a predominantly rural, wide open landscape. With little rainfall and limited alternative sources of water, the primary land use is grazing. Nevertheless, there is a range of other land uses. The major categories include agriculture, forested, mixed rangeland, urban, water, wetlands, coal mines, and barren land.

A large part of the PRB consists of split estate lands (privately owned surface lands underlain by federally owned minerals). Although federal grasslands and forests cover approximately 21 percent of the PRB area, most rangeland is privately owned (68 percent). Figure 5-2 shows the extent of surface ownership in the region. Future land uses are anticipated to remain the same as historic and current land uses. The dominant land use in terms of area is livestock grazing on rangeland. Very small but important amounts of land are used for roads to provide access to the local residences and for truck traffic for oil and gas production and CBM production areas. Recreational use of the land for hunting deer, antelope, and small game is limited since the land is nearly all privately owned as discussed in ER Section 3.1.7.

Within the land use study area, activities on both public and private lands, including oil, gas, CBM, and coal development, are ongoing and projected to expand in the future. Potential land use impacts could result from interruption to, reduction of, or impedance of livestock grazing areas, open wildlife areas, and land access. At the completion of decommissioning, AUC will restore the land to pre-existing conditions and uses, including all roads, except those the landowners have requested to remain.

Federal actions regarding land uses in the general region of the Proposed Project have been analyzed for environmental effects in numerous programmatic and project-specific Environmental Impact Statements (EISs) as listed in Table 5-1. Due to the small quantity of surface disturbance associated with the Proposed Action and the release of the Proposed Project area for unrestricted use following decommissioning, potential land use conflicts are expected to be small.

5.3 Transporation

As indicated previously in Section 5.1, there are other ongoing or planned activities occurring within the PRB and within the vicinity of the Proposed Project that contribute

to the analysis of cumulative impacts. These activities, which include CBM development, oil and gas extraction activities, and large surface mining operations that have railways and roadways to support the transport of coal among others, all have associated transportation impacts. Impacts could occur from fugitive dust, noise, incidental wildlife or livestock kills, increased traffic on local roads, and accidents.

The PRB Coal Review cumulative impact assessment of activities occurring within the PRB, including coal development, power generation, oil and gas, coal bed natural gas, and other mining activities, evaluated the potential transportation impacts to Campbell County roads, including the region surrounding the towns of Wright and Gillette (BLM, 2010a). That study concluded potential regional direct effects to roads and highways will include increased vehicular traffic and risk of traffic accidents on existing roadways in the BLM cumulative effects study area from daily travel by workers and their families. Indirect effects will include increased wear and tear on existing roads, additional air emissions, fugitive dust from roads, noise, increased potential access to remote areas, and an increased risk of vehicle collisions with livestock and wildlife. A lower and upper coal production model was used to forecast potential cumulative effects through 2020. The study projected increases in future traffic by assuming cumulative transportation impacts are largely tied to population increases (BLM, 2009b). BLM evaluated the impact of an estimated 48 percent increase in population (and therefore traffic) for Campbell County roads from year 2003 to 2020 based on high coal production population projections and concluded highways along major routes will not be affected but urban areas such as Gillette could experience additional traffic delays (BLM, 2010a).

In addition to the aforementioned ongoing or planned activities, there are numerous ISR sites either operating or planned within a 50-mile radius of the Proposed Project (Table 5-2) (Figure 5-1), each with transportation requirements comparable to the Proposed Project. The increases in projected traffic from the operating or planned ISR facilities combined with the other ongoing or planned activities in the region, and projected increases in population over time, could lead to regional traffic impacts that are similar to those evaluated by the aforementioned BLM study (that concluded no impacts to highways along major routes but an increased potential for traffic delays in urban areas such as Gillette).

In addition to potential traffic impacts, the existing or planned ISR facilities will require construction of new road surfaces or improvement of existing roads within the vicinity of the Proposed Project. Therefore, the number of roads and road networks will grow concurrently with the natural resource exploration and extraction activities with an associated increase in traffic and the potential for accidents.

The number of commuting construction workers and equipment and supply shipments will be reduced during operations along with the fugitive dust that the construction

activities will generate (ER Section 4.6). During operations (Section 4.2) there is a potential for toll ion exchange shipments from satellite facilities to the proposed CPP. This will produce more yellowcake annually, and will result in increased commuting workers and shipments of supplies, yellowcake, and byproduct materials each year. Therefore, operational traffic impacts and accident risks will be increased under the Proposed Action.

Based on the low volume of operational traffic, the low radiological risks from transportation accidents, and the implementation of AUC's safety practices as discussed in ER Section 4.2 the potential impacts from accidents will be minimal. Based on the low volume of traffic generated and required road dust mitigation, road dust impacts will also be minimal. Furthermore, the transportation system constructed to support the Proposed Project will be reclaimed and, therefore, the project-related road construction impacts will be minimal. Fugitive dust emissions are also evaluated as air quality impacts in ER Section 4.6, noise impacts are evaluated in ER Section 4.7, and the impact from wildlife kills is considered in ecological impacts in Section 4.5 of this ER.

5.4 Air Quality

Past, present, and reasonably foreseeable future actions in the vicinity of the Proposed Project that emit air pollutants include other uranium ISR operations, CBM, coal mining, coal power plant, and oil and gas operations (Section 5.1). Emissions from projected development of future oil and gas exploration and production, including CBM and coal mining, have been evaluated for impacts to air in previous EISs and SEISs and supporting documents for proposed developments in the PRB area (Table 5-3) where the Proposed Project is located.

The Task 1A Report for the PRB Coal Review (BLM 2005a) documents the modeled air quality impacts of operations during a baseline year, 2002, using actual emissions and operations for that year. The baseline year analysis evaluated impacts both within the PRB itself and at selected sensitive areas surrounding the region. The analysis looked at impacts of coal mines, power plants, CBNG development, and other development activities. Results were provided for both Wyoming and Montana. The Task 2 Report for the PRB Coal Review (BLM 2005b) identifies reasonably foreseeable development activities for the years 2010, 2015, and 2020.

The Task 3A Report for the PRB Coal Review (BLM 2006) evaluates impacts on air quality and air quality-related values for the year 2010 using the development levels projected for 2010 and the same model and meteorological data that were used for the baseline year study in the Task 1A Report. BLM updated the model and conducted impact analysis for the year 2015 (BLM 2008b). The updated Task 3A report for the PRB Coal Review Cumulative Air Quality Effects for 2015 uses a revised baseline year of

2004 with revised projected 2015 scenarios. BLM subsequently updated the model and conducted impact analysis for the year 2020 (BLM 2009d). The updated Task 3A report for the PRB Coal Review Cumulative Air Quality Effects for 2020 uses the same baseline year of 2004 with revised projected 2020 scenarios. The revised baseline year emissions inventory was developed using 2004 actual emissions data or emissions estimates and incorporated the recent analyses of emissions in Wyoming and Montana, which were not available when the 2010 modeling study was done.

Existing and projected emission sources for the baseline year (2004) and 2015 and 2020 analyses were identified within a study area comprised of the following counties in the PRB in Wyoming and Montana:

- Campbell County, all of Sheridan and Johnson Counties except the Bighorn National Forest lands to the west of the PRB, and the northern portion of Converse County, Wyoming; and
- Rosebud, Custer, Powder River, Big Horn, and Treasure Counties, Montana.

A state-of-the-art, guideline dispersion model was used to evaluate impacts of the existing and projected source emissions on several source groups, as follows:

- Near-field receptors in Wyoming and Montana covering the PRB Coal Review Task 1A and 3A study area in each state. Overall, the near-field receptor grid points were spaced at one kilometer intervals over the study area;
- Receptors in nearby federally designated pristine or "Class I" areas; and
- Receptors at other sensitive areas (Class II sensitive areas).

The EPA guideline CALPUFF model system (Scire et al. 1999a) and the same meteorological data set were used for the Task 1A and Task 3A studies. The impacts for the baseline year (2002) and for 2010 lower and upper coal production scenarios were directly modeled. As discussed above, the modeling domain extends over most of Wyoming, southeastern Montana, southwestern North Dakota, western South Dakota, and western Nebraska. An interagency group participated in developing the modeling protocol and related domain that were used for this analysis.

The modeling approach for the Task 3A Report used actual emissions from existing sources representative of 2002 operations and adjusted those emissions for the expected level of development in 2010. No specific emissions data were available for the projected levels of development. The baseline year emissions data were gathered from a variety of sources, but mainly relied on data collected by the WDEQ-AQD and the MDEQ. Only actual emission sources inside the study area described above were included in the modeling. Key major sources were included, such as the coal-fired power plants, gas-fired power plants, and sources that were included in the Title V (operating permit) program. The Dave Johnston power plant, which is located outside of, but adjacent to, the

study area in Converse County, was included in the baseline year study and in the projected emissions. Some operational adjustments were made to accommodate small sources with air permits that were presumed to be operating at less than full capacity. Emissions from other sources, including estimated construction-related fugitive dust emissions, were computed based on EPA emission factors and on input data from WDEQ-AQD.

Existing regional air quality conditions generally are very good in the PRB. There are limited air pollution emissions sources (few industrial facilities, including power plants and surface coal mines, and few residential emissions in relatively small communities and isolated ranches) and good atmospheric dispersion conditions. The available data show that the region is in compliance with the ambient air quality standards for NO_2 and SO_2. There have been no monitored exceedances of the annual particulates (PM_{10}) standard in the Wyoming PRB.

Air quality modeling indicates projected activities at the surface coal mines will be in compliance with the PM_{10} and $PM_{2.5}$ near-field and short-term NO_2 air standards for the 2015 and 2020 modeled air quality impacts at their currently permitted mining rates. Visibility data collected around the region indicate that, although there are some days with notable impacts at Class I areas, the general trend in the region shows little change in visibility impacts at the Badlands and Wind Cave National Parks and the Bridger/Fitzpatrick and Cloud Peak Wilderness Areas over the period from 1989 to 2008.

Predicted impacts from baseline year (2004) and projected 2015 and 2020 emissions were modeled for four air quality criteria pollutants (NO_2, SO_2, $PM_{2.5}$, and PM_{10}), along with changes in air quality-related values at Class I areas and at identified sensitive areas. For regulatory purposes, the Class I PSD evaluations are not directly comparable to the air quality permitting requirements because the modeling effort does not identify or separately evaluate increment-consuming sources that will need to be evaluated under the PSD program. The cumulative impact analysis focuses on changes in cumulative impacts, but not on a comparison to PSD-related evaluations, which will apply to specific sources.

The results of the modeling depict the anticipated changes under both development scenarios. For the Wyoming near-field receptors, the predicted impact of the 24-hour PM_{10} and $PM_{2.5}$ concentrations show localized exceedances of the National Ambient Air Quality Standard (NAAQS) for the baseline year (2004), as well as for both development scenarios for 2015 and 2020. The 2020 development scenarios show the concentration increases by a factor of 2.5 relative to the base year for these parameters. Additionally, while down about 10 percent from 2015, 2020 development scenarios show a 20 percent increase of annual PM_{10} and $PM_{2.5}$ concentrations at peak Wyoming near-field receptors. This level of increase indicated modeled exceedances of annual standards for $PM_{2.5}$.

Impacts of NO_2 and SO_2 emissions are predicted to be below the NAAQS and Wyoming Ambient Air Quality Standards (WAAQS) at the Wyoming near-field receptors.

None of the modeled Class I areas currently has, or is predicted to have, NAAQS or WAAQS exceedances. Modeling results for all sensitive Class II areas are below PSD increment levels for both 2020 development scenarios. For the baseline year, the maximum visibility impacts at Class I areas were determined to be at the Northern Cheyenne Indian Reservation in Montana and at Wind Cave and Badlands National Parks in South Dakota. For these locations, modeling showed more than 200 days of impacts with a change of 10 percent or more in extinction. A 10 percent change in extinction corresponds to 1.0 deciview (dv).

As with the 2015 modeling results, 2020 modeled visibility impacts at the identified Class I areas continue to show a similar pattern as exhibited for the base year (2004), with a high number of days with a greater than 10 percent change in visibility at the most impacted Class I areas. Visibility impacts at Badlands National Park, the Northern Cheyenne Indian Reservation, and Wind Cave National Park all have greater than 10 percent change for more than 200 days a year during the base year. These Class I areas are the top three Class I areas with the highest predicted change in light extinction in 2020. All but four of the sensitive Class II areas have more than 100 days per year with greater than a 10 percent change during the base year. The most significant visibility change to sensitive Class II areas in 2020 is predicted for Black Elk Wilderness Area and Mount Rushmore National Monument. Class II areas do not have any visibility protection under federal or state law. To provide a basis for discussing the modeled visibility impacts resulting from the projected increased production under the lower and upper coal production scenarios for 2020, the modeled visibility impacts for 2004 were subtracted from the model results for 2020.

Power plants currently are the major contributors to all SO_2 impacts in the near-field in both states. However, the projected impacts are well below any ambient standard or PSD increment. According to the PRB Coal Review Air Quality modeling analysis, predicted future expansion modeled to the year 2020 should not jeopardize the attainment of those standards. Impacts on NO_2 concentrations are the result of emissions from all the source groups. No one source group dominates the NO_2 impacts in the near-field.

Overall, based on the preceding analysis, the Proposed Project will have a small incremental effect on the moderate cumulative impacts to air quality resulting from past, ongoing, and future ISR projects, CBM projects, oil and gas operations, surface coal mining activities, and other development identified in Section 5.1.1.

5.5 Geology and Soils

Cumulative impacts on soils and geology were assessed within the planning area administered by the BLM Buffalo Field Office (herein referred to as the "Buffalo Planning Area"). This area was chosen as the geographic boundary for the analysis of cumulative impacts on soils and geology because the Proposed Project is centrally located within the area administered by this office. There are no BLM lands but some federal mineral rights are located within the Proposed Project area. Within the Buffalo Planning Area, which encompasses Johnson, Campbell, and Sheridan Counties, the BLM administers 780,291 acres of public land and 4.7 million acres of the mineral rights in these counties. Within the Buffalo Planning Area, energy extraction activities affecting the geology and soils include oil and gas and CBM development, coal mining, and uranium extraction. Impacts to soils result from earthmoving activities associated with these energy extraction activities, and the subsurface geology is affected by the removal of a resource or by the injection of fluids to recover a resource. Recent BLM reports, discussed in the following paragraphs, provide valuable information on past, present, and reasonably foreseeable future development activities within the Buffalo Planning Area. These reports were used to assess the cumulative impact on geology and soils.

The past, ongoing, and reasonably future foreseeable actions to explore for and extract minerals within the region contribute to the cumulative impact on geology and soils (BLM, 2008a). As of 2009, there were a total of 6,421 conventional oil and gas wells in the Buffalo Planning Area. An additional 1,359 conventional wells are projected to be drilled between 2009 and 2028, resulting in the potential disturbance of soils covering an area of approximately 19,090 acres (BLM, 2009a). BLM has estimated the potential surface disturbance of soils from the development of coal bed methane within the same area as 64,144 acres (BLM, 2009a). BLM (2005a) reported that coal mining across the PRB, which comprises all of Campbell, Johnson, and Sheridan Counties less the land comprising the Bighorn National Forest, had disturbed 51,107 acres; some of which has occurred within the Proposed Project watershed.

BLM (2005c) evaluated the cumulative impact on geology and soils from past, present, and reasonably foreseeable future actions in the PRB under two different coal production scenarios. Under the upper coal production scenario, a total of 149,089 acres of disturbed land are projected for the year 2020, versus the 2003 baseline total of 68,794 acres. There are other ISR projects either licensed or planned within a 50 mile radius of the Proposed Project, as shown in Figure 5-1 and Table 5-2 and that could impact geology and soils at an intensity comparable to that which will occur at the Proposed Project. Increased vehicle traffic, clearing of vegetated areas, salvaging and redistributing soils, discharging CBM produced groundwater, and constructing and maintaining project specific components (e.g., roads, well pads, industrial sites, and associated ancillary facilities) all contribute to the cumulative impacts on soils from both energy-related projects. The

removal of uranium from the target sandstones during ISR operations will result in a permanent change to the composition of uranium-bearing rock formations. However, the uranium mobilization and recovery process in the target sandstones does not result in the removal of rock matrix or structure, and therefore no significant matrix compression or ground subsidence is expected.

The main soil resource concerns within the Buffalo Planning Area are wind erosion and water erosion that occur where the ground cover has deteriorated (BLM, 2009h). Long-term and short-term impacts on soils include accelerated wind or water erosion; declining soil-quality factors; declining microbial populations, fertility, and organic matter; compaction; and the permanent removal of soil (BLM, 2005c). Some degree of soil reclamation is possible, although not all overburden materials can be used to reestablish vegetation. Potential impacts on soils can also include a change in alkalinity due to discharge of CBM-produced water. The principal impact on soils from the Proposed Project will result from earthmoving activities. Earthmoving activities that could impact soils include clearing of ground or topsoil and preparing surfaces for the CPP facilities, header houses, access roads, drilling pads, and pipeline trenching. As discussed in Section 4.3, soil covering approximately 154 acres will be affected by the Proposed Project. These potential impacts will be further reduced by the AUC's implementation of best management practices (BMPs). The potential impacts on the subsurface geology are described in Section 4.3, which assesses the cumulative impact on groundwater.

The approximate 154 acres of short and long term soil disturbance over the life of the project accounts for less than 0.03 percent of the soil disturbance occurring in Proposed Project area. Furthermore, the ways in which soils will be impacted during the Proposed Project are also far less damaging or adverse than soil impacts that result from surface coal mining, which is more invasive and removes much larger amounts of soil.

5.6 Water Resources

Surface and groundwater are used extensively throughout the PRB for agricultural water supply, municipal water supply, and both domestic and industrial water supply. Surface water use is limited to major perennial drainages and agricultural areas within the basin are found mainly along these drainages. Municipal water supply comes from a combination of surface and groundwater. Domestic and industrial water supply primarily is from groundwater.

5.6.1 Surface Waters and Wetlands

Section 3.4 of this ER describes the surface water features of the Proposed Project area. All streams in the area are ephemeral, flowing only during rainfall or snow melt events.

As discussed in Section 4.4, potential impacts to surface water include the possibility of increased sediment from disturbed areas reaching the streams or the possibility of a leak or spill of chemicals near the streams. These potential impacts will be minimized through the use of BMPs for erosion and sediment control and adhering to strict safety protocols for handling chemicals. Because of the infrequency of runoff events in this semiarid region as provided in TR Section 2.5, it is unlikely that a spill will be transported off site and reach a watercourse downstream.

As previously mentioned, CBM activity is prominent across the entire PRB. The BLM estimated that nine to 52 percent of CBM-produced water will contribute to surface water flows and perennial flows will be likely to develop in former ephemeral channels (BLM, 2003). CBM-produced water will increase the availability of surface waters for irrigation and other purposes for downstream users. BLM noted that noticeable changes in water quality will occur in the main channel drainages during periods of low flow and that sodicity and salinity are key water quality parameters because of their impact on water used for irrigation. BLM projected that the concentrations of suspended sediments in surface water will likely rise above baseline levels from increased flow and surface water runoff from disturbed areas. WDEQ adopted the Most Restrictive Proposed Limit for sodicity and salinity into its WYPDES permitting process to mitigate potential water quality impacts to downstream users.

Smith Ranch/Highland (operated by Power Resources, Inc., 38.8 miles south of the Proposed Project) and Willow Creek (operated by Uranium One, Inc., 19.1 miles northwest of the Proposed Project) are the only operating ISR projects within 50 miles of the Proposed Project. Due to the distance to these facilities from the Proposed Project, impacts associated with those facilities will not create adverse effects to this Proposed Project, and vice versa.

For all projects mentioned, industrial and construction permits from WDEQ are required prior to project construction. For all permits, BMPs are required in order to reduce the risk to waterways caused by proposed activities. Furthermore, permits issued by the U.S. Army Corps of Engineers (USACE) are required for surface waters and wetlands that are jurisdictional.

5.6.2 Groundwater

The potential for groundwater impacts created by the Proposed Project will most likely occur during the operation and restoration phases of the Proposed Project. To reduce the risk of any groundwater impact, monitoring wells will be installed around the perimeter of the production units and in the Overlying Aquifer for early detection and control of possible excursions. This method for detection and control is widely used and accepted at other ISR projects, and has shown to be very effective.

As previously mentioned, other uranium ISR projects are licensed within the vicinity of the Proposed Project. Smith Ranch/Highland (operated by Power Resources, Inc.), Reynolds Ranch, North Butte, and Ruth ISR satellite facilities (licensed to PRI), Willow Creek (operated by Uranium One), Nichols Ranch and Hank Unit (recently licensed to Uranerz Energy Corp.), and Moore Ranch (recently licensed to Uranium One) ISR projects are the only licensed ISR projects within 50-miles of the Proposed Project (Figure 5-1). Operations have not yet commenced at the licensed North Butte ISR project (operated by Power Resources, Inc.) nor at the Moore Ranch ISR Project. Nichols Ranch is currently under construction and it is not known when it will start operations. The Nichols Ranch–Hank Unit is licensed but not operational. The Reynolds Ranch and Ruth satellite facilities are also currently non-operational properties.

The DOE Spook facility is the only decommissioned conventional mill within a 50-mile radius of the Proposed Project. Given that the facility has been decommissioned and therefore meets NRC regulatory standards which demonstrate it does not pose a significant potential impact on public health, safety, or environment, the potential contribution to a cumulative impact on groundwater will be minimal. Another conventional mill, Bear Creek, resides within a 50 mile radius. It is a legacy site that is no longer in production and is awaiting DOE transfer of ownership. Both of these projects, including the aforementioned ISR projects, are located at sufficient distances from the Proposed Project for cumulative impacts to be minimal.

Cumulative impacts resulting from CBM activity is minimal due to the vertical differentiation of multiple stratigraphically separate, low-permeability horizons between the coal seams and that of the uranium ore-bearing aquifer (discussed in TR Section 2.6). Pump tests at the Proposed Project proved that the production zone is confined and that there is no hydraulic communication across aquifers. The potential impacts could be larger if the coal seams and ore-bearing aquifers are artificially connected through improperly abandoned, deep exploratory oil and gas wells. Integrity testing by Rocky Mountain Energy (Hydrogeologic Integrity Evaluation, 1982; TR Addendum 2.7E) provides a strong indication that old drill holes have been sealed by either natural swelling clays or by plug gel and that re-plugging of old drill holes may not be necessary. In any case, when identified, improperly abandoned wells within the Proposed Project will be sealed prior to ISR operations.

At present, some oil/gas wells occur on the lands within and adjacent to the Proposed Project. Oil wells are completed at greater depths (approximately 9,000 feet) than the targeted ore-bearing aquifers for ISR uranium production in the Wasatch Formation. The ISR uranium production wells are completed at thousands of feet above the oil-producing horizons. Therefore, the potential cumulative impact on oil production in the PRB from the Proposed Project will be minimal.

Liquid 11e.(2) byproduct generated at the Proposed Project will be disposed of by DDW. This method is widely used and accepted and requires an UIC permit for the targeted deep aquifer from WDEQ. The permit will be granted if the deep disposal practice is safe for public health and safety and will not impact potential underground sources of drinking water. The targeted formation will not interfere with other activities at the targeted formation due to horizontal and vertical distance.

5.7 Ecological Resources

5.7.1 Terrestrial Ecology

The potential exists for cumulative impacts to both flora and fauna due to land disturbance. Disturbance of the land may lead to loss of habitat and food source for a variety of species. The potential disturbance for the Proposed Project will not be continuous but rather small tracts distributed across the entire Proposed Project area. Sagebrush and mixed grasses cover the majority of the Proposed Project and these vegetative plant communities will be most affected by the Proposed Action. Disturbance from the construction and operations activities of the Proposed Project and others in the surrounding area could result in the spread of invasive and noxious weeds. However, it is a priority to ensure that any areas disturbed within the project area are promptly reseeded and reclaimed as stated in Section 6.1.3.6. Furthermore only areas that development is unavoidable will be disturbed, representing a small percentage of the entire Proposed Project area.

Big game usually travel large expanses of land; therefore the minimal impact from the Proposed Project will have minimal cumulative impacts on their range. Reptiles and amphibians will experience the greatest impact, albeit minimal, due to limited mobility during construction, however only a small area of the Proposed Project will be disturbed at any one time.

5.7.2 Aquatic Ecology

As previously mentioned, all streams within and adjacent to the Proposed Project are ephemeral. Cumulative impacts from other sources, primarily CBM activity, create the potential for disturbing the aquatic ecology. Currently, CBM production has not had any effect on aquatic ecosystems, and despite their dominance, the USGS concluded that, with a few exceptions, that water quality does not exceed state nor federal acute and chronic criteria for the protection of aquatic life (Peterson, 2010).

5.7.3 Threatened and Endangered Species

The USFWS has identified three federally listed species that could occur in Campbell County and require monitoring. Those include two plant species, the Ute ladies'-tresses (*Spiranthes diluvialis*) (threatened) and blowout penstemon (*Penstemon haydenii*) (endangered), and one vertebrate species, the Greater sage-grouse (candidate)(USFWS July 2010).

No threatened or endangered (T&E) plant species or their potential habitats were observed within the Proposed Project area during surveys in 2011, and available data sets do not indicate the occurrence of any T&E species within the Proposed Project area.

Other than a single female sage-grouse that was documented in 2011, no threatened, endangered, candidate, or proposed wildlife species have been documented in the Proposed Project area and associated wildlife review area during surveys in 2008, 2010, and 2011, and available data sets do not indicate the occurrence of any Threatened and Endangered (T&E) species in the survey area (ER Figure 3.5-1).

Fragmentation and degradation of the surrounding landscape has led to the decline of critical habitat for the three threatened and endangered species mentioned above. The landscape is dominated by sagebrush and mixed grasses. And although this ecosystem encompasses a high percentage of the expansive PRB, recent increases in diverse industrial activities create the potential for cumulative and compounding effects on the environment.

No suitable habitat for the blowout penstemon or Ute ladies'-tresses orchid exists on the proposed site as provided in ER Section 3.5.

The Greater sage-grouse is a species that requires a very distinct ecosystem; one that is dominated by sagebrush during all seasons and required for every phase of their lifecycle. Mineral extraction, irrigation, and grazing have altered the native canvas creating fragmented habitat to fill their niche. In the short-term, sage-grouse have declined. In the years between 1965 to 2007, their populations have been declining with the greatest decline in populations occurring before the mid-1980s. Compared to historic levels, total population decline is estimated at 45 to 80 percent (Becker, et al., 2009). From 1956 to 2003, sage-grouse populations have been declining at two percent each year (Connelly, et al., 2009). To date, the USFWS has listed the sage-grouse as a "candidate species" under the Endangered Species Act of 1973. The USFWS and State of Wyoming continues to monitor this species status. Doherty (Doherty, et al., 2009) found that the State of Wyoming currently contains 64 percent of all known sage-grouse habitat and more active leks than any other state.

Oil and gas development is regarded as playing a major role in the decline of sage-grouse (Becker, et al., 2009). The direct adverse impacts of energy development projects, especially CBM related exploration/production, on sage-grouse have been well documented (Doherty, et al., 2008; Walker, et al., 2007; Holloran, 2005; Braun et al., 2002,). Future oil and gas development is projected to cause a seven to 19 percent decline in sage-grouse lek population counts throughout much of the current and historic sage-grouse range (Connelly, et al., 2009). If current trends of development continue, forecasts of future sage-grouse populations across 23 populations and seven sage-grouse management zones (SMZs) suggest that 75 percent of the populations and 29 percent of the SMZs to decline below breeding population sizes of 500 within 100 years.

Black-tailed prairie dog complexes are known to exist throughout the PRB. However, none were found within or adjacent to the Proposed Project. The black-tailed prairie dog is important to the federally endangered black-footed ferret by means of forage and habitat. The closest successful reintroduced population of the black-footed ferret is in the Shirley Basin, Wyoming, approximately 100 miles south-southwest of the Proposed Project.

The cumulative impacts on threatened and endangered species caused by industrial activities and other anthropogenic sources can directly impact a species survival and reproductive capacity. Indirectly, habitat quality and quantity, as well as increased predation, can impact a species. In the case of the sage-grouse, this already weakened population could experience even greater reductions in populations due to an already fragmented ecosystem. Furthermore, the cluster of oil and gas wells far exceed the species' threshold of tolerance and energy development threatens to extirpate birds from otherwise suitable habitats and further isolate remaining populations (Naugle, et al., 2006). With an estimated 13,800 additional CBM wells projected to be drilled in the area by year end 2028, cumulative impacts to sage-grouse across the study area will be further increased.

Overall, based on the preceding analysis, the Proposed Project will have a small incremental effect on ecological resources compared to the moderate cumulative impacts from past, ongoing, and future ISR projects, CBM projects, oil and gas operations, surface coal mining activities, and other development identified in Section 5.1.1.

5.8 Noise

Cumulative impacts from noise are assessed within a five mile review radius of the Proposed Project. This area served as the cumulative assessment geographic boundary and was chosen because noise dissipates rapidly with distance from the source. GEIS Section 4.3.7 stated that sound levels as high as 132 dBA will taper off to the lower limit of human hearing (20 dBA) at a distance of 3.7 miles in this region.

Past, present, and reasonably foreseeable future noise-generating activities in the vicinity of the Proposed Project will primarily be from traffic noise, uranium recovery operations, oil and gas operations, and CBM operations. The FEIS for the Powder River Basin Oil and Gas Project noted that sound levels from CBM operations will be expected to be unnoticeable at distances of 1,600 feet and beyond, and the FEIS concluded there will be no cumulative impact on the surrounding area (BLM, 2003). CBM operations are also active near the Proposed Project area. Table 3.1-5 of this ER shows that 324 CBM wells are within two miles of the Proposed Project and 46 producing oil and gas well within five miles (Figure 3.1-5). The FEIS noted that oil and gas operations will generate noise during well drilling, which decreases to 54 decibels (dBA) at 2,000 feet from the drill rig. Oil and gas operations generate noise during the, ongoing operations of compressor stations, although noise levels were anticipated to be below 55 dBA at distances of 1,600 feet and beyond (BLM, 2003). According to EPA, 55 dBA is the level that protects against interference and annoyance with a margin of safety (EPA, 1978).

The Proposed Project area does not overlap with any of the core or connectivity areas for sage-grouse as designated by the State of Wyoming. The closest core area ("Thunder Basin") is over 20 miles to the east. No known sage-grouse leks are present within the Proposed Project area, but three sage-grouse leks (160 Acre, Porcupine Creek, and Spring Creek) exist within four miles of the Proposed Project boundary (ER Figure 3.5-1). Mitigation measures to potential ecological resources impacts include:

- Implementing speed limits on access roads within the Proposed Project area and enforcement of speed limits on county roads for AUC employees and contractors; and
- Minimize vegetation impacts by ensuring employees use only existing and proposed roads in the Proposed Project area.

These actions should reduce potential noise impacts on the Greater sage-grouse and other wildlife in and around the Proposed Project area.

5.9 Historical and Cultural Resources

Since the emergence of CBM activities in the late 1990s, over one thousand archaeological sites are evaluated each year (BLM, 2009h – RMP Revision dated March 27, 2009). Hundreds of archaeological sites are discovered and recorded each year as the result of cultural resource investigations associated with energy development projects (BLM, 2009 –RMP). The revised RMP states as the demand for federally-owned minerals increases, there will be a demand to identify cultural resources. Within the study area, activities on both public and private lands include oil, gas, and CBM development. These activities are ongoing and are projected to expand in the future. However, any potential impacts to historic and cultural resources will likely be minimized for projects

occurring on federal or state lands, licensed or permitted by Federal agencies, or which are licensed or funded in part by the government because these projects will be subject to the National Historic Preservation Act (NHPA), Section 106 consultation process, and applicable statues.

As discussed in Section 3.8 of the ER, a thorough survey of the historical and cultural resources, pertinent to the Proposed Project, was conducted. None of the cultural remains in the Proposed Project are considered eligible for the National Register. However, the Proposed Project area is geographically located 7.5 miles east of the Pumpkin Buttes which has been identified as a TCP and has potential cultural affiliation with seven tribes. AUC has committed to following cultural resource mitigation measures identified in Section 3.8 of this ER.

According to the Environmental Impact Statement for the Nichols Ranch ISR Project (NUREG-1910, Supplement 2, Section 3.9.2.3), the TCP boundary for the North Middle Butte of the Pumpkin Buttes is 5,500 feet from the center of the top of the butte. The Proposed Project area, unlike the URZ Nichols Ranch ISR Project, is located well beyond the TCP boundary. This distance between the Proposed Project and the Pumpkin Buttes negates the necessity to obtain a MOA for the operation of the Proposed Project facility. Given the distance that the Proposed Project is from the nearest Butte, the cumulative impact is negligible.

Regarding paleontological resources, should activities involve ground disturbance depths exceeding a few feet, AUC will have procedures that cover inadvertent discoveries.

5.10 Visual and Scenic Resources

Within the area administered by the BLM Field Office and with the PRB region, energy development is expected to grow over the next 20 years and could involve constructing uranium recovery facilities, transportation infrastructure, coal fired power plants, major transmission lines (230kV), coal technology projects, oil and gas facilities, and CBM processing plants all that have an impact on visual and scenic resources.

A viewshed analysis was conducted for an area extending two miles from the Proposed Project boundary, and the general area from where the proposed CPP can be viewed is classified as BLM Visual Resource Management (VRM) Class with no Class I areas in the vicinity. Oil and gas production facilities are visible from great distances due to their taller profile and are located within and adjacent to the Proposed Project. However there are very few of them and they are not clustered together. Other existing facilities that are visible from the Proposed Project include: roads, a CBM compressor station, telephone/electric lines and poles, fences, jump jacks, ranch buildings, and reservoirs.

The Proposed Project is projected to have a small incremental impact on visual and scenic resources when added to the other past, present, and foreseeable future actions.

5.11 Socioeconomics

A regional economic model (Regional Economic Model, Inc. Policy Insight) that was part of BLM Powder River Basin Coal Review Task 3C Report: Cumulative Social and Economic Effects (BLM, 2005d), was used to develop reasonably foreseeable cumulative employment and population projections. Two future scenarios were modeled showing a lower and upper coal production scenario in the Powder River Basin. The two scenarios represent a projected range of economic activity derived by combining the range of future coal production with other identified foreseeable activities, including oil and gas production and other mining operations. The timeframe for the model analysis spans from 2007 to 2020, and older data were incorporated into the model to build upon historic employment and population trends.

The Powder River Basin BLM coal review study area served as the geographic boundary for the coal-review study. Across the entire six-county Powder River Basin (Campbell, Johnson, Converse, Crook, Sheridan, and Wetson), projected increases in employment from coal mining operations and oil and gas development will range from 12,120 to 28,625 jobs under the lower and upper coal-production scenarios between 2003 and 2020. Most of this gain is expected to take place in Campbell County, which is projected to capture 60 percent of the new jobs under the lower projection scenario and 65 percent under the upper coal-production scenario (BLM, 2009e). Based on the relatively small number of workers expected at the Proposed Project, it will have a small incremental contributory impact on employment.

While Campbell County and the entire PRB have been described as possessing an enhanced capacity to respond to and accommodate growth, periods of rapid growth have been known to stress communities and their social structures, housing resources, and public infrastructure and service systems.

Both the lower and upper coal-production scenarios indicate a strong demand for housing resources through the year 2020. Based on the lower coal-production scenario, Campbell County is expected to require a minimum 58 percent increase in total housing demand between 2003 and 2020. This demand is anticipated to exert substantial pressure on housing markets, prices, and the real estate development and construction industries, all at a time when demand for labor and other resources will also be high. However, the incremental impact to housing demand from the proposed construction and operation of the Proposed Project will be small, based on the small number of expected workers.

Based on assessments of population, employment, housing, school enrollment, public services, and local finances, the Proposed Project is projected to have a minimal incremental socioeconomic effect on the region when added to the moderate impacts expected from other past, present, and reasonably foreseeable future actions described in Section 5.1.1. This conclusion is based on the small number of workers required to support the Proposed Action.

Additional detailed information on economic benefits and costs of the Proposed Project is presented quantitatively in Section 8 of this ER.

5.12 Environmental Justice

No minority and low-income populations have been identified as residing near the Proposed Project area. The percentage of minority populations living in the two nearest block groups are very small when compared to the percentage of minority populations recorded at the state level and much less than the national level. The economic base of the region is largely comprised of ranching and resource extraction. Low income populations are generally dispersed throughout the study area. Potential impacts to minority and low-income populations from the construction, operation, restoration, and decommissioning of the Proposed Project including other past, present, and reasonably foreseeable future actions, will not be disproportionately high and adverse.

5.13 Public and Occupational Health and Safety

The cumulative impact on public and occupational health and safety was considered within a 50 mile radius of the Proposed Project. Historically, NRC has used the 50 mile radius as a standard bounding geographic area to evaluate population radiation doses from releases at ISR facilities. This section considers both radiological and non-radiological impacts from normal operations and accidents.

Several companies are actively investigating the potential for ISR extraction, as well as other types of mining and milling, in areas near the Proposed Project. A review of the surrounding area indicated there are five NRC-licensed nuclear facilities within 50 miles of the Proposed Project area as shown in Figure 5-1 and Table 5-2. Two of the licensed facilities, Willow Creek and Smith Ranch-Highland, currently have existing yellowcake processing plants, both in operation. Several inactive and decommissioned conventional uranium mills and Proposed Projects are also within a 50 mile radius.

The highest calculated dose to a member of the public at the site boundary for the Proposed Project is 4.3 mrem per year. The calculated collective dose using MILDOS-AREA for the population residing within 50 miles is 0.1 person-rem per year. Table 4.2-2

of the NUREG-1910 (GEIS) shows the offsite maximum dose to a member of the public could range from less than 1 mrem per year to 31.7 mrem per year. Because the range of the doses for these facilities are well below the 100 mrem/yr limit in 10 CFR 20.1301(a)(1), the cumulative impacts from other similar facilities located within 50 miles will be minimal.

A radiological hazard assessment (Mackin, et al., 2001) considers three types of accidents, representing the sources containing the higher levels of radioactivity for all aspects of uranium recovery operations: thickener failure and spill, pregnant lixiviant and loaded resin spills (radon release), yellowcake dryer accident release. The impacts to workers from these accidents are considered minimal except in the unlikely event that the accidents will not be mitigated. Under that circumstance, the dose impacts could be considered moderate.

The types and quantities of chemicals (hazardous and nonhazardous) for proposed use at the Proposed Project do not differ from those evaluated in the ISR GEIS. The use of hazardous chemicals at ISR facilities is controlled under several regulations that are designed to provide adequate protection to workers and the public. The handling and storage of chemicals at the facility will follow standard industrial safety standards and practices. Industrial safety aspects associated with the use of hazardous chemicals are regulated by the Wyoming Occupational Safety and Health Administration. Nonradiological worker safety will be addressed through occupational health and safety regulations and practices.

Since the Proposed Project is located in a remote, sparsely populated area with limited public access, the exposure to members of the public will be limited. Occupational health hazards will be limited because applicants are required to implement an NRC-approved radiation protection program to protect occupational workers. Additionally, ISR facilities will follow standard industrial safety standards and practices.

5.14 Byproduct Material Management

All stages of the proposed project (construction, operation, groundwater restoration, and decommissioning) will generate liquid and solid byproduct materials, all of which will be handled and disposed of properly and in accordance with NRC, WDEQ and other laws and regulations. Any byproduct generated as part of the uranium extraction phase of site operations will be classified as 11e.(2) byproduct material (NRC, 2000).

<u>Solid 11e.(2) Byproduct Material</u>

During operation and groundwater restoration, AUC estimates that approximately 100 yd^3 of solid 11e.(2) byproduct material will be generated annually. Estimated quantities

generated during decommissioning are provided in the financial assurance calculations in the Restoration Action Plan (RAP) TR Addendum 6-A. During decommissioning, up to an estimated 4,000 yd^3 of solid 11e.(2) byproduct material. The total quantity of solid 11e.(2) byproduct material that is expected to be generated from the Proposed Project is up to 5,300 yd^3, based on 13 years of operation and groundwater restoration at 100 yd^3 per year and an additional 4,000 yd^3 during decommissioning.

Solid Non-11e.(2) Byproduct Material

Solid non-11e.(2) byproduct or waste material will include construction debris, office trash, and decontaminated material and equipment. It will be generated during all project phases, including construction, operation, groundwater restoration, and decommissioning. Most of the solid byproduct material will be generated during decommissioning. As described in Section 6 in the TR, AUC estimates that 2,000 yd^3 of solid non-11e.(2) byproduct material will be generated during decommissioning. During the prior three project phases, only about 30 yd^3 per week (1,500 yd^3 per year) are expected.

Past, present, and reasonably foreseeable future actions in the vicinity of the Proposed Project area that could generate solid, hazardous or 11e.(2) byproduct materials include uranium recovery activities, CBM activities, and oil and gas exploration. Each of these facilities will be responsible for complying with applicable regulations and site-specific application agreements that manage generated byproduct materials and will likely utilize the same disposal facilities. Within a 50 mile radius of the proposed project, there are at least nine either operating or planned ISR facilities that will generate 11e.(2) and non-11e.(2) byproduct volumes consistent with those projected for the Proposed Project. The total amounts of byproduct material generated will be wholly dependent of each project's life span. The cumulative effects on present and reasonably foreseeable future actions that will contribute to the total amount of solid 11e.(2) byproduct material generated by ISR facilities could, therefore, be as much as approximately 47,700 yd^3 (i.e., 5,300 yd^3 × 9 facilities). Similarly, the cumulative volume of solid non-11e.(2) byproduct material that could be generated from these facilities could be approximately 207,000 yd^3.

Available local capacity for disposal of solid 11e.(2) byproduct material is at the Pathfinder-Shirley Basin site located in Shirley Basin, Wyoming (Figure 3.2-3). As reasonably foreseeable additional ISR sites are licensed, this local capacity may become limited. Future ISR applicants could engage other low-level solid 11e.(2) byproduct disposal facilities licensed to accept byproduct material. Additionally, three sites in NRC-licensed agreement states can accept byproduct material for disposal (i.e., the Energy Solutions site in Clive, Utah; the White Mesa uranium mill site in Blanding, Utah; and the Waste Controls Specialists site in Andrews, Texas).

Non 11e.(2) solid byproduct material from the Proposed Project will be disposed of at a landfill located near the city of Gillette in Campbell County, Wyoming. The landfill in Gillette, Wyoming has planned available capacity for approximately the next 30 years. The total nonhazardous material volume from seven ISR projects will represent about eight percent of the material that will be disposed at the Gillette landfill based on 2005 disposal rates (Wyoming Office of State Lands and Investments, 2007).

Liquid 11e.(2) Byproduct Material

Regarding the potential cumulative impacts of liquid 11e.(2) byproduct material disposal, AUC is awaiting approval from WDEQ for four deep disposal wells for liquid byproduct material. Additional deep disposal well use in the region is anticipated as additional ISR facilities are licensed. The State permitting process for these wells evaluates the suitability of proposals to ensure underground sources of drinking water (USDWs) are protected.

Table 5-1: Powder River Basin EISs

Date	Agency	Report	Title
4/13/2007	BLM	Final EIS	Maysdorf Coal Lease by Application (LBA) Tract, (Federal Coal Application WYW154432), Implementation, Campbell Counties, WY
8/17/2007	USFS	Final EIS	Thunder Basin Analysis Area Vegetation Management, To Implement Best Management Grazing Practices and Activities, Douglas Ranger District, Medicine Bow-Routt National Forests and Thunder Basin National Grassland, Campbell, Converse and Weston Counties, WY
8/31/2007	BLM	Final EIS	Eagle Butte West Coal Lease Application, Issuance of Lease for a Tract of Federal Coal, Wyoming Powder River Basin, Campbell County, WY
12/19/2008	BLM	Final EIS	West Antelope Coal Lease Application (Federal Coal Lease Application WYW163340), Implementation, Converse and Campbell Counties, WY
8/17/2009	BLM	Final EIS	South Gillette Area Coal Lease Applications, WYW172585, WYW173360, WYW172657,WYW161248, Proposal to Lease Four Tracts of Federal Coal Reserves, Belle Ayr, Coal Creek, Caballo, and Cordero Rojo Mines, Wyoming Powder River Basin, Campbell County, WY
10/16/2009	UDFS	Final EIS	Thunder Basin National Grassland Prairie Dog Management Strategy, Land and Resource Management Plan Amendment #3, Proposes to Implement a Site-Specific Strategy to Manage Black Trailed Prairie Dog, Douglas Ranger District, Medicine Bow-Routt National Forests and Thunder Basin National Grassland, Campbell, Converse, Niobrara and Weston Counties, WY
7/30/2010	BLM	Final EIS	Wright Area Coal Lease Project, Applications for Leasing Six Tracts of Federal Coal Reserves Adjacent to the Black Thunder, Jacob Ranch, and North Antelope Rochelle Mines, Wyoming Powder River Basin, Campbell County, WY
8/27/2010	NRC	Final EIS	Moore Ranch In-Situ Uranium Recovery (ISR) Project, Proposal to Construct, Operate, Conduct Aquifer Restoration, and Decommission an In-Situ Recovery (ISR) Facility, NUREG-1910, Campbell County, WY
1/28/2011	NRC	Final EIS	Nichols Ranch In-Situ Uranium Recovery (ISR) Project, Proposal to Construct, Operate, Conduct Aquifer Restoration, and Decommission and In-Situ Recovery Uranium Milling Facility, Campbell and Johnson Counties, WY
9/16/2011	USFS	Final EIS	Livestock Grazing and Vegetation Management on Five Project Area, Proposes to Continue to Authorize Livestock Grazing, Tongue, Medicine Wheel/Paintrock, and Power River Districts of the Bighorn National Forest, Johnson, Sheridan, Big Horn and Washakie Counties, WY

Source: U.S. Environmental Protection Agency, 2011

Table 5-2: Past, Existing, and Potential Uranium Recovery Sites Within 50-miles of the Proposed Project

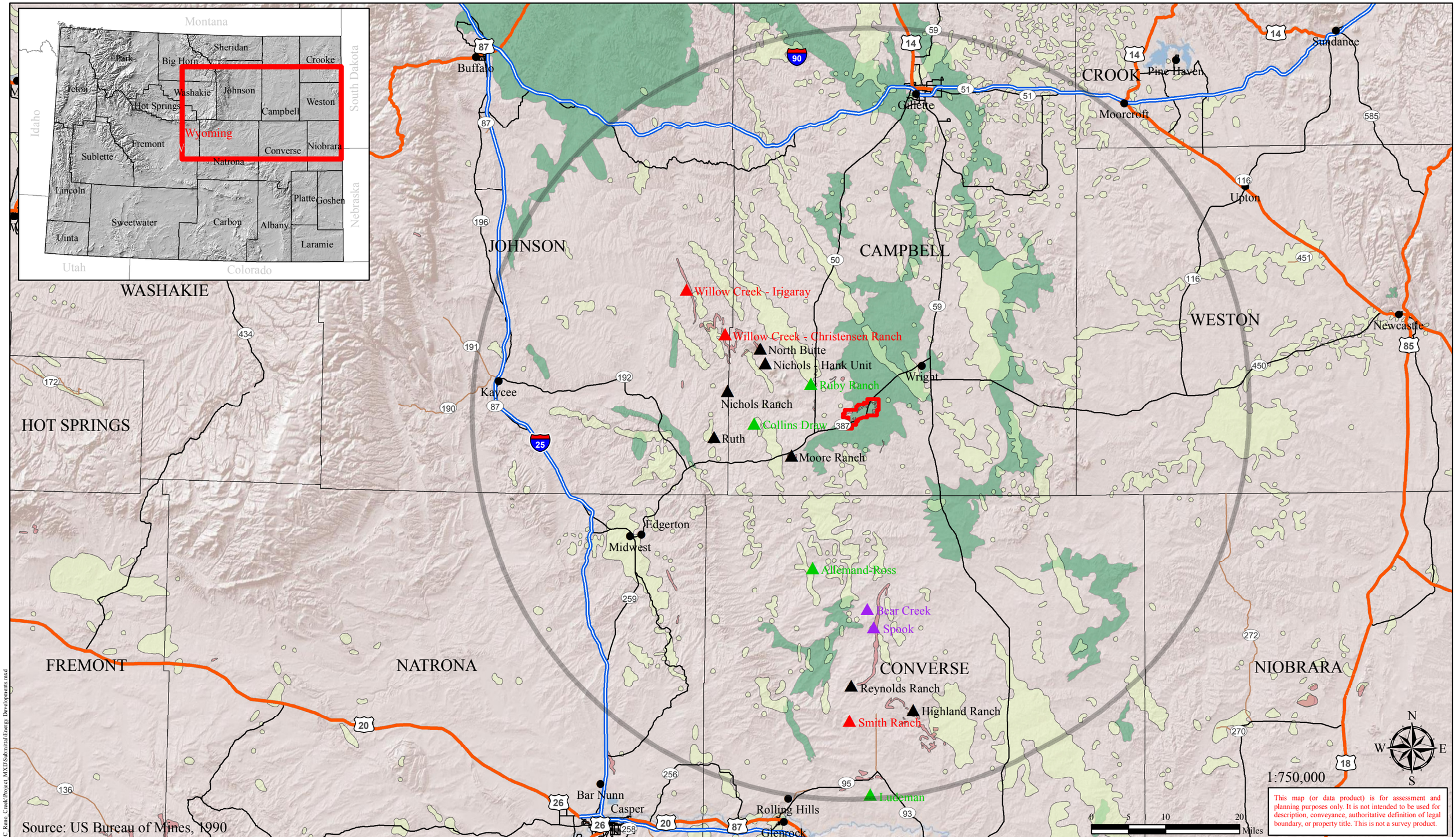
Site Name	Company/Owner	Type	County, State	Status Code†	Approximate Distance in mi (km)	Direction
Allemand-Ross	Uranium One	ISR-Expansion	Johnson, WY	1	19.4 (31.2)	SSW
Bear Creek	Bear Creek Uranium Co.	Conventional	Converse, WY	Decommissioning	24.4 (39.3)	S
Highland Ranch	Exxon Minerals	Conventional	Converse, WY	Decommissioning	38.8 (62.5)	SSE
Ludeman	Uranium One	ISR-Expansion	Converse, WY	2	49.5 (79.6)	S
Moore Ranch	Uranium One	ISR-Expansion	Campbell, WY	4	8.3 (13.3)	SW
Nichols Ranch and Hank	Uranerz	ISR-New	Johnson and Campbell, WY	4	12.4 (20)	NW
North Butte and Ruth	Power Resources, Inc.	ISR-Expansion	Campbell and Johnson, WY	4	14.1 (22.7)	NW and WSW
Reynolds Ranch	Power Resources, Inc.	ISR-Expansion	Converse, WY	4	34.7 (55.8)	S
Ruby Ranch	Power Resources, Inc.	ISR-Expansion	Campbell, WY	1	5.8 (9.3)	NW
Smith Ranch-Highland Ranch	Power Resources, Inc.	ISR-Expansion	Converse, WY	4	38.8 (62.5)	S
Spook	DOE	Conventional	Johnson, WY	UMTRCA Title I disposal site	27 (43.4)	S
Willow Creek	Uranium One	ISR-Restart	Johnson and Campbell, WY	4	19.1 (30.8)	NW

†= Code indicating the status of the application where: (1)=Not Received, (2)=Acceptance Review Ongoing, (3)=Technical Review Ongoing, and (4)=Licensing Action Completed. Source: NRC 2011

Table 5-3: Wyoming Coal Mines Near the Proposed Project

Site Name	Company/Owner	Type	County, State	Production in 2010 (in tons)	Approximate Distance in mi (km)	Direction
Antelope	Cloud Peak Energy, LLC	Surface	Converse, WY	35,803,519	52.3 (84.2)	SE
Buckskin	Buckskin Mining Co.	Surface	Campbell, WY	25,532,409	18.5 (29.8)	NNE
Belle Ayr	Alpha Coal West Inc.	Surface	Campbell, WY	25,766,025	30.6 (49.2)	NNE
Black Thunder	Thunder Basin Coal Co. LLC	Surface	Campbell, WY	116,225,527	16.2 (26.1)	ENE
Caballo	Peabody Powder River Operations, LLC	Surface	Campbell, WY	23,500,122	34.3 (55.2)	NNE
Coal Creek	Thunder Basin Coal Co. LLC	Surface	Campbell, WY	11,414,277	24.9 (40.1)	NE
Cordero Rojo Complex	Cloud Peak Energy, LLC	Surface	Campbell, WY	38,499,809	28.4 (45.7)	NNE
Dave Johnston	Glenrock Coal Co.	Surface	Converse, WY	Reclaimed-no production since 2000	39.9 (64.2)	SSW
Dry Fork	Western Fuels of Wyoming, Inc.	Surface	Campbell, WY	5,448,073	48.2 (77.6)	NNE
Eagle Butte	Alpha Coal West Inc.	Surface	Campbell, WY	23,225,757	48.7 (78.4)	NNE
KFX plant/Fort Union	Evergreen Energy	Surface	Campbell, WY	0	47.8 (76.9)	NNE
North Antelope Rochelle	Peabody Powder River Operations, LLC	Surface	Campbell, WY	105,755,685	18.4 (29.6)	E
Rawhide	Peabody Powder River Operations, LLC	Surface	Campbell, WY	11,229,907	50.5 (81.3)	NNE
Wyodak	Wyodak Resources Develop. Corp.	Surface	Campbell, WY	5,930,614	44.4 (71.4)	NNE

Source: WMA 2011



Path: O:\WY_Projects\2010-100_AUC_Reno_Creek\Project_MXD\Submittal\Energy_Developments.mxd

TREC, Inc.
Engineering & Environmental Management
900 Werner Court
Suite 150
Casper, WY 82601
Phone (307) 265-0696
Fax (307) 265-2498
www.treccorp.com

PROPOSED RENO CREEK PROJECT
CAMPBELL COUNTY, WY
PREPARED FOR AUC LLC
LAKEWOOD, CO

Legend

- Proposed Reno Creek Project Boundary
- 50 Mile Review
- Cities and Towns
- Legacy Conventional Uranium Project

Uranium ISR Projects

- Licensed - Operating
- Licensed - Not Operating
- Proposed

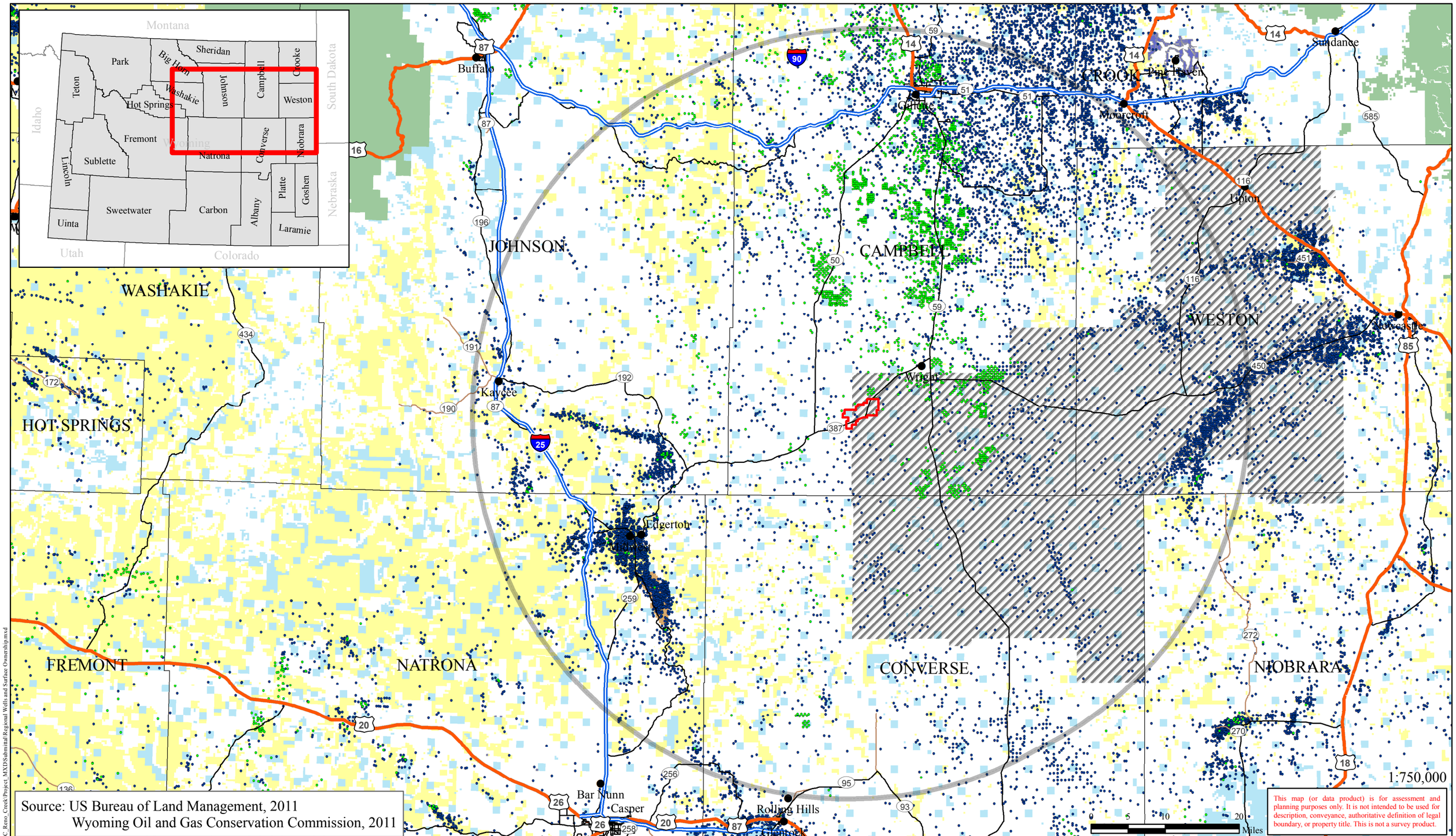
- Uranium Occurance - Highly Favorable
- Oil and Gas Fields - Highly Favorable
- Coal Fields - Highly Favorable

- Interstate
- Highway
- Major Road
- Local Road

DRAWN BY: RHK
CHECKED BY: RMD
APPROVED BY: JEY

Energy Developments

REV #	DESCRIPTION	BY	DATE	FIGURE
0	Draft for Review	RHK	12/20/11	5-1
1	Final	RHK	01/09/11	
2				



Source: US Bureau of Land Management, 2011
Wyoming Oil and Gas Conservation Commission, 2011

This map (or data product) is for assessment and planning purposes only. It is not intended to be used for description, conveyance, authoritative definition of legal boundary, or property title. This is not a survey product.

Path: O:\WY_Projects\2010-100_AUC_Reno_Creek\Project_MXD\Submittal\Regional Wells and Surface Ownership.mxd

TREC, Inc.
Engineering & Environmental Management
900 Werner Court
Suite 150
Casper, WY 82601
Phone (307) 265-0696
Fax (307) 265-2498
www.treccorp.com

PROPOSED RENO CREEK PROJECT
CAMPBELL COUNTY, WY

PREPARED FOR AUC LLC
LAKEWOOD, CO

Legend

- Proposed Reno Creek Project Boundary
- 50 Mile Review
- County Line
- Cities and Towns
- Gas Well
- Oil Well
- Thunder Basin National Grassland

Surface Ownership

- Bureau of Land Management
- Bureau of Reclamation
- Department of Defense
- Forest Service
- State
- Interstate
- Highway
- Major Road
- Local Road

N W E S

DRAWN BY: RHK
CHECKED BY: RMD
APPROVED BY: JEY

Regional Wells and Surface Ownership

REV #	DESCRIPTION	BY	DATE
0	Draft for Review	RHK	12/20/11
1	Final	RHK	12/21/11
2			

FIGURE 5-2

TABLE OF CONTENTS

6 MITIGATION MEASURES 6-1
6.1 Mitigation of Potential Land Use Impacts 6-1
6.1.1 Mitigation of Potential Construction Impacts 6-1
6.1.1.1 Changing and Disturbing Existing Land Uses 6-2
6.1.1.2 Access Restrictions and Establishment of Right-of-Way 6-2
6.1.1.3 Mineral Rights 6-3
6.1.1.4 Livestock Grazing and Agricultural Production 6-3
6.1.1.5 Restrictions on Recreational Activities 6-3
6.1.1.6 Altering Historic and Cultural Resources 6-3
6.1.2 Mitigation of Potential Operation and Groundwater Restoration Impacts 6-4
6.1.3 Mitigation of Potential Decommissioning Impacts 6-4
6.1.3.1 Access Road Reclamation 6-5
6.1.3.2 Wellfield Decommissioning 6-5
6.1.3.3 Process Buildings and Equipment Decommissioning 6-6
6.1.3.4 Final Contouring 6-7
6.1.3.5 Topsoil Replacement 6-8
6.1.3.6 Re-vegetation 6-8
6.2 Mitigation of Potential Transportation Impacts 6-9
6.2.1 Mitigation of Potential Access Road Construction Impacts 6-9
6.2.1.1 Land Use 6-9
6.2.1.2 Soils 6-10
6.2.1.3 Water Resources 6-10
6.2.1.4 Vegetation and Wildlife 6-11
6.2.1.5 Air Quality 6-11
6.2.1.6 Noise 6-11
6.2.1.7 Cultural Resources 6-12
6.2.1.8 Visual and Scenic Resources 6-12
6.2.2 Mitigation of Potential Traffic Impacts 6-12
6.2.3 Mitigation of Potential Accidents during Material Transport 6-13
6.3 Mitigation of Potential Geology and Soils Impacts 6-16
6.3.1 Mitigation of Potential Geologic Impacts 6-16
6.3.2 Mitigation of Potential Soil Impacts 6-16
6.3.2.1 Soil Loss Mitigation Measures 6-17
6.3.2.2 Soil Compaction Mitigation Measures 6-19
6.3.2.3 Soil Salinity Mitigation Measures 6-19
6.3.2.4 Loss of Soil Productivity Mitigation Measures 6-20
6.3.2.5 Soil Contamination Mitigation Measures 6-20
6.4 Mitigation of Potential Water Resources Impacts 6-21
6.4.1 Mitigation of Potential Surface Water Impacts 6-21

6.4.1.1 Erosion and Sedimentation 6-21
6.4.1.2 Flood Protection 6-22
6.4.1.3 Spills and Leaks 6-23
6.4.1.4 Surface Discharges 6-24
6.4.2 Mitigation of Potential Groundwater Impacts 6-25
6.4.2.1 Groundwater Quantity/Consumption 6-25
6.4.2.1.1 Abandoning Exploration and Delineation Boreholes 6-25
6.4.2.2 Groundwater Quality 6-26
6.4.2.2.1 Groundwater Transfer 6-28
6.4.2.2.2 Groundwater Sweep 6-28
6.4.2.2.3 RO Treatment with Permeate Injection and Reductant Addition 6-29
6.4.2.2.4 Stability Monitoring 6-29
6.4.2.2.5 Restoration Analogs 6-29
6.4.2.2.6 Excursions 6-30
6.4.2.2.7 Spills and Leaks 6-31
6.4.2.2.8 Deep Well Disposal 6-33
6.5 Mitigation Measures for Potential Ecological Resources Impacts 6-34
6.5.1 Vegetation 6-34
6.5.1.1 Wetland Encroachment 6-34
6.5.2 Wildlife and Fisheries 6-35
6.6 Mitigation of Potential Air Quality Impacts 6-37
6.7 Mitigation of Potential Noise Impacts 6-39
6.8 Mitigation of Potential Historic and Cultural Resources Impacts 6-40
6.9 Mitigation of Potenial Visual and Scenic Resources Impacts 6-41
6.10 Mitigation Measures for Potential Public and Occupational Health Impacts 6-42
6.10.1 Mitigation of Potential Construction Impacts 6-42
6.10.2 Mitigation of Potential Operation Impacts 6-42
6.10.3 Mitigation of Potential Groundwater Restoration Impacts 6-44
6.11 Mitigation of Potential Byproduct Management Impacts 6-45

List of Tables

Table 6-1: Seed Mixture 6-49

6 MITIGATION MEASURES

AUC is committed to implementing mitigation measures to ensure the Proposed Project proceeds in an environmentally sound manner. The ISR process has minimal potential impacts by design when compared to conventional mining practices, and these reduced impacts can further be negated using the latest available mitigation techniques. This section describes these effective mitigation measures proposed to minimize the potential impacts as described in Section 4 (Environmental Impacts). To the extent practicable, specific mitigation measures are detailed within this section as required by Section 5.5 of NUREG-1748. While several mitigation techniques are outlined in this application, appropriate ancillary permit applications will include the final selection of the appropriate mitigation measures. Ancillary permits with additional mitigation measures include sediment and erosion control BMPs addressed in SWPPPs as reviewed and approved by WDEQ/WQD, air quality 'Best Available Control Technology' (BACT) reviewed and approved by WDEQ/AQD, and jurisdictional wetland mitigation measures reviewed and approved by USACE.

6.1 Mitigation of Potential Land Use Impacts

Potential impacts to lands disturbed or affected by the Proposed Project's associated activities will be mitigated through the return of these lands consistent with their pre-existing uses as described in Section 3.1. of this ER. Mitigations will result in all lands being released for unrestricted use following decommissioning. The surface disturbances associated with the Proposed Project will total approximately 154 acres, or about 2.5 percent of the entire Proposed Project area. Further details summarizing AUC's proposed mitigation plans for potential land use impacts during construction, operation, groundwater restoration, and decommissioning can be found in the following subsections.

6.1.1 Mitigation of Potential Construction Impacts

Construction activities associated with the Proposed Project as described in Section 4.1 of this ER have the potential to impact land use in small portions (2.5 percent) the Proposed Project area. Construction activities are temporary in nature and may include:

- Changing and disturbing existing land uses;
- Restricting access or establishing right-of-way access;
- Affecting mineral rights;
- Restricting livestock grazing areas;
- Restricting recreational activities; and
- Altering historic and cultural resources.

The following subsections are comprehensive descriptions of the mitigation measures proposed to minimize potential construction impacts to land use.

6.1.1.1 Changing and Disturbing Existing Land Uses

AUC will minimize changing and disturbing existing land uses through the following mitigation measures:

- Restoration and re-seeding of disturbed areas as soon as practicable with an approved seed mix designed to stabilize soils and reduce the potential for exotic invasive plants;
- Construction efforts with the oil and gas production companies operating within the Proposed Project area (currently Williams Production RMT Co.; Yates Petroleum Corp; Lance Oil and Gas Co.; Bill Barrett Corp) will be coordinated to ensure that AUC causes no interruptions in their activities;
- Project engineering and design will use existing county roads and oil and gas access roads to the extent possible to limit new access road construction;
- Modern GIS topographical data assisting in design details will best utilize existing topography during access road construction to minimize cut and fill;
- Secondary and tertiary access road width will be as narrow as practicable; and
- Common corridors will be used while locating access roads, pipelines, and utilities.

6.1.1.2 Access Restrictions and Establishment of Right-of-Way

The following mitigation measures will be used by AUC to minimize potential access restrictions or impacts from establishment of right-of-ways within the Proposed Project area;

- Fenced areas will include the CPP area, Production Unit infrastructure, and DDWs. This represents about 481 acres, or about eight percent of the entire Proposed Project area (6,057 acres). Production Unit development will occur in a progressive manner, therefore the actual fenced area during construction activities is anticipated to concurrently encompass significantly less than the eight percent of the Proposed Project area; and
- AUC will actively facilitate coordination with oil and gas production companies within the Proposed Project area prior to and during construction to ensure no interruptions in oil production activities.

6.1.1.3 Mineral Rights

Other than the mineral rights proposed to be developed by AUC, the only known minerals within the project area are conventional oil and gas and CBM. AUC will mitigate potential impacts to mineral rights by developing a good working relationship with the oil and gas production companies operating within the Proposed Project area. Currently operating oil and gas companies within the Proposed Project area are Williams Production RMT Co., Yates Petroleum Corp, Lance Oil and Gas Co., and Bill Barrett Corp. Additionally, AUC will implement similar measures should other minerals be discovered and developed during the lifespan of the Proposed Project.

6.1.1.4 Livestock Grazing and Agricultural Production

Mitigation measures for potential impacts to livestock grazing and agricultural production include the following:

- Timely restoration and re-seeding of disturbed areas with an approved seed mix;
- As the Proposed Project will be operated on a phased schedule, AUC will fence less than 8 percent of the Proposed Project area at any one time. This includes the CPP area, Production Unit infrastructure, and DDWs; and
- AUC will establish surface use agreements with surface owners/lessees to provide mitigation or compensation for temporary loss of areas currently used for livestock grazing or crop production.

6.1.1.5 Restrictions on Recreational Activities

Although there are minimal recreational resources available within the Proposed Project permit area, AUC will mitigate potential impacts to the limited recreational activities through the following measures:

- AUC will fence less than 8 percent of the Proposed Project area at any one time, including the CPP area and production unit infrastructure, which will limit disruptions to big game populations and behaviors; and
- Timely restoration and re-seeding of disturbed areas.

6.1.1.6 Altering Historic and Cultural Resources

Thorough investigations into historic and cultural resources within the Proposed Project area have been completed (ER Section 3.8). AUC is aware of the findings of these

investigations and will mitigate potential impacts to historic and cultural resources through the following measures:

- Consultation with SHPO and potentially affected THPOs or other designated Tribal officials;
- Preparing and implementing an Unanticipated Discovery Plan (UDP) prior to ground disturbance activities. This plan is briefly outlined in ER Section 7.5;
- AUC will complete a pre-construction survey to identify any previously undiscovered cultural artifacts or cultural resource sites;
- Ceasing any work upon the unanticipated discovery of previously unknown cultural artifacts. Work will remain ceased until appropriate action is taken to preserve the site or recover the data;
- Determine and consult with a professional archaeologist or paleontologist to evaluate the significance of any fossilized material found at the site during construction within the Proposed Project area; and
- Active participation in the Section 106 process.

6.1.2 Mitigation of Potential Operation and Groundwater Restoration Impacts

Whenever practicable, mitigation measures specifically designed to address potential land use impacts during operation and groundwater restoration will be implemented, these may include:

- Cooperation with the oil and gas production companies operating within the Proposed Project area (currently Williams Production RMT Co.; Yates Petroleum Corp; Lance Oil and Gas Co.; Bill Barrett Corp) or other industries if further mineral development occurs;
- Re-vegetating disturbed areas to minimize wind and water erosion;
- Implementing cultural resource mitigation measures described above (UDP) for any surface disturbance which may occur during operation or groundwater restoration; and
- Well plugging in accordance with WDEQ and WSEO requirements.

6.1.3 Mitigation of Potential Decommissioning Impacts

Decommissioning and the associated restoration of all aspects of the Proposed Project are in and of themselves mitigation measures. However, AUC will take precautions to prevent adverse impacts during decommissioning. The following sections describe the mitigation measures that will be implemented during decommissioning to ensure there are no long-term impacts to land use within the Proposed Project area.

6.1.3.1 Access Road Reclamation

Access roads constructed for access to the facilities and Production Units (primary, secondary, and tertiary) will be removed and reclaimed unless exempted from reclamation by the request of respective landowners/lessees. In those cases the landowners/lessees will assume all responsibilities for the long-term maintenance and ultimate disposition of the roads.

Before the reclamation of roadways process begins, any potential contamination issues which resulted from ISR facility construction or operation will be addressed to satisfy relevant NRC standards. Any contaminated material that is not able to be decontaminated on site will be properly disposed at a licensed disposal facility. All 11e.(2) contaminated soil or gravel will be disposed at a licensed 11e.(2) byproduct material disposal facility. All Petroleum-contaminated soil potentially generated by the Proposed Project will be disposed at a WDEQ/SHWD licensed facility. Subject to NRC and WDEQ regulations and the desires of the surface land owners, the removal of roads will be accomplished by removing excess imported road surfacing material and ripping the road surface and shallow subsoil, loosening the subsoil. Culverts will be removed and drainages reestablished consistent with pre-construction conditions. Areas associated with road or culvert removal will be graded to a contour consistent with the surrounding landscape and pre-existing conditions, followed by replacement of the topsoil from topsoil stockpiles created during stripping and roadway construction. Finally, seeding with an approved seed mix for revegetation.

6.1.3.2 Wellfield Decommissioning

Production Unit wellfield decommissioning will be ongoing as wellfields receive regulatory approval for successful groundwater restoration. Wellfield decommissioning includes the plugging and abandonment of all wells in accordance with applicable standards, and the removal, decontamination, and disposal of wellfield piping and appurtenances.

Wells will be plugged and abandoned in accordance with the procedures described in TR Addendum 2.6-B as they become deemed no longer required for ISR operations or groundwater restoration. These procedures have been prepared to comply with Chapter 11, Section 8 of the WDEQ/LQD Non-Coal Rules and Regulations. The NRC has accepted complying with these regulations in the Uranerz Energy Corporation SEIS (URZ Nichols Ranch SEIS, January 2011), and UR Energy's SEIS (URE Lost Creek SEIS, June 2011). The plugging and abandonment procedures will include removing any piping, pumps, and equipment suspended in the well casing, filling the casing from the total depth to just below the ground surface with cement grout or bentonite, cutting off the surface casing below ground, and restoring and re-seeding the disturbed area.

Wellfield equipment will be removed, including injection and recovery wells, individual flow lines, buried electrical cable, and wellhead covers. Trunk lines, feeder lines, valve manholes, wellfield facilities, and deep disposal well pipelines also will be removed. AUC anticipates that all downhole pipe and electrical cable, individual well flow lines, feeder lines, trunk lines, and valves will be disposed as 11e.(2) byproduct material off-site to one of three licensed 11e.(2) disposal facilities:

- Pathfinder Mines Corporation, Shirley Basin Facility;
- Denison Mines Corporation, White Mesa Uranium Mill; or
- Energy Solutions LLC, Clive Disposal Site.

Mitigation measures for minimizing the quantity of 11e.(2) byproduct material during decommissioning are addressed in ER Section 4.13. Wherever possible, equipment and facilities will be decontaminated for release for unrestricted use, including disposal in a nearby municipal landfill or re-use in another facility. Additional information about the fate of wellfield equipment during decommissioning is presented in ER Section 4.2 (potential transportation impacts) and ER Section 4.13 (potential byproduct material management impacts).

Following wellfield equipment removal and disposal, the affected areas will be recontoured, topsoil will be replaced, and those areas will be re-vegetated.

6.1.3.3 Process Buildings and Equipment Decommissioning

AUC will decommission the CPP area and all remaining infrastructure, unless turned over to the landowner, once groundwater restoration is complete and approved. A radiological survey will be conducted on all process equipment and area soils during the decommissioning process. Based on those survey results, the equipment will be removed to a new location within the Proposed Project area for further use, placed in storage, removed to another licensed facility for use, released for permanent disposal, or decontaminated to meet unrestricted use criteria for release.

Salvageable building materials, equipment, pipe, and other materials to be released for unrestricted use will be decontaminated by completing a preliminary radiological survey to determine the precise location and complete extent of the contamination and to identify any potential hazards. Upon completion of the decontamination processes, final alpha and, where necessary, beta surveys will be conducted. The release limits for alpha and beta-gamma radiation from NRC Regulatory Guide 1.86 are as follows:

Alpha Radiation

- Removable alpha contamination of 1,000 dpm/100 cm^2;
- Average total alpha contamination of 5,000 dpm/100 cm^2 over an area no greater than 1 m^2;
- Maximum total alpha contamination of 15,000 dpm/100 cm^2 over an area no greater than 100 cm^2;

Beta-Gamma Radiation

- Removable beta-gamma contamination of 1,000 dpm/100 cm^2;
- Average total beta-gamma contamination of 5,000 dpm/100 cm^2 over an area no greater than 1 m^2; and
- Maximum total beta-gamma contamination of 15,000 dpm/100 cm^2 over an area no greater than 100 cm^2.

The ALARA principle, defined in Section 5.1.7 of the TR, will apply to the decontamination of surfaces to reduce surface contamination to levels as low as reasonably achievable. Equipment which cannot be decontaminated to these standards will be sent off-site to an licensed 11e.(2) facility for disposal.

All structures and contents will be dismantled, decontaminated, and either disposed of in accordance with applicable regulations or prepared for use at another facility. Structures will be decontaminated and either salvaged or disposed of at an appropriately permitted facility, including foundations and flooring as necessary.

Records of equipment decontamination, distribution, disposal, and related decommissioning activities will be maintained and any necessary decontamination activities will be conducted in accordance with the operating procedures for the project. ER Section 4.13 contains additional information about the anticipated quantities of solid 11e.(2) byproduct material and solid non-11e.(2) materials generated from various sources during facility decommissioning.

6.1.3.4 Final Contouring

Topography within the disturbed areas will be surveyed prior to construction activities to enable final re-contouring consistent with pre-construction conditions. The primary area of contouring will be in the proposed CPP location as the Production Units will not alter topography. Any access roads that are removed will also be contoured to be consistent with pre-construction conditions. Any affected drainage channels will also be restored to pre-construction conditions during decommissioning, although this is not anticipated to be necessary due to the CPP location.

6.1.3.5 Topsoil Replacement

Topsoil stripping depths will vary throughout the Proposed Project area but is expected to average 1.31 feet, as determined from baseline soil survey results described in ER Section 3.3. Topsoil stockpiles will be vegetated as soon as practicable using an approved seed mix to minimize wind and water erosion. Topsoil within the disturbed areas will be salvaged in accordance with WDEQ/LQD guidelines and conditions of the WDEQ/LQD Permit to Mine for the Proposed Project.

Topsoil will be redistributed across disturbed areas to a depth approximately equal to pre-construction conditions during the decommissioning and reclamation phase. As necessary, the subsoil will be ripped to alleviate compaction prior to revegetation.

6.1.3.6 Re-vegetation

Re-vegetation of disturbed areas will occur in accordance with the WDEQ/LQD Reclamation Plan and the Restoration Action Plan (RAP), shown in TR Addendum 6-A of the TR. After replacing topsoil, disturbed areas will be re-vegetated by seeding with a seed mix developed through discussions with WDEQ/LQD and area landowners. Seeding will be conducted by drill or broadcast methods depending upon the type of seed being planted. The WDEQ/LQD-approved RAP will address the types and quantities of mulch and seasonal re-vegetation restrictions.

In accordance with NUREG-1569 (Section 6.2.3), AUC commits to providing final (detailed) reclamation plans for land (soil) to the NRC for review and approval at least 12 months before the planned reclamation of the licensed area. Additionally, the extended reference area concept, as defined in WDEQ/LQD Guideline No. 2, will be used to evaluate the success of re-vegetation. The extended reference area means all of the undisturbed portions of a vegetation type which has experienced disturbance in any phase of the ISR process. At the conclusion of decommissioning, quantitative vegetation data for extended reference areas representing each disturbed vegetation type will be directly compared by statistical analysis to quantitative vegetative data from reclaimed vegetation types. WDEQ/LQD requires a confidence level of 80 percent with no mathematical adjustments for climatic change. Qualitative comparisons between extended reference areas and reclaimed areas also will be required for each disturbed vegetation type. WDEQ/LQD will be consulted when choosing the extended reference area and when selecting the standard procedures for qualitative comparisons. Prior to release of the WDEQ/LQD reclamation bond, AUC will demonstrate re-vegetation success through quantitative and qualitative comparisons between external reference areas and reclaimed areas for each disturbed vegetation type.

6.2 Mitigation of Potential Transportation Impacts

Transportation impacts associated with the Proposed Project are expected to be small; however, AUC will implement mitigation measures to minimize potential impacts that may occur. Potential transportation impacts are described in ER Section 4.2 and generally result from access road construction, increased traffic, and material transport. The following subsections describe the proposed mitigation measures.

6.2.1 Mitigation of Potential Access Road Construction Impacts

Construction of access roads may result in potential impacts as described in ER Section 4.2. Potential impacts from road construction could occur to land use, soils, water resources, vegetation, wildlife, air quality, noise, historic and cultural resources, and visual and scenic resources. Mitigation measures for potential impacts from road construction to each of these resource areas are described below.

6.2.1.1 Land Use

A variety of mitigation techniques have been explored as possible mitigation measures to minimize changing and disturbing land use. Measures proposed to reduce impacts from road construction include:

- Existing county roads and CBM access roads will be used wherever possible to minimize access road construction;
- Existing topography will be followed during access road construction to minimize cut and fill;
- Minimizing the width of secondary and temporary access road;
- Restoring and re-seeding disturbed areas promptly, typically within one construction season;
- Implementing a one-way in/one-way out driving approach, where sequentially developed Production Unit infrastructure will be accessed through previously developed routes. This measure avoids constructing new access roads from the CPP area to remote production areas;
- Coordinating construction efforts with the oil and gas production companies or future mineral developing industries operating within the Proposed Project area (currently Williams Production RMT Co.; Yates Petroleum Corp; Lance Oil and Gas Co.; Bill Barrett Corp) to ensure that AUC causes no interruptions in oil and gas production activities; and
- Locating access roads, pipelines, and utilities in common corridors.

6.2.1.2 Soils

Mitigation measures to potential soil impacts include:

- Existing county roads and CBM access roads will be used wherever possible to minimize access road construction;
- The width of secondary and temporary access roads will be minimized;
- Contouring all disturbed areas to blend with the surrounding natural terrain and consistent with pre-construction topography upon decommissioning;
- Timely restoration and re-seeding of disturbed areas.
- Implementing erosion control BMPs such as silt fence, sediment logs, or straw bale check dams;
- Compacted soil will be ripped during reclamation, as necessary, and continuing to refine soil reclamation techniques developed during pre-application baseline monitoring and exploratory drilling; and
- Removing soil contaminated by leaks or spills and transporting the contaminated soil off-site to a licensed 11e.(2) disposal facility.

6.2.1.3 Water Resources

Potential water resources impacts, especially surface waters, will be mitigated using the following practices:

Surface Water

- Minimizing surface water crossings when practicable and, where surface water crossings are necessary, minimize the disturbance by constructing the access road perpendicular to the direction of flow;
- Use culverts capable of passing the runoff resulting from the 10-year, 24-hour precipitation event in secondary access road ephemeral stream channel crossings;
- Implementing sediment control BMPs such as silt fence, sediment logs, and straw bale check dams; and
- Developing and implementing a spill response plan to contain any spill that occurs during access road construction and to clean up the affected soil or surface water.

Groundwater

- Developing and implementing a spill response plan to contain any spill that occurs during access road construction and to clean up the affected soil or surface water.

6.2.1.4 Vegetation and Wildlife

Mitigation measures to potential ecological resources impacts resulting from road construction include:

- Implementing speed limits on access roads within the Proposed Project area and enforcement of speed limits on county roads for AUC employees and contractors;
- Avoiding sensitive areas such as wetlands during access road construction;
- Minimize vegetation impacts by ensuring employees use only existing and proposed roads in the Proposed Project area; and
- Timely restoration and re-seeding of disturbed areas with an approved seed mix.

6.2.1.5 Air Quality

AUC will implement mitigation measures to reduce potential air quality impacts, including vehicle emissions and dust, these may include:

- Minimize disturbed area to the extent practicable;
- Limiting access road widths, utilizing existing county and oilfield roads where possible, and implementing a one-way in/one-way out policy;
- Implementing dust abatement BMPs such as wetting disturbed areas and gravel access roads; and
- Implementing speed limits on access roads within the Proposed Project area and enforcement of speed limits on county roads for AUC employees and contractors.

Further discussions regarding air quality impact mitigation follow in Section 6.6.

6.2.1.6 Noise

The Proposed Project location is very rural and while potential for impacts from noise are very minimal, AUC will use mitigation measures to reduce potential noise impacts These mitigation measures may include:

- Implementing speed limits on access roads within the Proposed Project area and enforcement of speed limits on county roads for AUC employees and contractors; and
- Restricting access road construction activities during night time hours.

6.2.1.7 Cultural Resources

Mitigation measures to reduce potential cultural resources impacts include:

- Discussion and consultation with SHPO and potentially affected THPOs as directed in NUREG-1910 (GEIS Section 4.3.8);
- Preparing and implementing an Unanticipated Discovery Plan prior to construction. This plan is briefly outlined in ER Section 7.5;
- Conduct pre-construction surveys to identify any previously undiscovered cultural artifacts or cultural resource sites;
- Consulting with a professional archaeologist or paleontologist to evaluate the significance of fossilized material found at the site prior to any construction within the Proposed Project area; and
- Ceasing any work resulting in the discovery of previously unknown cultural artifacts until appropriate action is taken to preserve the site or recover the data.

6.2.1.8 Visual and Scenic Resources

Mitigation measures to reduce potential visual and scenic resource impacts include:

- Constructing secondary and temporary access roads along existing topography to minimize cut/fill and reduce the visual contrast created by straight roads; and
- Minimizing disturbed areas by minimizing access road widths, utilizing existing county and CBM roads where possible, and implementation of a one-way in/one-way out policy.

6.2.2 Mitigation of Potential Traffic Impacts

Traffic projections presented in ER Section 4 suggest the added traffic resulting from the Proposed Action will have a small impact to traffic volumes on state roads. These same projections suggest a potentially moderate impact on traffic volumes on local county roads. These impacts are expected to be highest during construction, when the number of workers and shipments of materials and equipment will be highest. Potential mitigation measures for traffic impacts are discussed below and include working with the local Community, plus Campbell County, the WDOT, State Patrol and other agencies:

- Working with Campbell County and WYDOT to develop an emergency notification and response plan for the Proposed Project, including ongoing training activities.
- Improve signage on affected portions of Clarkelen/Turnercrest Road and Highway 387;

- Implementing a policy to enforce speed limits on county roads for AUC employees and contractors;
- Performing routine assessments of the road condition;
- Implementing dust control BMPs such as wetting affected portions of county roads, particularly near residences; and

While AUC cannot enforce speed limits for the general public, AUC can and will work with Campbell County and WYDOT to provide more information about existing speed limits. All sign placement and usage will be coordinated with Campbell County and WYDOT and will meet federal standards as set forth in the 2009 Manual of Uniform Traffic Control Devices and the 2006 AASHTO Roadside Design Guide, 3rd Edition with updated Chapter 6.

Supplemental gravel surfacing may be required along the primary access route. Once again, AUC will work with Campbell County to provide its share of necessary upgrades to the affected portions of the county road system. AUC will also assist Campbell County with dust control on affected county roads. Dust control will aid in providing a safer roadway and less dust-related potential impacts to adjacent properties. Coordinating efforts with Campbell County will be defined in a County Development Plan that will be required for construction of the Proposed Project.

6.2.3 Mitigation of Potential Accidents during Material Transport

Potential transportation impacts from accidents may result from the following categories of material transport:

- Shipment of process chemicals and fuel from suppliers to the site;
- Shipment of yellowcake from the Proposed Project CPP to a uranium conversion facility;
- Shipment of uranium loaded resin from future AUC satellites or non-AUC facilities;
- Shipments of 11e.(2) byproduct material from the site to a licensed disposal facility; and
- Shipments of hazardous material from the site to a WDEQ/SHWD disposal facility.

AUC will develop at least two mitigation measures that will be applicable to all material shipments, including:

1) Coordination with local emergency response personnel and appropriately licensed transporters. AUC will develop an SOP (post-license issuance), and make it available for NRC inspection, to provide ongoing training to local emergency response personnel including EMTs, firefighters, and municipal and county law enforcement personnel. Specific information will be provided about the physical and chemical characteristics, hazards, potential exposure pathways, and spill response, containment, and cleanup procedures for each type of material. The training will be ongoing and will include updates on a routine schedule or as new materials are transported to or from the site.
2) All material shipments will be made by appropriately licensed transporters in accordance with DOT hazardous material regulations and requirements including 10 CFR Paragraph 71.5 (Transportation of Licensed Materials). The Federal Hazardous Materials Transportation Law (Federal Hazmat Law), 49 U.S.C. § 5101 et seq., is the basic statute regulating hazardous materials transportation in the United States. Section 5101 states the purpose of the Federal hazmat law is to "protect against the risks to life, property, and the environment that are inherent in the transportation of hazardous material in intrastate, interstate, and foreign commerce." Section 5103 provides that the Secretary of Transportation shall:
    - Designate material (including an explosive, radioactive material, infectious substance, flammable or combustible liquid, solid or gas, toxic, oxidizing, or corrosive material, and compressed gas) or a group or class of material as hazardous when the Secretary determines that transporting the material in commerce in a particular amount and form may pose an unreasonable risk to health and safety or property; and
    - Issue regulations for the safe transportation, including security, of hazardous material in intrastate, interstate, and foreign commerce.

Federal regulations applying to safe transportation of materials classed as hazardous are found at 49 CFR Parts 171-180. These hazardous materials regulations (HMR) cover the following areas:

- Hazardous materials classification (Parts 171 and 173);
- Hazard communication (Part 172, Subparts A-G);
- Packaging requirements (Parts 173, 178, 179, and 180);
- Operational rules (Parts 171, 173, 174, 175, 176 and 177);
- Training and Security (Part 172, Subparts H and I); and
- Registration (Part 171; see also Part 107, Subpart G).

AUC will implement a specific mitigation measure for shipments of yellowcake and shipments of 11e.(2) byproduct material. A spill of a radioactive material as a result of a transportation-related incident will invoke activities found in the HMR regulations found at 49 CFR Part 171, Subpart B – Incident Reporting, Bureau of Explosives (BOE) Approvals and Authorization. Among other conditions, these regulations require immediate notice of certain incidents, detailed incident reports, submission of examination reports, and assistance with investigations and special studies. Should an accident occur resulting in the release of any of these materials to the environment, AUC will commit to providing a post clean-up radiological survey to NRC of the affected area to verify that there are no long term hazards associated with the spilled material in accordance with 10 CFR Part 20.2202 and Part 20.2203.

6.3 Mitigation of Potential Geology and Soils Impacts

6.3.1 Mitigation of Potential Geologic Impacts

Potential impacts to geology and soils may occur during all phases of the Proposed Action; however, the potential impacts would largely be concentrated during the construction phase of the Proposed Project including construction of the CPP and associated facilities, Production Units, access roads, deep disposal wells, pipelines, and utilities. Activities potentially resulting in soil impacts include clearing vegetation, topsoil stripping, excavation, backfill, compaction, grading, and utility and pipeline trenching.

Potential geologic impacts of the Proposed Project include minor disturbance of the surficial aquifer during construction of the lined backup storage pond and a very low risk of hydraulic fracturing during operation of injection wells. This includes the Class III injection wells in the production zone and Class I deep disposal wells. Mitigation measures to minimize impacts to shallow geologic features involve re-contouring and restoring disturbed areas to pre-construction topography and conditions if need be. These include restoring pre-construction flow patterns in the surficial aquifer during decommissioning. For Class III and Class I UIC wells, the injection pressure will be monitored and maintained at a level that does not exceed the fracture pressures specified in the UIC permit.

An earthquake poses the highest potential for the most credible geologic hazard. Such an impact to the project will be minimized by designing buildings and structures to the 2,500-year seismic probability standards in the International Building Code (IBC). Five earthquakes with a magnitude greater than 2.5 (Richter Scale) have been recorded in Campbell County. Due to such a limited historic record, it is nearly impossible to determine when a 2,500-year event last occurred in Campbell County. Because of the uncertainty involved, and based on the fact that the new IBC uses 2,500-year events for building design, the WSGS suggests that the 2,500-year probabilistic map be used for seismic analysis in the design of critical facilities in this part of Wyoming (Case, Toner and Kirkwood 2002). Such a conservative approach is in the interest of public safety and will be implemented by AUC for buildings and structures at the Proposed Project.

6.3.2 Mitigation of Potential Soil Impacts

Proposed mitigation measures for potential soil impacts are described in terms of the five potential impact categories presented in ER Section 4.3: soil loss, soil compaction, salinity, loss of soil productivity, and soil contamination.

6.3.2.1 Soil Loss Mitigation Measures

Soil loss typically occurs through either wind or water erosion and can be adversely impacted by increased erosion rates from disturbances. Potential soil loss impacts will be minimized by implementing BMPs related to topsoil handling, storm water control, sediment control, and wind erosion protection in accordance with WDEQ/LQD guidelines and conditions of the WDEQ/LQD Permit to Mine for this Proposed Project. A more detailed discussion of BMPs can be found in Section 3.3 of this ER.

Topsoil and Subsoil Handling

Prior to surface disturbance activities from construction of building sites, storage areas, backup storage pond site, and access roads, topsoil will be salvaged in accordance with WDEQ/LQD guidelines and conditions of the WDEQ/LQD Permit to Mine for this Proposed Project. Areas to be stripped will be staked and typical earth moving equipment, such as rubber tire scrapers, bulldozers, or front end loaders will be used for stripping and stockpiling. The topsoil stripping depth will vary but is expected to average about 1.31 feet, as described in ER Section 3.3.

Stockpiles will be used for the temporary storage of topsoil material. These stockpiles will be placed on the leeward hill sides when practicable and out of drainage channels to avoid excessive wind and water erosion. All stockpiles will be built with slopes of 3:1 grade or flatter. These stockpiles will be clearly marked with a “topsoil” label and unique ID. Traffic flow during stockpiling and re-spreading will be minimized to reduce compaction. Each topsoil stockpile will be seeded as soon as practicable with an appropriate seed mix to help prevent erosion.

During excavation of mud pits associated with well construction, exploration drilling, and delineation drilling activities, topsoil will be separated from the subsoil with a backhoe. The topsoil will be removed and placed in a separate temporary stockpile, while the subsoil is removed and deposited next to the mud pit. When the use of the mud pit is complete, usually within 30 days, the subsoil will be re-deposited in the mud pit followed by replacement of topsoil.

Similar procedures will be utilized during pipeline and utility trench construction. Here the topsoil and subsoil will be stored separately, typically on opposite sides of the trench, with the topsoil being placed on top of the subsoil after the trench has been backfilled. Alternately, the topsoil may also be bladed to the side to allow for pipeline or utility installation and then bladed back after construction is complete.

Where subsoil removal will occur, such as the CPP area, subsoil will generally not be stockpiled. Instead it will be transported to fill areas such as backup storage pond

embankments and will be used as fill to construct the primary access road. During the decommissioning phase, the subsoil will be replaced and the CPP area will be contoured to match pre-construction topography if need be.

Re-vegetation

Following topsoil replacement, disturbed areas will be re-vegetated via seeding with a preselected and approved seed mix. Seeding will be conducted by drill or broadcast methods depending upon the type of seed being planted. The WDEQ/LQD approved Reclamation Plan will address the types and quantities of mulch and seasonal re-vegetation restrictions.

WDEQ/LQD (Guideline No. 2, 2004) defines the extended reference area concept which will be used to evaluate the success of final re-vegetation and productivity. The extended reference area refers to all of the undisturbed portions of a vegetation type which have experienced disturbance in any phase of the ISR process. At the conclusion of decommissioning, quantitative vegetation data for extended reference areas representing each disturbed vegetation type will be directly compared by statistical analysis to quantitative vegetative data from reclaimed vegetation types. WDEQ/LQD requires a confidence level of 80 percent with no mathematical adjustments for climatic change. Qualitative comparisons between extended reference areas and reclaimed areas will also be required for each disturbed vegetation type. AUC will consult WDEQ/LQD when choosing the extended reference area and when selecting the standard procedures for qualitative comparisons.

AUC will demonstrate re-vegetation success through quantitative and qualitative comparisons between external reference areas and reclaimed areas for each disturbed vegetation type prior to release of the WDEQ/LQD reclamation bond.

Storm Water Control

Engineering controls will be implemented to minimize potential soil loss by routing storm water away from disturbed areas. These may include the following:

- Constructing a storm water control system within the CPP area consisting of :
  - Sloped pavement with slot drains in areas adjacent to the CPP;
  - Storm water conveyance pipes connecting the slot drains to discharge storm water away from facilities; and
  - Grading the CPP area to drain down gradient.
- Constructing culverts designed to pass runoff resulting from the 10-year, 24-hour precipitation event where secondary access roads cross ephemeral stream channels.

Sediment Control

AUC will implement sediment control mitigation measures in all disturbed areas to minimize soil loss and water quality impacts from sediment transport. Sediment control mitigation measures utilized at the Proposed Project may include:

- Avoiding construction or minimizing disturbances in sensitive areas, such as those adjacent to ephemeral stream channels;
- Utilizing temporary sediment control BMPs such as silt fence, sediment logs, or straw bale check dams. Silt fence will typically be used at the toes of disturbed slopes to trap sediment. Sediment logs and straw bale check dams will typically be used in disturbed drainages to capture sediment;
- Incorporating wing ditches into topsoil stockpiles; and
- Promptly restoring and seeding disturbed areas, typically within one construction season.

Wind Erosion Protection

Mitigation measures designed to minimize soil loss from wind erosion include:

- Minimize disturbed area to the extent practicable;
- Placing topsoil stockpiles on leeward sides of hills'
- Wetting exposed soil during construction; and
- Restoring and re-seeding disturbed areas promptly, typically within one construction season.

6.3.2.2 Soil Compaction Mitigation Measures

AUC will mitigate potential soil compaction impacts by using existing roads where practicable. Two county roads traverse the Proposed Project area, and numerous private CBM access roads are found throughout the Proposed Project area (Figure 1-2). These will be used by AUC employees and contractors during all project phases to prevent unnecessary new road development. In addition, AUC will minimize secondary access road widths and implement a single direction of travel policy to access wellfield facilities. During decommissioning, soils which have undergone compaction, such as access roads, will be ripped as needed to loosen soils.

6.3.2.3 Soil Salinity Mitigation Measures

If magnesium chloride is used for access road dust control or a salt/sand mixture is used for traction on the primary access road, AUC will sample soil salinity beneath and

adjacent to access roads during decommissioning. Any salt-affected soil will be removed and properly remediated.

6.3.2.4 Loss of Soil Productivity Mitigation Measures

The following mitigation measures will be implemented by AUC to minimize potential loss of soil productivity:

- Segregating topsoil from subsoil during construction;
- Protecting topsoil stockpiles from wind and water erosion (see ER Section 6.3.2.1);
- Seeding topsoil stockpiles during inactive periods with an appropriate perennial seed mix;
- Redistributing topsoil and applying a permanent seed mix approved by WDEQ/LQD during decommissioning; and
- Comparing re-vegetated areas with extended reference areas using a statistical, quantitative comparison and a qualitative comparison as approved by WDEQ/LQD.

6.3.2.5 Soil Contamination Mitigation Measures

It is possible that soils could be contaminated by spills or leaks during the various project phases. During wellfield construction, potential soil contamination impacts from drilling fluid and drilling mud will be minimized by directing drilling fluids and muds into mud pits to control the spread of fluids. During work-over operations, contaminated liquids from injection and recovery wells will be contained in the backup storage pond for disposal through deep injection well. Minor fuel and oil leaks will be promptly cleaned up and contaminated soil removed and disposed off-site in approved facility. Soils contaminated with process fluids resulting from spills or leaks will be sampled, removed, and transported as necessary to a licensed 11e.(2) byproduct material disposal facility.

Soil survey and cleanup methods are presented in TR Section 6.4. These include assessing the background uranium and ^{226}Ra concentrations of the soil during pre-operational monitoring, using hand-held radiological survey instrumentation and GPS-based gamma surveys to guide soil remediation efforts, removing contaminated soil and transporting it to a licensed disposal facility, performing post-cleanup analysis of uranium and ^{226}Ra concentrations in the soil, and comparing the concentrations to 10 CFR Part 40, Appendix A, Criterion 6(6) cleanup standards.

6.4 Mitigation of Potential Water Resources Impacts

There are limited, primarily ephemeral surface water resources present within the Proposed Project area, as well as groundwater resources. The following sections summarize AUC's mitigation measures for potential impacts to these resources as further described in ER Section 4.4. Monitoring activities associated with the mitigation measures are discussed in ER Section 7.2.

6.4.1 Mitigation of Potential Surface Water Impacts

The mitigation measures for surface water impacts are similar to those presented in Section 6.1, Mitigation of Potential Land Use Impacts, and Section 6.3, Mitigation of Potential Geology and Soils Impacts. In general, AUC will minimize surface water impacts by limiting soil disturbance and compaction, diverting and controlling runoff, avoiding or promptly detecting and correcting accidental spills and leaks, and completing reclamation in a complete and timely manner.

6.4.1.1 Erosion and Sedimentation

To mitigate soil loss, AUC will limit the surface disturbance to soil and vegetation by using existing roads where possible, limiting secondary and tertiary road widths, and locating access roads adjacent to common utility corridors. Topsoil handling and replacement, final contouring, vegetation reclamation, and road removal and reclamation are discussed in detail in ER Section 6.1.

Erosion and sedimentation mitigation measures will be addressed in a SWPPP prepared by AUC and reviewed by WDEQ/WQD. AUC will prepare and submit to WDEQ/WQD a SWPPP along with a notice of intent for coverage under the Large Construction General WYPDES Storm Water Permit. The SWPPP will describe the nature and sequence of construction activities, identify potential sources of pollution, and describe BMPs to be used, including erosion and sediment controls (e.g., silt fence, sediment logs, straw bale check dams, etc.) and operational controls (e.g., housekeeping, signage, hydrocarbon storage, etc.). The SWPPP will be reviewed by WDEQ/WQD prior to issuing coverage under the general WYPDES permit.

Final selection of erosion and sedimentation BMPs will be performed during preparation of the SWPPP. These may include silt fence, sediment logs, or straw bale check dams among others. Silt fence will typically be used at the toes of disturbed slopes to trap sediment. Sediment logs and straw bale check dams typically will be used in disturbed drainages to capture sediment.

Prior to ISR operations, AUC will apply to WDEQ/WQD for coverage under either the Industrial General WYPDES Storm Water Permit or an individual storm water permit. As part of the application, AUC will either update the existing SWPPP or prepare a new SWPPP that describes erosion and sediment controls as well as operational controls that will be used during operation to ensure that storm water discharges from the facility do not cause a violation of surface water quality standards (i.e., Chapter 1 of the Wyoming Water Quality Rules and Regulations). Qualified AUC personnel will inspect storm water BMPs semiannually or as required by the WYPDES storm water permit and maintain inspection reports on file. The SWPPP will be updated as needed, such as in response to potential problems identified during inspections or changes in operation (e.g., transition from operation to groundwater restoration). The WYPDES storm water permit also will require storm water discharge sampling and compliance with numeric effluent limits.

6.4.1.2 Flood Protection

All significant structures and operations will be located outside of floodplains. In particular, the CPP, and its ancillary facilities, chemical storage, backup storage pond, etc., will all be located above the 100 year floodplain. Drainage structures will be designed to route storm water runoff away from structures, roads, and the backup storage pond. Details of the storm water management will be addressed in SWPPP(s) prepared in support of the construction and industrial WYPDES permits required by WDEQ/WQD for this project. One of the key features of the SWPPP(s) will be demonstrating how BMPs are designed to minimize exposure to pollutants. This will be accomplished in part through flood protection. It will also involve erosion and sediment control measures described previously.

Protection of equipment and facilities from large runoff events typically will be accomplished by placement on high ground out of the flood plain. The injection, recovery and monitor wells will be protected from flooding by installation of cement seals around the well casings and use of watertight well caps.

The CPP at the Proposed Project will not be located in the channel of any ephemeral stream. The proposed CPP site is on a hill. This can be seen on the USGS quadrangle.

To minimize surface water impacts, runoff will be routed around the CPP through a facilities flood control diversion channel designed to pass runoff resulting from the 100-yr, 24-hr precipitation event. Refer to TR Section 3 for design details of the diversion channel.

6.4.1.3 Spills and Leaks

This section discusses the potential for leak or spill pollution events and describes AUC's plans to recognize, control, and safely clean up any leaks or spills. In general, the potential for liquid byproduct release will be minimized by adhering to NRC and WDEQ design criteria for ISR facilities including:

- Designing adequate spill containment and leak detection systems;
- Training employees on how to monitor process parameters and recognize potential upset conditions before leaks or spills occur;
- Training employees on inspection procedures for spill control BMPs in the SWPPP;
- Frequently inspecting byproduct management systems and effluent control systems; and
- Training employees in spill detection, containment and clean up procedures.

Hazardous and non-hazardous chemicals will be used throughout the life of the project. Hazardous chemicals which have the potential to affect radiological safety will be stored out of the CPP, typically in the adjacent chemical storage area, and away from areas where licensed material is stored. Hazardous chemicals also will be stored away from incompatible chemicals and away from areas populated by workers to reduce the risk of injury during an accidental release. All hazardous chemicals at the Proposed Project area will be handled and stored in accordance with the acceptance criteria outlined in NUREG-1569 (Section 3.2.3). Additionally, AUC will adhere to all state and local regulations including the WDEQ, OSHA, and EPA. All storage tanks will be vented to atmosphere, per Federal and State regulations. Secondary containment equal to 110 percent of the largest tank volume will be provided in all chemical storage areas. Within the chemical storage area, chemicals will either be stored in a covered area or additional secondary containment capacity will be provided to contain rainfall/runoff resulting from a 25-year, 24-hour precipitation event.

Secondary containment materials will be compatible with the chemicals stored and will be provided for all areas of the plant where chemicals and licensed materials are handled. Most of the secondary containment will be provided by curbing as part of the floor of each area. Curbs will divide areas to ensure that there is no mixing of incompatible fluids. The depth of the containment curbing will be designed to contain 110 percent of the volume of the largest vessel in the contained area. Each containment area inside the plant will be provided with a collection sump on a sloping floor to drain to the sump. Each sump will have a pump constructed of materials appropriate for the material it is designed to pump, and pumps will be of a type proper to pump the spills to the double-lined backup storage pond.

Process fluids will be contained in process vessels and pipes during operation. Included will be instrumentation, controls, and alarms to monitor the flows, pressures and tank levels to maintain parameters within prescribed limits. If a tank or process vessel were to have a failure, such as a rupture, in the process building, all fluid will be contained in the process building. The fluid will be collected in the plant sumps and then pumped to other process vessels or the double-lined backup storage pond. After removal the fluids in the area will be washed down with plant water. The water will be collected in the plant sump system and pumped to the double-lined backup storage pond, thereby mitigating a potential environmental impact from the potential tank failure.

Spills or leaks could also occur from piping or equipment outside the CPP and chemical storage areas. In such an event, operational controls will signal an alarm (e.g., low pipeline pressure or water in a sump), the leak or spill will be contained, and fluids will be captured and transported to the double-lined backup storage pond for disposal along with brine and process byproduct water. The environmental impact of such an incident could result in some soils being contaminated, requiring controlled disposal. All areas affected by such a failure or leak will be surveyed and any contaminated soils or material will be removed and disposed in accordance with NRC and State requirements. The environmental impact of such an incident will be small with no long-term potential effect.

In the event of a piping failure within the CPP, low pressure sensors will trigger alarms in manned control areas, and the pump system will shut down, preventing any further release. Any liquid byproducts released in the CPP or chemical storage area will be transported to the double-lined backup storage pond for disposal.

Wellfield facilities will be equipped with leak detection equipment which will signal alarms at the CPP. In addition, routine periodic inspections of wellfield facilities and well heads will be conducted by AUC personnel. As described in TR Section 5.3, wellfield operators will visually inspect all piping and equipment within facilities, wellheads, and valve vaults at least weekly. In the event of an environmentally significant leak, the affected soil will be surveyed for contamination and the area of the spill will be documented. If contamination is detected, the soil will be sampled and analyzed for the appropriate radionuclides. Contaminated soil will be removed and disposed in accordance with NRC and State requirements.

6.4.1.4 Surface Discharges

AUC will mitigate potential erosion and water quality degradation impacts resulting from controlled discharge to the surface (e.g. aquifer test discharge or pipeline hydrostatic testing discharge). Prior to discharging to the surface, AUC will submit an application to the WDEQ/WQD. The permit will limit flow rates and effluent concentrations based on the classification of the receiving stream. To minimize erosional impacts AUC will

utilize energy dissipation devices to convey the discharge water into the receiving channel at a non-erosive velocity.

6.4.2 Mitigation of Potential Groundwater Impacts

6.4.2.1 Groundwater Quantity/Consumption

AUC will mitigate to the extent practicable impacts to groundwater resources. The following sections describe mitigation measures designed to prevent or limit impacts to water quantity in the groundwater aquifers.

6.4.2.1.1 Abandoning Exploration and Delineation Boreholes

AUC will plug old drill holes in proximity to well fields if pump testing and hydrologic results indicate that leakage through old drill holes is a potential problem prior to the initiation of ISR operations. Holes will be plugged and abandoned as described in TR Addendum 2.6-B. Each hole will be re-entered with a drill rig, to total depth. The hole will be logged, and then it will be plugged using a plug gel or other method as required by the WDEQ.

Limiting Over-Penetration into Underlying Aquifers

One of the main functions of the hydrologic isolation program is limiting over-penetration during drilling programs. AUC will use geologic data (currently existing of information from more than 1,000 exploration and delineation holes) to minimize over-penetration into underlying units.

Well Construction Techniques

Appropriate geological supervision will be onsite during any drilling projects. Injection, recovery, and monitor wells, will be constructed by AUC that use methods approved by WDEQ/LQD and in compliance with WDEQ/LQD Chapter 11, Section 6 construction requirements for well locations, casing types and, most importantly, annular sealing techniques. Proper annular sealing methods ensure that vertical migration pathways are not created outside either the casing or inside the borehole walls. Key characteristics of the well installation programs will include a sufficiently sized borehole diameter to provide adequate annular space for sealing materials, selection of appropriate annular seal materials approved by the LQD Administrator, displacement of the cement slurry sufficient to fill the entire annular volume from the bottom of the casing to ground surface, allowing sufficient curing time so additional well construction work does not

jeopardize the annular integrity, and selection of casing type with sufficient strength and diameter to prevent collapse and to accommodate the necessary injection pressures.

Mechanical Integrity Testing (MIT) Program

AUC will implement an approved MIT program for all Class III wells to ensure casing integrity. A primary function of the proposed MIT program include using a pressure-based testing method, a proactive testing program that targets wells displaying anomalous pressures or characteristics, retesting every five years and any time a well is re-entered by a drill bit or under-reaming tool, maintenance of records and quarterly reporting of all wells tested along with any subsequent actions (repair or abandonment). In the unlikely event that a well fails the MIT, it will either be repaired or abandoned using permit approved procedures.

Minimizing Consumptive Use

Mitigation measures for minimizing consumptive use have been engineered into the design of modern ISR facilities. Mitigation measures will help ensure that consumptive use of groundwater is minimized during operation and groundwater restoration. These mitigations may include:

- Designing Production Units to enable adequate balancing;
- Minimizing the production bleed through continuous adjustments to injection and recovery rates in order to keep the Production Unit balanced while simultaneously limiting the amount of production bleed necessary to maintain an inward hydraulic gradient. This will also limit potential excursions, which will result in consumptive use during over-production to recover fluids outside of the production zone;
- Employing two stages of RO to treat the production stream and restoration fluids;
- Treating water recovered during groundwater sweep (see discussion below);
- Employing limited groundwater sweep (see discussion below); and
- Groundwater sweep may be used selectively (e.g., around the perimeter of the wellfield) rather than throughout the entire wellfield to maximize benefits while minimizing consumptive use of groundwater.

6.4.2.2 Groundwater Quality

Groundwater restoration is a major component of the restoration and decommissioning process. Impacts to groundwater quality in the PZA will be mitigated by these groundwater restoration activities. A detailed discussion of the proposed groundwater

restoration program is provided in TR Section 6.1 and in the RAP included as TR Addendum 6-A. This section summarizes that information.

Groundwater will be restored consistent with the groundwater protection standards presented in 10 CFR 40, Appendix A, Criterion 5(B)(5) on a parameter-by-parameter basis using BPT. If the restoration activities are unable to achieve the background or maximum contaminant levels (whichever is greater) in Criterion 5(B)(5), AUC will submit a license amendment application request for NRC approval of ACLs. AUC will utilize EPA's ProUCL software to statistically calculate baseline/background data for appropriate ACLs from the site specific baseline data.

Restoration Target Values (RTVs) representative of baseline water quality will be established for the first production unit after sampling representative production zone monitor wells. AUC proposes to adapt the statistical principles described in the Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities: Unified Guidance (EPA 2009). The principles in the Unified Guidance are embodied in the EPA sourced ProUCL software, plus as required, WDEQ regulations and guidance that is consistent with ProUCL. AUC will use the Unified Guidance to evaluate baseline groundwater geochemical data for all identified constituents, establishing RTVs for each production unit. The data will describe in detail the data distributions and spatial and temporal dependencies for each constituent. Where appropriate, groups of wells may be subdivided to assure representativeness of populations. These statistical data will then be used to calculate appropriate RTVs for each production unit or portion thereof.

The first step in the application of the Unified Guidance is to validate the analytical data, using a series of Standard Operating Procedures (SOPs) for both sampling and laboratory analytical procedures. These SOPs will be developed and implemented prior to commencement of operations. Groundwater quality data that passes the data validation will be incorporated into AUC's monitoring database.

The process will include a statistically sound treatment of Outliers and Non-Detects. Outliers, which are anomalously high or low values relative to the other values, will be determined using ProUCL and procedures described in WDEQ/LQD (Guideline 4, Attachment 1, 2000), which has been determined to be consistent with the principles included in ProUCL and the Unified Guidance. Sample results that are determined to be true Outliers will be removed from the statistical analysis that is used to calculate RTVs.

The treatment of Non-Detects will also be accomplished using the principles outlined in the Unified Guidance, and will be used to populate the RTV listing.

AUC's proposed groundwater restoration program will be conducted in two phases:

1) Active groundwater restoration; and
2) Stability monitoring.

The active groundwater restoration phase will include the following methods:

- Groundwater Transfer; and
- Groundwater Sweep (targeted or selective);
- RO Treatment with Permeate Injection and Reductant Addition.

6.4.2.2.1 Groundwater Transfer

As noted in NUREG-1910 (GEIS Section 2.5.1), groundwater transfer involves moving groundwater between one wellfield entering restoration and another wellfield entering production, or moving water between two areas within a single wellfield that are in different stages of restoration.

6.4.2.2.2 Groundwater Sweep

During groundwater sweep, water will be pumped from the recovery and injection wells to the CPP without reinjection into the wellfields undergoing groundwater sweep.

A drawback of groundwater sweep is significant consumptive use of groundwater. WDEQ/LQD has determined that groundwater sweep with direct disposal of produced water is not considered BPT due to excessive consumption of groundwater and resultant impacts to groundwater resources (LCI 2009). AUC will use the following strategy to minimize consumptive use of groundwater during groundwater sweep:

- Water produced during groundwater sweep will be treated by RO, avoiding any occurrence of groundwater sweep with direct disposal of produced water;
- Whenever possible, permeate generated from one wellfield undergoing groundwater sweep will be re-injected into another wellfield undergoing RO treatment with permeate reinjection; and
- Groundwater sweep will be used selectively, as necessary, rather than throughout an entire wellfield to maximize benefits while minimizing consumptive use of groundwater.

6.4.2.2.3 RO Treatment with Permeate Injection and Reductant Addition

Water will be pumped from one or more Production Units to the CPP for treatment during this phase of groundwater restoration. Treatment will include uranium removal in ion exchange columns and RO treatment to reduce dissolved constituents. Two stages of RO treatment will be used to maximize permeate production and minimize brine production. Permeate will be re-injected into the production zone, while brine will be disposed of in the deep disposal wells. As stated in NUREG-1910 (Section 2.5.3), this phase of groundwater restoration will occur immediately following or in conjunction with any selective groundwater sweep.

The influx of natural groundwater will be kept to a minimum by maximizing the quantity of permeate re-injected into wellfields undergoing RO treatment with permeate injection. This will be accomplished through two separate phases of RO treatment, which will significantly reduce the amount of brine as compared to single-pass treatment.

6.4.2.2.4 Stability Monitoring

When AUC has received written approval from WDEQ/LQD and NRC that the groundwater restoration goal has been achieved using BPT as determined by the LQD Administrator and NRC, active groundwater restoration will cease and stability monitoring will commence.

AUC will initiate the stability monitoring phase to monitor constituents for statistically significant trends in concentration subsequent to restoration, in accordance with the principles laid out in the Unified Guidance, and in comparison to the RTVs previously established. The Stability monitoring phase of groundwater restoration is described in detail in Section 6.1 of the TR.

6.4.2.2.5 Restoration Analogs

Restoration activities at other Wyoming ISRs, including the RME R&D site, have proven that groundwater can be restored to baseline water quality or ACLs approved by NRC and WDEQ/LQD following commercial ISR uranium recovery operations. Similarities between the production zone hydrogeologic and chemical conditions at the Proposed Project and the Irigaray Uranium Recovery Facility, and the Smith Ranch/Highland Uranium Project indicate that groundwater restoration in the Proposed Project area is achievable using the methods and volumes proposed in this application. Detailed restoration analogs are provided in TR Section 6.1.7.

6.4.2.2.6 Excursions

During any operation where injection fluids are utilized, excursions can be a potential concern. As stated in NUREG-1910 (GEIS Section 2.4.1.3), the unintended movement of the injected lixiviant out of the wellfield to a monitor well is considered an excursion A horizontal excursion is a lateral movement of production solution to a monitor well outside the well field. As noted in NUREG/CR-6733, significant risk from a horizontal excursion will occur only if it persisted for a long period without being detected. A vertical excursion is a movement of production solution to a monitor well in an overlying or underlying aquifer. Vertical excursions can be caused by improperly cemented well casings, well casing failures, improperly abandoned exploration wells, or leaky or discontinuous confining layers.

The historical experience at other ISR uranium operations indicates that excursion indicator parameters selected due to their high level of mobility in ground water and UCLs allow detection of horizontal excursions early enough that corrective action can be undertaken before water quality outside the exempted aquifer boundary is degraded. According to NUREG-1910 (SEIS, Supplement 3, Section 4.5.2.1.2.2), excursions have occurred at ISR operating facilities. Following analysis of 60 excursion events by NRC staff, most excursions were controlled through pumping and extraction of nearby production wells. In all cases, however, none of these excursions resulted in significant, adverse environmental impacts.

To mitigate the potential for excursions AUC proposes to construct a monitor well network around each production unit in accordance to NUREG-1910 (Section 2.4.1.4). This monitor well network will include perimeter wells and wells completed in the Overlying Aquifer. The function of the monitor well network will be to detect any recovery solutions that may migrate away from the production area. Production Zone monitor well spacing will be based on the aquifer characteristics determined from hydrologic modeling and aquifer testing, while the overlying and underlying monitor wells will be installed on an the approximate basis of one well per four acres of wellfield.

Water quality samples will be collected from monitor wells on a biweekly basis and analyzed for excursion parameters that are designed specifically to detect and provide “early warning” of recovery solution excursions. Water levels in monitor wells also will be measured in order to provide an early warning of a potential excursion and allow AUC to correct the wellfield imbalance before an actual excursion occurs. An increasing water level in a perimeter monitor well will indicate a flow imbalance locally within the wellfield, which could result in an excursion if not corrected. An increasing water level in an Overlying monitor well will be indicative of the migration of fluid from the Production Zone, possibly by an injection well casing failure. AUC’s proposed monitor

well network will allow corrective action to be immediately taken to locally balance the injection and production flows or for individual wells to be shut down as necessary.

To reduce the potential of an excursion due to an improperly abandoned exploration hole, AUC will plug old drill holes in proximity to well fields if pump testing and hydrologic results indicate that leakage through old drill holes is a potential problem. Procedures are detailed in Addendum 2.6B to this document. These holes will be reentered to total depth and sealed with plug gel or other method as required by the WDEQ.

6.4.2.2.7 Spills and Leaks

Mitigation measures for accidental spill and leaks that could potentially affect groundwater are similar to those presented previously in this section (6.4.1.3).

Wellfields and Pipelines

Within the wellfield facilities, wellfield flows will be continuously monitored for any variations in flow or pressure that could indicate a leak in the pipelines or wells. Effective mitigation measures to control the adverse impact of potential spills and leaks may include:

- Automated equipment capable of detecting leaks and shutting down pump systems;
- Facilities and manholes will be equipped with leak detectors with audible and visible alarms;
- Wells will undergo regular MIT to search for potential leakage;
- Pipelines from wellfields will be buried and made of corrosion-resistant HDPE;
- Piping with the CPP will be corrosion-resistant HDPE, PVC, or stainless steel;
- Piping will be hydrostatically tested;
- Piping will be rated for pressures greater than maximum operating pressure; and
- Thrust blocking will be provided at pipe bends and valves.

Lined Backup Storage Pond

A double-lined backup storage pond will be designed to meet the requirements of NRC Regulatory Guide 3.11 for embankment retention systems and WDEQ Water Quality Rules and Regulations, Chapter 11, for lined backup disposal ponds. Additional mitigation measures for minimizing spills and leaks from the storage pond include:

- Selecting the optimum pond location based on:
    - Topography;

  - Access;
  - Proximity to the CPP; and
  - Distance from surface drainage features
- Limit backup pond use to when deep disposal wells are not functioning due to maintenance or MIT;
- Use of two layers of low permeability liners; and
- Equip the pond with a leak detection system between the liner layers consisting of a perforated pipe system with collection sumps which will be checked regularly.

Pond location will be selected based on topography, proximity to the CPP, access, distance from surface drainage features, and potential for minimizing erosion, disturbance, and water dispersion by natural features. The backup storage pond will only be used when a deep disposal well is not functioning due to MIT or maintenance.

The backup storage pond will have two layers of low permeable liner with geotextile fabric and a leak detection system between the two liners. The pond will be equipped with a leak detection system which consists of a perforated collection pipe system with sumps. The leak detection taps will be monitored every two weeks for the presence of moisture when the ponds are in use. The design of the leak detection system will enable the identification of leak locations if water is detected in the system as the pond will have been divided into six zones, with detection taps in each zone.

The leak detection system can also be used to remove water (if a leak is present) from between the primary and secondary liners, and to estimate the size of a leak based on the recovered volume from the leak detection system. The leak detection system will help to maintain low to zero head pressure on the secondary liner. Liquid recorded in the leak detections system does not necessarily constitute a release of pond water to the environment but serves as an active tool to monitor the integrity of the total liner system.

The backup storage pond is designed to contain the maximum byproduct water flow anticipated for a seven-day period. The maximum volume of byproduct water also accounts for any byproduct water collected from well swabbing and also includes the volume of water contained in the curbing within the plant. The pond design will be updated as byproduct water disposal requirements become more defined for the proposed projectProposed Project. The conceptual design of the backup storage pond is described in TR Section 4.2.3.5 as well as a discussion of the conceptual pond leak detection systems.

In the event of a leak from a lined pond cell, the leak will be repaired as quickly and efficiently as possible, and the NRC will be notified by telephone within 48 hours of leak verification. . AUC will analyze standpipe water quality samples for leak parameters once

every seven days during the leak period and once every seven days for at least 14 days following repairs. A written report including analytical data and descriptions of the correction actions and results of those actions will be submitted to the NRC within 30 days of initial leak notification.

6.4.2.2.8 Deep Well Disposal

The brine generated by the Proposed Project will be disposed in Class I deep disposal wells. The wells will be constructed according to WDEQ/WQD Class I disposal well construction standards. AUC will also perform routine monitoring and perform internal and external MIT in accordance with the conditions of the UIC permit.

6.5 Mitigation Measures for Potential Ecological Resources Impacts

Primary potential ecological resource impacts would typically be limited to the areas of soil and vegetation disturbance, with indirect impacts potentially occurring in the vicinity of these more direct impacts. AUC anticipates that direct impacts will affect only approximately 154 acres percent (2.5 acres) of the Proposed Project area. These impacts are associated with the construction of wellfields, processing facilities, and associated infrastructure. Secondary indirect impacts will extend away from these areas, with the area of potential effect (APE) varying according to the susceptibility of each species of flora or fauna. The disturbance will occur in Production Units spread across the Proposed Project area. AUC respects the ecological and intrinsic values of all biota, and will mitigate potential impacts to the extent practicable to minimize the potential for adverse ecological resource impacts. Specific mitigations can be found in the following subsections.

6.5.1 Vegetation

A professional survey of vegetation within the Proposed Project area meeting the high standards of the WDEQ vegetative survey methodologies has been completed, the results of which are presented in Section 3.5 of this ER. Potential impacts to vegetation resulting from the Proposed Action are detailed in Section 4 of this ER. It is anticipated that impacts to vegetation communities will be small, AUC will however implement mitigation measures specifically designed to further limit negative effects to vegetation. These mitigation measures may include:

- Limit new road construction by using existing roads;
- Minimize new road widths, especially tertiary roads;
- Strip topsoil and stockpile for reclamation purposes where necessary;
- Prevent soil erosion and sedimentation;
- Soil decompaction through ripping to allow vegetation re-establishment; and
- Re-vegetation of disturbed areas in accordance to WDEQ/LQD standards.

Suggested permanent seed mixtures are included in Table 6-1.

6.5.1.1 Wetland Encroachment

As required by USACE, a wetland inventory assessment was conducted in accordance to the USACE Wetland Delineation Manual: Great Plains Region (Version 2.0). The majority of the wetlands were found along and within existing drainage bottoms. However, these wetlands were generally not continuous along the entire length of the

drainages. Classifications of the wetlands along the drainages were primarily Palustrine Emergent (PEM) Other Waters of the United States (OWUS). The sum wetland and OWUS, acres identified within the project area, totals approximately 42 acres. See Addendum 3.5-F in this ER for a summary of wetland areas within the Proposed Project area. AUC will follow construction practices as defined by the Army Corps of Engineers to reduce potential impacts to wetlands.

6.5.2 Wildlife and Fisheries

There are no surface waters within the Proposed Project area capable of supporting fish species, either game species or otherwise, therefore there are no fisheries specific mitigations. Potential impacts to terrestrial and non-fish aquatic biota associated with the Proposed Project are discussed in ER Section 4.5. The potential for impacts associated with ISR construction, operation, groundwater restoration, and decommissioning activities will be limited due to the relatively small area of disturbance. AUC will implement mitigation measures included in regulatory guidelines and requirements designed to prevent or reduce impacts to wildlife which may include one or more of the following practices:

- Fencing designed to allow big game passage (WGFD, 2004);
- Use existing roads to the extent practicable:
- When new roads must be constructed, use common corridor roads to limit the number of roads;
- Implementation of speed limits to minimize collisions with wildlife;
- If direct impacts to raptors or migratory bird species of management concern result from ISR development and operations, a Monitoring and Mitigation Plan for those species will be prepared and approved by the USFWS, including one or more of the following provisions:
    - Relocation of active and inactive raptor nests that will be impacted by drilling, construction, or operation activities in accordance with the approved raptor monitoring and mitigation plan;
    - Creation of raptor nests and nesting habitat through enhancement efforts such as nest platforms to mitigate other nest sites impacted by ISR operations;
    - Obtaining appropriate permits for all removal and mitigation activities;
    - Establishing buffer zones protecting raptor nests where necessary and restricting project-related disturbances from encroaching within buffers around active raptor nests (from egg-laying until fledging) to prevent nest abandonment, or injury to eggs or young;

  - Re-establishing the ground cover necessary to attract and sustain a suitable raptor prey base after drilling, construction, and future ISR uranium recovery; or
  - Required use of raptor-safe construction for overhead power lines according to current guidelines and recommendations by the Avian Power Line Interaction Commission and/or USFWS.
- Restoration of sagebrush and other shrubs on reclaimed lands and grading of reclamation to create swales and depressions for sagebrush obligates and their young (WDEQ/LQD);
- Restoration of pre-drilling and pre-construction native habitats for species that nest and forage in those vegetative communities (WDEQ/LQD);
- Restoration of diverse landforms, direct topsoil replacement, and the construction of brush piles, snags, and/or rock piles to enhance habitat for wildlife (WDEQ/LQD);
- Restoration of habitat provided by jurisdictional wetlands (WDEQ/LQD, USACE); and
- Reclamation of creek channels and restoration of surface water flow quantity and quality after ISR operations to approximate pre-operational conditions (WDEQ/LQD).

6.6 Mitigation of Potential Air Quality Impacts

Potential impacts to air quality during all phases of the Proposed Project (ER Section 4.6) include the generation of non-radiological and radiological airborne emissions. Non-radiological emissions include fugitive dust and combustion emissions, which will be highest during construction and decommissioning, oxygen, carbon dioxide and trace chemicals released from the CPP, and oxygen and carbon dioxide released from the wellfield. Radiological emissions will be limited to ^{222}Rn released in small quantities from the wellfields, CPP, and the double-lined backup storage pond.

AUC estimates fugitive dust emissions from operations in the Proposed Project area based on projected activity levels and using emission factors supplied by the WDEQ. Projected activities impacting dust emissions included ongoing Production Unit construction activities, routine site traffic related to operations and maintenance, heavy truck traffic delivering chemicals and material and shipping product, and employee traffic to and from the site. Based on these activities, the projected total particulate matter (PM_{10}) emissions will be less than 200 tons per year. This level of emissions is small relative to surface mines and other industrial operations that generate dust from vehicles and disturbed areas. The larger surface mines in the PRB show PM_{10} emissions inventories in the thousands of tons per year. Sections of unpaved county roads can also exceed 18.5 tons per year emission rate. 40 CFR 51.165(b)(2) defines the Significant Impact Level (SIL) for PM_{10} as 1.0 $\mu g/m^3$ or more. For reference purposes, 40 CFR 50.6(a) defines the national ambient standard for annual average PM_{10} as 150 $\mu g /m^3$.

It is not anticipated that there will be any significant radiological particulate emissions from the CPP and facility operations. This is due to the selection of components used in yellowcake drying operations that when used in combination, emit zero particulates in the drying and packaging process. As all other aspects of the operation are fluid based, there is little if any chance that operations aside from yellowcake drying and packaging will contribute any impacts to radiological particulate emissions.

Air quality protection measures that will be implemented at the site may include the following:

- Reduce fugitive dust emissions via standard dust control measures, including speed limits, use of water or chemical dust suppression compounds such as magnesium chloride, and selection of road surface materials that will minimize fugitive dust;
- Reduce the potential for release of fugitive dust from construction activities by suppressing dust in disturbed areas via wetting and promptly re-vegetating disturbed areas;

- Use pressurized down-flow ion exchange columns, pressure piping, and modern vacuum dryers to limit ^{222}Rn emissions and eliminate radiological particulate emissions; and
- Dryers will be equipped with a bag filter that will adequately filter out airborne uranium.

6.7 Mitigation of Potential Noise Impacts

The Proposed Project will occur in a remote location with a low population density of the surrounding area, noise impacts are therefore expected to be small. According to NUREG-1910 (GEIS Section 3.3.7), this kind of rural, undeveloped area tends to be quiet where natural phenomena such as wind, rain and wildlife account for most natural background sounds. AUC will mitigate sounds associated with the Proposed Project construction and operations which may include some of the following measures;

- Posting signs throughout the Proposed Project area to ensure all employees and contractors are aware of speed limits;
- Implement a policy that will include adherence to county road speed limits for all AUC employees and contract workers;
- Locate process machinery such as pumps and generators within the CPP, which is fully enclosed.
- Keeping all overhead CPP doors closed as much as possible will help minimize the amount of noise generated.
- Restrict drilling to daytime hours (7 a.m. to 8 p.m.) in areas where the annoyance noise threshold could be exceeded at nearby residences.

Employees working at drilling or construction sites will be required to wear hearing protection. As described in ER Section 4.7, OSHA recommends an exposure limit for workplace noise of 85 dBA for a duration of eight hours per day. Several types of construction equipment such as bulldozers, excavators, and front-end loaders can reach noise levels well above 85 dBA. AUC will implement a hearing conservation program to ensure that proper PPE is worn and engineering controls are in place to protect workers from potentially damaging noise.

6.8 Mitigation of Potential Historic and Cultural Resources Impacts

Class I and III cultural resource surveys have been completed within the Proposed Project area as described in ER Section 3.8. The results are included as ER Addendum 3.8-A. The inventory report contains information that falls under the confidentiality requirement for archeological resources under the National Historic Preservation Act, Section 304 (16 U.S.C. 470w-3(a)). Mitigation measures that will be implemented at the project site to minimize impacts to historical and cultural resources may include the following:

- Consultations with Native American governments early in the planning process to identify traditional cultural properties, sacred landscapes, and other issues and concerns regarding the Proposed Project ;
- An unexpected discovery of cultural resources during any phase of the project shall result in a work stoppage in the vicinity of the find until the resources can be evaluated by a professional archaeologist;
- If resources eligible for listing on the NRHP are present, modify the development plan to avoid significant cultural resources;
- Implementation of an Unanticipated Discovery Plan prior to construction;
- Consultation with SHPO and appropriate THPOs;
- Pre-construction surveys have been completed to ensure that work will not affect important historical, cultural, and archaeological resources;
- Use existing roads to the maximum extent practicable to avoid additional surface disturbance; and
- Adhere to anticipated NRC License Conditions requiring phased identification of previously unidentified historical, cultural or archaeological resources by an archaeologist or historian meeting the U.S. Secretary of Interior's Professional Qualification Standards (DOI, 1983).

6.9 Mitigation of Potenial Visual and Scenic Resources Impacts

Potential impacts to the visual and scenic resources of the Proposed Project area are discussed in Section 4.9. of this ER. AUC will implement mitigation measures to reduce the visual effects of the wellfields, processing facility, access roads, and drill rigs during the construction, operation, and reclamation phases. The mitigations used to reduce impacts to visual and scenic resources may include:

- Restoration and reclamation with re-vegetation of disturbed areas;
- Centralization of CPP, office area, and associated structures within a single fenced location;
- CPP and associated structures will be painted a neutral color;
- Well head covers will be short (approximately three feet) and painted a neutral color;
- Align roads to topography, thereby reducing straight line roads as well as cut and fill requirements;
- Limitation of nighttime activities, thereby reducing lighting requirements; and
- Dust suppression to reduce potential for visible dust clouds.

6.10 Mitigation Measures for Potential Public and Occupational Health Impacts

AUC is committed to a maintaining a safe working environment at all times, this includes safety measures protecting AUC employees, contractors, and members of the public. Potential public and occupational health impacts from non-radiological and radiological sources are described in ER Section 4.12 as required by NUREG1748 and NUREG-1569. AUC will minimize impacts to public and occupational health by complying with the Radiation Protection Standards contained in 10 CFR 20 and following the ALARA principle. The radiation safety controls and monitoring programs that will be implemented at the Proposed Project are discussed in TR Section 5.7.

As discussed in Section 3.10, the Proposed Project area is located in a sparsely populated area of southwestern Campbell County, Wyoming. The nearest community is Wright, Wyoming (2010 U.S. Census population of 1,807), about 7.5 miles northeast. The closest urban area to the Proposed Project area is Gillette, Wyoming (2010 U.S. Census population of 29,087), about 41 miles north. The population distribution for the 50 mile (80 km) radius around the Proposed Project area is depicted in ER Figure 3.10-1. There will be no residences within the Proposed Project area by the time any construction activities begin. Within two miles there are three residences. The nearest residence to the Proposed Project boundary is about 0.42 miles north, and the nearest residence to the CPP is approximately 2.2 miles north of its location.

6.10.1 Mitigation of Potential Construction Impacts

During the construction phase of the Proposed Project, potential impacts to public and occupational health include: fugitive dust, combustion emissions, noise, and occupational hazards associated with construction of the wellfield, CPP, and associated facilities. AUC will implement safe working policies that must be adhered to by AUC employees as well as contractors to reduce the risks associated with construction. Mitigation measures that may be used during construction include:

- Controlling fugitive dust exposures with appropriate suppression measures;
- Implement a hearing conservation program for all workers on site; and
- Implement a worker safety procedures and training program that conforms to the Wyoming Occupational Health and Safety Act, Title 27, Labor and Employment, Chapter 11, Occupational Health and Safety and applicable OSHA standards.

6.10.2 Mitigation of Potential Operation Impacts

Operation of the Proposed Project has the potential for radiological and non-radiological impacts to public and occupational health (ER Section 4.12.1.2). Potential non-

radiological public and occupational health impacts will be related to fugitive dust, combustion emissions, noise, permitted surface discharges and contamination of water supplies. ER Section 4.12 includes descriptions of these potential impacts based on the potential pathways of exposure. There are no anticipated potential public health impacts resulting from any permeate discharge due to the high effluent quality (see ER Section 4.4 and TR Section 2.3.1.1) and small discharge rate.

As stated above, AUC is committed to the safety of both workers associated with the Proposed Project and members of the public. AUC will therefore take precautions to avoid adverse impacts to public and occupational health. Mitigation measures to be used in these efforts may include:

- Implementing dust control measures;
- Managing for clean air quality;
- Managing for reduced noise potential;
- Incorporate recommendations concerning materials of construction for tanks and piping systems and the use of local ventilation with explosion-proof fans to control vapors in the event of a leak of hydrogen peroxide;
- Design and install underground and above-ground gaseous oxygen piping in accordance with industry standards contained in Compressed Gas Association (CGA) G4.4;
- Design facilities that conform to standards detailed in National Fire Protection Association (NFPA) 55;
- Develop procedures that implement emergency response instructions for a spill or fire;
- Storage containers will be located above ground with safety and environmental provisions according to federal, state and local regulations;
- Control and monitor the solutions in the production zone to ensure that migration does not occur;
- Equipment, including the pressurized down-flow ion exchange columns, precipitation, drying, and packaging facilities, will be located on curbed concrete pads with secondary containment of sufficient size to contain the contents of the largest tank in the event of a rupture; and
- The CPP will have ventilation systems to remove small amounts of ^{222}Rn that may be released during resin exchanges, solution spills, filter changes, and maintenance activities.

The NRC has previously evaluated the effects of accidents at conventional uranium milling facilities in NUREG-0706 and at ISR uranium facilities in NUREG/CR-6733. These analyses demonstrate, for most credible potential accidents, consequences are minor so long as effective emergency procedures and properly trained personnel are used. The Proposed Project facilities will be consistent with the operating assumptions, site

features, and designs examined in the NRC analyses in NUREG/CR-6733. AUC will mitigate the effects of accidents by implementing and enforcing emergency management procedures following the recommendations contained in the NRC analyses. Training programs, discussed in Section 5 of the TR, will ensure that AUC personnel are trained adequately to respond to all potential emergencies.

NUREG/CR-6733 noted that the scope of the NRC mission includes hazardous chemicals to the extent that mishaps with these chemicals could affect releases of radioactive materials. AUC will mitigate the effects of chemical spills by adopting and enforcing SOPs regarding receiving, storing, handling, and disposal of chemicals to ensure the safety of the public and workers. AUC will submit to the EPA a Risk Management Plan (RMP) to comply with the RMP Rule which covers all hazardous chemicals per 40 CFR 68.130. Additionally, AUC will submit a "Top-Screen" analysis in order for the Department of Homeland Security (DHS) to evaluate the chemical security risks associated with the Proposed Project.

Mitigation measures to reduce or eliminate impacts from potential accident scenarios that could have radiological impacts are discussed in ER Section 6.12.2 and Section 6.7 of the TR describes the radiation safety controls and monitoring programs that will be implemented at the Proposed Project. These programs were developed to assure that operations criteria established in NUREG/CR-6733 will be followed such that the occupational health impacts and accident risks described in that document will be applicable to the Proposed Project. Additional details of each potential credible accident are discussed in TR Section 7.5.

Potential transportation accidents are discussed in ER Section 4.2 and in greater detail in TR Section 7.5.4. Mitigation of effects from transportation accidents are discussed in ER Section 6.2. To mitigate the effects of any transportation accidents, extensive emergency response programs will be in place along with environmental emergency response contractors for spill cleanup. AUC will provide training for local emergency personnel including firemen, police and EMTs in the hazards and emergency response procedures to ensure safe working practices in the presence of spilled materials.

6.10.3 Mitigation of Potential Groundwater Restoration Impacts

Potential public and occupational health impacts during restoration and decommissioning will be similar to those during operation. There will be similar types of occupational hazards such as equipment operation. AUC will be required by the NRC to submit a decommissioning plan for review. The plan will include details on the implementation of a 10 CFR Part 20 compliant radiation safety program. The safety program will ensure that the safety of the workers and public is maintained and that any residual impacts are mitigated during decommissioning.

6.11 Mitigation of Potential Byproduct Management Impacts

This section describes measures that will be taken by AUC to mitigate any adverse byproduct material management impacts that might result from the Proposed Action. Section 4.13 of the ER describes the anticipated quantities, proposed byproduct management systems, and potential impacts resulting from the management of liquid and solid byproduct material generated.

Most of the brine and other liquid 11e.(2) byproduct material generated by the Proposed Action will be disposed in Class I deep disposal wells. Deep well disposal is selected as the preferred method of brine disposal due to minimal potential impacts to human health and the environment compared to more and larger evaporation ponds or off-site brine transport. Potential impacts of brine disposal by deep well injection are small, and any slight adverse effects will be mitigated using techniques which may include:

- Reducing the amount of brine produced by employing two stages of RO. The brine from the first stage of production and restoration RO will be further treated in a second stage.
- Further reduce the brine quantity by employing selective groundwater sweep. As described in TR Section 6.1, a limited groundwater sweep is proposed to minimize consumptive use of groundwater coming from outside of the exempted aquifer, thereby mitigating the effects of water withdrawal from the production zone aquifer.
- Any effects of leaks or spills from the brine management system will be mitigated by early detection and response to correct the leak, prevent future leaks, and proper disposal of any affected soils.

Any potential impacts from permeate management and disposal will be mitigated by minimizing the amount of permeate produced. Most permeate will be recycled into producing wellfields or wellfields undergoing groundwater restoration. Permeate impacts will be mitigated using practices including:

- Employing two-stage RO units, maximizing permeate production and minimizing brine production.
- Permeate generated through the use of RO units will be injected either into the barren lixiviant stream or into the groundwater restoration circuit.
- Permeate which is not recycled back to operation or restoration activities will be used as plant makeup water.

Solid 11e.(2) byproduct material will be generated during all project phases except construction. The 11e.(2) byproduct material will be transported off-site by an appropriately licensed transporter to a disposal facility licensed by NRC or an agreement state. Potential impacts resulting from the management and disposal of 11e.(2) byproduct

material include potential spills, addressed in ER Section 4.4, and potential transportation impacts, addressed in ER Section 4.2. Potential disposal facilities evaluated in this ER include the following;

- Pathfinder Mine Corporation, Shirley Basin Facility, Shirley Basin, Wyoming;
- Denison Mines Corporation, White Mesa Uranium Mill, Blanding, Utah;
- Energy Solutions LLC, Clive Disposal Site, Clive, Utah;
- Waste Control Specialists LLC, Byproduct Material Disposal Facility, Andrews, Texas; This facility was noted, however; was rejected due to the distance from the Proposed Project; and
- AUC may consider the Kennecott Sweetwater (WY) Uranium Mill in the future should it become active.

The primary method of mitigating any potential impacts from disposal of 11e.(2) byproduct material will include:

- Minimize the amount of this material through process design, decontamination, and volume reduction during decommissioning;
- Filter media for the production and restoration circuits will be selected based on filtration efficiency and on minimizing byproduct material;
- Equipment and building surfaces will be decontaminated and reclassified as non-hazardous material for unrestricted release. Decontamination procedures are discussed in TR Section 6.3 and may include high pressure washing, sand blasting, and acid rinsing.

Solid non-11e.(2) byproduct materials will include construction debris, office trash, and decontaminated material and equipment. It will be generated during all project phases, including construction, operation, groundwater restoration, and decommissioning. Most of the solid byproduct material will be generated during decommissioning as described in ER Section 4.13.

Non-hazardous solid waste material will be disposed off-site in a municipal landfill permitted by WDEQ/SHWD. The nearest municipal landfill is the Campbell County landfill in Gillette (approximately 60 miles north).

The primary method of minimizing any potential impacts from solid waste disposal will be to minimize the amount of waste material produced by recycling and decontaminating materials and process equipment and by using a chipper or grinder during decommissioning. Recyclable materials that will be taken to an approved municipal landfill include newspaper, magazines, phone books, cardboard, aluminum and steel cans, and plastic.

TENORM management plans and quantity estimates are described in ER Section 4.13.1.1.3.2. AUC anticipates using mitigation techniques to reduce the potential for any adverse impacts from TENORM materials, these techniques may include:

- Mud pits containing drilling fluids and cuttings will be backfilled and graded in accordance with WDEQ/LQD regulations;
- TENORM groundwater generated will be discharged under a WDEQ Class I UIC Permit for deep well injection.
- Quantities of drilling fluids will be minimized by using the minimum quantity of water that is technically practicable for well drilling and development.
- Mud pits will be included in the decommissioning gamma surveys to ensure that there are no potential long-term impacts from radioactivity in mud pits.

Small amounts of hazardous material are expected to be generated during all project phases in similar quantities (ER Section 4.13.1.1.3.3). In order to maintain classification as a Conditionally Exempt Small Quantity Generator (CESQG) by WDEQ/SHWD, the project will be required to generate less than 220 pounds (100 kg) of hazardous material, and less than 2.2 pounds (one kg) of acute hazardous material in any calendar month and store less than 2,200 pounds (1,000 kg) of hazardous material at any one time.

Hazardous material will be transported to an off-site facility that is licensed by WDEQ/SHWD or a nearby State to manage hazardous byproducts. The Campbell County Landfill, located just north of Gillette, accepts used oil and batteries for recycling and certain other hazardous material by contract (CCGov 2010).

AUC will mitigate any potential impacts from hazardous waste management by minimizing the quantity of hazardous materials generated. This will be done by generally servicing vehicles and equipment at off-site facilities and by limiting laboratory reagent orders to quantities that can be consumed within the reagent shelf lives. The quantity of hazardous waste generated and stored in the Proposed Project area will be kept small enough to comply with CESQG requirements.

Domestic waste management is described in Section 4.13.1.1.3.4. Sewage will be collected in a gravity sewer collection system serving the office/administration building, CPP, maintenance building, and any other buildings with restrooms. The effluent will be disposed of in a conventional septic tank – leach field system designed according to WDEQ/WQD standards. Potential groundwater impacts resulting from effluent disposal will be small and are addressed in ER Section 4.4. The small quantity of effluent (about two gpm on average) spread over a large area will have very limited potential to impact groundwater quality, considering that a properly sized and maintained septic tank will remove most of the solids and significantly reduce total suspended solids, organic carbon, and ammonia. A properly sized drainfield will provide further treatment, including bacteria reduction.

AUC will consider constructing an on-site effluent material disposal system for personnel using temporary holding tanks pumped by a waste material disposal contractor for construction and decommissioning phases, when a large number of workers will be on site. This will reduce the amount of on-site effluent disposal and will eliminate the need to design the sewage disposal system for the short-term construction workforce. Domestic effluent also will be minimized by using modern, low-flow restroom fixtures.

Table 6-1: Seed Mixture

Life Form/Species	Private Land	State Land
Perennial Cool Season Grass		
Western Wheatgrass (Arriba)	20%	25%
Thickspike Wheatgrass (Critana)	20%	25%
Green Needle (Lodorn)		20%
Perennial Cool Season Bunchgrass		
Basin Wildrye (Magnar)		12%
Slender Wheatgrass (San Louis)	7%	18%
Russian Wildrye (Bozoisky)	12%	
Intermediate Wheatgrass		
Pubescent Wheatgrass (Manska)	14%	
Blue Bunch Wheatgrass (Secar)	13%	
Intermediate Wheatgrass (Oahe)	14%	

TABLE OF CONTENTS

7 ENVIRONMENTAL MEASUREMENTS AND MONITORING..... 7-1
7.1 Radiological Monitoring 7-1
7.1.1 Radiation Monitoring 7-2
7.1.1.1 Ambient Monitoring..... 7-2
7.1.1.2 In-Plant Monitoring..... 7-2
7.1.2 External Radiation Exposure Monitoring..... 7-3
7.1.3 Soil and Sediment Sampling 7-3
7.1.4 Vegetation, Food, and Fish Monitoring 7-4
7.1.5 Water Resource Monitoring 7-4
7.1.5.1 Surface Water Monitoring..... 7-4
7.1.5.2 Groundwater Monitoring..... 7-5
7.2 Physiochemical Monitoring 7-6
7.2.1 Physiochemical Groundwater Monitoring 7-6
7.2.1.1 Groundwater Monitoring 7-7
7.2.1.2 Production Unit Baseline Sampling 7-7
7.2.1.3 Monitor Well Baseline Water Quality..... 7-7
7.2.2 Wellfield Hydrologic Data Package..... 7-8
7.2.2.1 Operational UCLs and potential Excursion Monitoring 7-9
7.2.2.2 Potential Excursion Verification and Corrective Action..... 7-10
7.2.3 Wellfield and Pipeline Flow and Pressure Monitoring 7-12
7.2.4 Backup Pond Leak Detection Monitoring..... 7-12
7.2.5 Meteorological Monitoring 7-13
7.3 Ecological Monitoring..... 7-13
7.3.1 Vegetation, Food and Fish..... 7-13
7.3.2 Wildlife..... 7-13
7.4 Quality Assurance Program..... 7-14
7.5 Historic and Cultural Resource Monitoring 7-16

7 ENVIRONMENTAL MEASUREMENTS AND MONITORING

As discussed in the ISR Generic Environmental Impact Statement (GEIS, NUREG-1910, 2009) (Section 8), monitoring programs, in general, are developed for licensed ISR facilities to verify compliance with standards for the protection of licensee and non-licensee worker health and safety operational areas and for the protection of the public and environment beyond the project boundary (NRC, 2009). Monitoring programs provide data on operational and environmental conditions so that prompt corrective actions can be implemented if an adverse condition is detected. These programs help minimize or eliminate potential worker and environmental impacts.

This section provides AUC's proposed environmental measurement and monitoring programs for the proposed Reno Creek ISR Project (Proposed Project), including radiological monitoring, airborne effluents monitoring, physiochemical monitoring, ecological monitoring, and historic and cultural resource monitoring. These monitoring programs will be used to measure and address the potential impacts addressed in Section 4 of this ER and mitigation measures described in Section 6 of this ER.

Related discussions to this section are found throughout both the TR and ER. Some of the more pertinent discussions can be found in:

- Section 2.9 of the TR (Radiological Baseline Characteristics);
- Section 3.1.6 of the TR (Wellfield Monitoring);
- Section 3.4.4 of the TR (Radiological Monitoring);
- Section 5.7 of the TR (Radiation Safety Controls and Monitoring); and
- Section 6 of the TR (Restoration, Reclamation and Decommissioning).

7.1 Radiological Monitoring

This section describes the proposed radiological monitoring program for the Proposed Project during plant operations. This operational radiological program is based on the guidance found in Regulatory Guide 4.14 (NRC, 1980), 4.15 (NRC, 1979) and 8.37 (NRC, 1993) to meet the requirements of 10 CFR 20 and 10 CFR 40. The purpose of this monitoring program is to characterize and evaluate the radiological environment, to provide data on measurable levels of radiation and radioactivity, and to provide data on the principal pathways of radiological exposure to the workers and public. All monitoring will be conducted in accordance with the accepted scientific protocols and guidance, which have been incorporated into Standard Operating Procedures (SOPs) presented in Addendum 2.9-A of the TR.

7.1.1 Radiation Monitoring

7.1.1.1 Ambient Monitoring

Potential air particulate releases from the CPP processes will be monitored in a manner similar to that employed for baseline determination of air particulate concentrations. Sampling locations are selected as recommended in USNRC Regulatory Guide 4.14 (the Guide). Monitoring will be performed using air particulate samplers operating at approximately 30 lpm or better. Filters will be collected monthly in accordance with a modified procedure discussed with the NRC and determined by AUC during pre-operational testing to be effective. The white paper supplied to the NRC can be found in Addendum 2.9-C of the TR. Filters will be composited on an approximate quarterly basis to provide average radionuclide air concentrations as noted in the Guide. Each quarterly batch of air filters from the monitoring stations will be submitted to a contract laboratory for analysis in accordance with the Guide. Results of the operational air particulate monitoring program will be reported in the semi-annual effluent reports required by 10 CFR §40.65. The LLD values for air particulate radionuclides as recommended in Regulatory Guide 4.14 (including U-nat, ^{226}Ra, ^{210}Pb, and ^{230}Th) are readily achieved by the selected air particulate monitoring method.

These air particulate monitoring systems have been operated during the pre-operational phase to establish background concentrations of airborne particulate radionuclides. Because the systems are designed to follow applicable regulatory guidance concerning LLD values for airborne particulate radionuclides, and because they are operated continuously with filter analyses performed quarterly by a qualified contract laboratory, their ability to demonstrate compliance with dose limits for members of the public has been demonstrated (TR Table 5-3).

Radon monitoring will be performed at locations recommended by Regulatory Guide 4.14 (the same locations selected for air particulate monitoring), using the same detectors (high-sensitivity Landauer track etch devices or equivalent) and analysis frequencies (quarterly analysis) as employed during pre-operational monitoring. TR Section 2.9 provides detail concerning ^{222}Rn monitoring systems and procedures.

7.1.1.2 In-Plant Monitoring

Although exposure to uranium particulates within the CPP area is expected to be low due to use of vacuum dryers, the potential for exposure does exist. AUC proposes to monitor air within the plant, therefore air samples will be collected on a monthly basis in accordance with Regulatory Guide 8.25.

AUC will also monitor the CPP area for ^{222}Rn and its progeny, as described in Section 5.7.3.2 of the TR. Initial sampling will determine specific monitoring locations and frequency such that areas exceeding 10 percent of the regulatory limit or 0.03 working levels (WL) above background will be monitored monthly, while all other areas will be monitored quarterly. In the event that a ^{222}Rn progeny sample exceeds 0.08 WL an investigation will be conducted. Samples will then be taken weekly at this location until four consecutive samples show levels below 0.08 WL. Additional samples will be taken in areas where there is an upset condition, maintenance, or operational change that could result in the release of ^{222}Rn or before a radiation work permit can be issued for work in confined spaces likely to contain ^{222}Rn.

7.1.2 External Radiation Exposure Monitoring

In addition to the airborne radiation-monitoring program, AUC will also have an external radiation-monitoring program to ensure the safety of workers and the public. Occupational exposure to external gamma and beta radiation will be measured using personnel dosimeters such as Thermo luminescent Dosimeters (TLD) or Optically Stimulated Luminescence (OSL) dosimeters as discussed in Section 5.7.2.2 of the TR. Consistent with 10 CFR §20.1502 and Regulatory Guide 8.34, occupational exposure to external radiation will be used to determine the TEDE for employees whose work locations or functions may be expected to exceed 10 percent of the occupational exposure limits. During initial operation of the Proposed Project, all workers will be monitored for external exposure. Once an adequate exposure history is established, AUC may discontinue monitoring for worker classifications that have been shown to have no likelihood of exceeding 10 percent of the allowable occupational dose limit. The RSO will use historical and current monitoring and survey data to ensure that external radiation exposures are less than 10 percent of the occupational dose limit for all unmonitored workers. The results of the external radiation-monitoring program will be recorded and reviewed when results are received by the RSO to ensure that unmonitored employees have not exceeded 10 percent of the dose limit.

7.1.3 Soil and Sediment Sampling

During operations, AUC will conduct soil sampling on an annual basis. Following Regulatory Guide 4.14, discrete grab samples of soil samples will be collected at the air particulate stations and sediment samples will be collected at the same baseline surface water sampling locations discussed in ER Section 3.4.1. All soil and sediment samples will be collected to a depth of five cm for consistency with the baseline soil sampling surveys then analyzed for natural uranium, ^{226}Ra, ^{210}Pb, and gross alpha. Prior to decommissioning, following the conclusion of operations, subsurface soil samples will be

taken to compare the results with subsurface soil samples collected as part of the pre-operational monitoring program to demonstrate compliance with App. A Criteria 6(b).

7.1.4 Vegetation, Food, and Fish Monitoring

As described in Section 3.5.4.1, AUC conducted pre-operational vegetation sampling in 2010 at various locations across the Proposed Project area. A detailed description of the vegetation sampling procedures are described in SOP-8 in Addendum 2.9-A of the TR. After evaluating the ingestion pathway to individuals from vegetation, using the MILDOS-AREA model AUC concluded that the ingestion pathway is not significant. Following Regulatory Guide 4.14, AUC does not propose to perform operational vegetation sampling at the environmental monitoring stations. In accordance with the provisions of USNRC Regulatory Guide 4.14, Footnote (o) to Table 2 requires that "*vegetation and forage sampling need be carried out only if dose calculations indicate that the ingestion pathway from grazing animals is a potentially significant exposure pathway...*" defined as a pathway which would expose an individual to a dose in excess of five percent of the applicable radiation protection standard. In the event monitoring is required, sample collection will be conducted similar to the pre-operational baseline monitoring described in Section 2.9 of the TR and will meet the recommendations of the Regulatory Guide 4.14.

Operational fish sampling is not planned for the Proposed Project. Under natural conditions, aquatic habitat in and near the Proposed Project area is limited by the ephemeral nature of surface waters in the survey area. The lack of deep-water habitat and extensive water sources precludes the presence of fish, and limits the abundance and diversity of other aquatic species. Tissue sampling is not planned, as there should be no particulate radionuclide releases (to vegetation, then to cattle) from any part of an ISR operation.

7.1.5 Water Resource Monitoring

AUC will utilize a detailed water sampling program during operations to identify any potential impacts to water resources in the Proposed Project area. The following presents the radiological component of the monitoring program, while Section 7.2 describes the physiochemical monitoring including potential excursions and aquifer restoration.

7.1.5.1 Surface Water Monitoring

During operations, AUC will monitor the surface water locations that were established in the pre-operational baseline monitoring. Details of the sites are discussed in Section 3.4.1

of this document and depicted in Addendum 2.7-A of the TR. The Proposed Project area contains only ephemeral streams and natural runoff occurs during heavy rainfall and snowmelt events. Current CBM operations within the Proposed Project area create outfalls that contain water in select locations across the Proposed Project area for portions of the year and are depicted in Addendum 2.7-A.

Grab samples from each site will be collected on a quarterly basis and analyzed for dissolved and suspended U-nat, ^{226}Ra, ^{230}Th, ^{210}Pb and ^{210}Po. Surface water results will be submitted to the NRC in the semi-annual environmental and effluent monitoring reports. A detailed description of the surface water sampling procedures are described in SOP-3 in Addendum 2.9-A of the TR.

7.1.5.2 Groundwater Monitoring

All private wells used for drinking water, livestock watering or crop irrigation within two miles of the wellfield area boundary will be sampled on a quarterly basis during operations, given the owner's consent. Groundwater samples will be analyzed for dissolved and suspended U-nat, ^{226}Ra, ^{230}Th, ^{210}Pb and ^{210}Po (Regulatory Guide 4.14 Table 2) with results reported to the NRC and landowners. Details of the sites are discussed in ER Section 3.4 and depicted in TR Addendum 2.7-B.

In an effort to attain accurate groundwater samples at the Proposed Project, AUC utilized low-flow methods of purging and sampling groundwater wells in its baseline characterization program. Low-flow groundwater sampling is an increasingly accepted method of collecting ground water samples with a strict set of guidelines to ensure better sample representation and quality. This technique is widely accepted by the EPA and WDEQ and eliminates the need for removal of several well volumes prior to the collection of samples, thus reducing the amount of time to sample and significantly reduces the amount of purge water.

It also improves sample quality, accuracy, precision and variability through reduced disturbance to the well and formation. Low-flow purging involves removing water directly from the screened interval without physically or hydraulically disturbing the stagnant water column above the screen. This is achieved by using a dedicated or non-dedicated pump with the pump intake at or near the middle of the screen and pumping at a rate that is equal to or less than the natural recovery rate of the formation. Purge rates vary from 0.1 l/m to 1.0 l/m depending on the hydraulic performance of the well and the site-specific hydrology. Water level measurements are taken every few minutes to ensure drawdown is minimized and stabilized.

In addition to continuous water level monitoring, low flow purging and sampling requires continuous or periodic measurement of selected water quality indicator parameters. The

chemical stabilization is confirmed when three consecutive readings for all parameters are achieved. Indictor parameters used for stabilization at the Proposed Project include water level, pH, temperature and specific conductance. Additional parameters monitored during low flow sampling may include, turbidity, dissolved oxygen, and redox potential.

Low-flow sampling methods were utilized at Fernald Environmental Management Project (FEMP) located in southwestern Ohio (DOE-FEMP 1995). The project formerly produced uranium metal products and groundwater transport was primary exit pathway of concern for contamination from radioactive and nonradioactive pollutants. A uranium plume was identified migrating off-site and the discovery prompted the need for groundwater restoration and long term monitoring. A comparison of analytical data from low-flow sample sets to conventional sample sets was made. The comparison concluded the conventional sampling methods of removing multiple well volumes prior to sampling was not necessary and that low-flow method was well suited for sites undergoing long term monitoring. Regulatory approval was obtained by both Ohio Environmental and EPA Region V to use low-flow sampling at the FEMP.

AUC proposes utilizing the low-flow method of purging and sampling groundwater wells (when applicable) in its operational monitoring program using the methods described above. A detailed description of the low-flow sampling procedures are described in SOP-5 in Addendum 2.9-A of the TR.

7.2 Physiochemical Monitoring

The following sections provide an overview of AUC proposed physiochemical-monitoring program for the Proposed Project area. The monitoring program provides data on operational and environmental conditions so that prompt corrective actions can be taken if an adverse condition is detected. Physiochemical monitoring will be completed concurrently with radiological monitoring discussed in Section 7.1.

7.2.1 Physiochemical Groundwater Monitoring

During operations at the Proposed Project, a detailed water sampling program will be conducted to identify any potential impacts to water resources of the area. AUC's operational water monitoring program will include the evaluation of groundwater on a regional basis and site specific basis within the Proposed Project area.

7.2.1.1 Groundwater Monitoring

The groundwater-monitoring program is designed to detect excursions of lixiviant outside of the production units in operation and into the overlying aquifer. During uranium recovery monitor wells (OM and RM) will be sampled on a biweekly basis to detect potential excursions. Upper control limit excursion indicators will be established for each Production Unit based on water quality data collected during the baseline groundwater monitoring program. AUC proposes to use chloride, conductivity and total alkalinity as excursion indicators in the monitor wells. AUC proposes to adapt the statistical principles described in the Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance, March 2009, EPA 530/R-09-007 (Unified Guidance). The principles in the Unified Guidance are embodied in the EPA sourced ProUCL software, plus as required, WDEQ regulations and guidance that is consistent with ProUCL. AUC will use the Unified Guidance to evaluate baseline groundwater geochemical data for all identified constituents for each production unit. The data will describe in detail the data distributions and spatial and temporal dependencies for each constituent. Where appropriate, groups of wells may be subdivided to assure representativeness of populations.

The first step in the application of the Unified Guidance is to validate the analytical data, using a series of Standard Operating Procedures (SOPs) for both sampling and laboratory analytical procedures. These SOPs will be developed and implemented prior to commencement of operations. Groundwater quality data that passes the data validation will be incorporated into AUC's monitoring database.

The process will include a statistically sound treatment of Outliers and Non-Detects. Outliers, which are anomalously high or low values relative to the other values, will be determined using ProUCL and procedures described in WDEQ/LQD Guideline 4, Attachment 1, which has been determined to be consistent with the principles included in ProUCL and the Unified Guidance. Sample results that are determined to be true Outliers will be removed from the statistical analysis.

The treatment of Non-Detects will also be accomplished using the principles outlined in the Unified Guidance.

7.2.1.2 Monitor Well Baseline Water Quality

AUC commits to the following sampling routine. Perimeter monitor well ring wells will be installed within the Production Zone Aquifer (PZA), outside the production pattern area in a "ring" around the wellfield area. In addition, monitor wells will be installed in the overlying aquifer at a minimum density of one well per every four acres of pattern area. Four samples will be collected from each overlying and perimeter ring monitoring

well at least two weeks apart for constituents of concern, as listed in Table 2.7B-22 in Addendum 2.7-B, to establish baseline groundwater quality for each monitor well.

The first and second sample events will include analyses for all constituents of concern listed in Table 2.7B-22 in Addendum 2.7-B. If specific constituents are not detected during the first and second sampling events, those constituents will not be analyzed for during the third and fourth sample events.

Upper Control Limits (UCL's) are determined for these wells from the baseline groundwater quality data. The UCLs will be used in operational excursion monitoring. AUC will adapt the statistical principles described in the Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance, March 2009, EPA 530/R-09-007 (Unified Guidance) plus as required, WDEQ regulations and guidance that is consistent with ProUCL to determine the UCLs.

As determined from the numerical groundwater flow model described in Addendum 2.7-C of this TR, the distance between the perimeter ring monitor wells will be no more than 500 feet and the distance between these monitor wells and the production patterns will also be no more than 500 feet for Production Units located within the fully saturated portion of the PZA. The model determined a distance of 400 feet between the perimeter ring monitor wells and 400 feet between these monitor wells and the production patterns for Production Units located within the partially saturated portion of the PZA is appropriate. The acceptable distance between monitor wells and the production patterns also took into account the demonstration that if an excursion were to occur, production fluids could be controlled within 60 days, as required by WDEQ rules and regulations.

7.2.2 Wellfield Hydrologic Data Package

Following completion of the field data collection, the Wellfield Hydrologic Data Package is assembled and submitted to the WDEQ for review. In accordance with NRC Performance Based Licensing requirements, the Wellfield Hydrologic Data Package is reviewed by AUC's SERP to ensure that the results of the hydrologic testing and the planned ISR activities are consistent with technical requirements and do not conflict with any requirement stated in NRC regulations or in the NRC license. A written SERP evaluation will evaluate safety and environmental concerns and demonstrate compliance with applicable NRC license requirements as discussed in Section 5 of the TR. The written SERP evaluation will be maintained at the site and submitted to NRC for its records if necessary. Additionally, AUC will provide a copy of the Production Unit Hydrologic Data Package to NRC for review only.

The Wellfield Hydrologic Data Package contains the following:

- A description of the proposed production unit (location, extent, etc.);
- A map(s) showing the proposed production patterns and locations of all monitor wells;
- Geologic cross-sections and cross-section location maps;
- Isopach maps of the Production Zone sand, overlying confining unit and underlying confining unit;
- Discussion of how the hydrologic test was performed, including well completion reports;
- Discussion of the results and conclusions of the hydrologic test including pump test raw data, drawdown match curves, potentiometric surface maps, water level graphs, drawdown maps and when appropriate, directional transmissivity data and graphs;
- Sufficient information to show that wells in the monitor well ring are in adequate communication with the production patterns;
- Baseline water quality information including proposed UCLs for monitor wells and production unit restoration target values; and
- Any other information pertinent to the area tested will be included and discussed.

7.2.2.1 Operational UCLs and Potential Excursion Monitoring

After baseline water quality is established for the monitor wells for a particular production unit, UCLs are set for chemical constituents that are indicative of a migration of lixiviant from the well field. The constituents chosen for indicators of lixiviant migration and for which UCLs will be set are chloride, conductivity, and total alkalinity. These parameters are consistent with the NUREG-1910 (GEIS Section 2.4.1.4) (2009) and other approved ISR operations in the region. Chloride is chosen due to its low natural levels in the native groundwater and because chloride is introduced into the lixiviant from the ion exchange process. Chloride also is a very mobile constituent in the groundwater and will show up very quickly in the case of a lixiviant migration to a monitor well. Conductivity is chosen because it is an excellent general indicator of overall groundwater quality. Total alkalinity concentrations should be detected during an excursion as bicarbonate is the major constituent added to the lixiviant during ISR operations. Water levels are obtained and recorded prior to each well sampling.

Operational monitoring consists of sampling the monitor wells at least twice monthly and at least 10 days apart and analyzing the samples for the excursion indicators chloride, conductivity, and total alkalinity. AUC requests that in the event of certain situations

such as inclement weather, mechanical failure, or other factors that may result in placing an employee at risk or potentially damaging the surrounding environment, NRC allow a delay in sampling of no more than five days. In these situations, AUC will document the cause and the duration of any delays.

To assure water within the well casing has been adequately displaced and/or formation water is sampled, wells will be purged before sample collection to ensure representative water is obtained. Samples will be taken when field water quality parameters such as pH and specific conductivity appear to be stable and consistent with the anticipated water quality of the area. Low-flow purging may also be used in certain instances to prevent pulling of process fluids to the monitor well from excessive purging which ensures only formation water is sampled.

Water level and analytical monitoring data for the UCL parameters are reported to the WDEQ/LQD on a quarterly basis and the data retained on site for review by NRC.

7.2.2.2 Potential Excursion Verification and Corrective Action

An excursion is the unintended spread, either horizontally or vertically, of recovery solutions from the wellfield to a monitor well. Monitor wells are installed to analyze for appropriate groundwater quality parameters and detect excursions. During routine sampling, if two of the three UCL values are exceeded in a monitor well, an excursion is deemed to have occurred. According to NUREG-1569, Section 5.7.8.3 (Criterion 5), a series of sampling events must occur to verify the excursion event. AUC will follow those guidelines listed here:

- Following the first sample of the monitor well in question (where at least two of the three UCLs were exceeded), a second verification sample must be taken within 48 hours after receiving the initial sample's data. The verification sample will be split and analyzed in duplicate to assess analytical error;
- If the second sample's UCLs are not exceeded, then a third verification sample must be taken within 48 hours after receiving the second sample's data;
- If neither the second or third sample's data do not exceed the UCLs, then the original sample's data is considered in error, and the well is removed from excursion status; and
- If either the second or the third sample contains indicators above UCLs, an excursion is confirmed, the well is placed in excursion status, and corrective action must be initiated.

Upon verification of an excursion, the NRC Project Manager and the WDEQ/LQD is notified by telephone or email within 24 hours and notified in writing within seven days

as required by NUREG-1569, Section 5.7.8.3 (Criterion 5). Additionally, a more detailed written report describing the excursion event, corrective actions, and corrective action results will be submitted to the NRC within 60 days of the excursion confirmation.

If an excursion is verified, the following methods of corrective action will be instituted (not necessarily in the order given) dependent upon the circumstances:

- A preliminary investigation will be completed to determine the probable cause;
- Production and/or injection rates in the vicinity of the monitor well will be adjusted as necessary to increase the net bleed, thus forming a hydraulic gradient toward the production zone;
- Individual wells will be pumped to enhance recovery of recovery solutions;
- Injection into the well field area adjacent to the monitor well may be suspended. Recovery operations continue, increasing the overall bleed rate and the recovery of wellfield solutions;
- According to NUREG-1569, Section 5.7.8.3 (Criterion 5), stability in the excursion indicator concentrations must be demonstrated by measurements over a suitable time period before the corrective action measures can be discontinued. AUC will increase sampling frequency of any monitor well on excursion status to a minimum of once every seven days; and
- In compliance with NUREG-1569, Section 5.7.8.3 (Criterion 5), AUC will consider corrective action complete when all excursion indicators are below their respective UCLs, or if only one excursion indicator exceeds its respective UCL by less than 20 percent.

If the concentration of the UCL parameters detected in the monitor well(s) does not begin to decline within 60 days after the excursion is verified, either injection into the production zone adjacent to the excursion will be suspended or AUC will provide an increase to the reclamation surety in an amount that is agreeable to NRC and that would cover the expected full cost of correcting and cleaning up the excursion. The surety increase will remain in force until the excursion is corrected. The written 60 day excursion report will state and justify which course of action will be followed. An excursion will be considered concluded when the concentrations of excursion indicators do not exceed the criteria defining an excursion, or if only one excursion indicator exceeds its respective UCL by less than 20 percent and has been demonstrated over three consecutive seven day sampling periods.

A numerical model has been developed to further demonstrate that an excursion can be recovered under hydrologic conditions present at the Proposed Project. The numerical model is used to simulate the occurrence and recovery of an excursion using pumping

rates that could be achieved and maintained at the site. Details of the model simulation are provided in Addendum 2.7-C of the TR.

7.2.3 Wellfield and Pipeline Flow and Pressure Monitoring

Section 8.3.2 of NUREG-1910 discusses operator monitoring of injection and recovery well flow rates to manage the entire wellfield water balance. The pressure of each the production trunk lines in each header house also will be monitored. Unexpected pressure changes could indicate equipment failure, a leak, or wellfield problems.

The Proposed Project will have an extensive program of wellfield and pipeline flow and pressure monitoring as described in Section 3.4.1 of the TR. Injection and recovery flow rates will be monitored at each header house to balance injection and recovery in each pattern and throughout the wellfield. The recovery and injection flow rate in each well will be continuously individually monitored by electronic flow meters in each wellfield header house. The pressure of each recovery and injection trunk line also will be monitored at the header house with electronic pressure gauges. Both flow meter and pressure gauges will tie into the header house control panel that will ultimately tie into the CPP control room. High and low, pressure and/or flow alarms will alert wellfield and plant operators if specified ranges are exceeded. Automatic shutoff valves will stop the flow in the event of significant changes in volume or pressure. This monitoring will alert the operators to detect malfunctions that could lead to either wellfield infrastructure or pipeline failures.

7.2.4 Backup Pond Leak Detection Monitoring

The backup pond design will utilize a double liner system with an intervening leak detection system. The backup pond liners and the leak detection system will meet the requirements of NRC Regulatory Guide 3.11. The backup pond primary liner will likely be a high density polyethylene (HDPE) or a polypropylene (PP) liner with a minimum thickness of 36 mils (0.036 inch). HDPE and PP liners are generally very resistant to chemicals and alkaline and acid agents, with the exception of oxidizing acids and salt solutions (Renken et al 2005). Site preparation and liner installation will be in accordance with manufacturer's specifications.

The leak detection system will consist of a permeable drainage layer and a collection piping system, sandwiched between the upper and lower layers. The permeable drainage layer will be located directly under the primary liner. This layer will provide support for the overlying liner, and will also transmit any leakage to collection pipes. The drainage layer will be constructed of suitable, non-reactive transport media (e.g. washed silica sand). Beneath the backup pond leak detection system will be a secondary geosynthetic

liner, with a minimum thickness of 36 mils (0.036 inch). The secondary liner will function to contain potential leaks in the primary liner, and will be installed on top of the underlying foundation material. Standpipes will be installed to allow water level measurements to be taken of the permeable leak detection drainage layer. A detailed description of the leak detection system design will be included in the backup pond design plan which AUC will provide to NRC.

7.2.5 Meteorological Monitoring

AUC will continue to operate the meteorological monitoring station established during pre-operational baseline monitoring. Results will be used in conjunction with the airborne radiological program.

7.3 Ecological Monitoring

7.3.1 Vegetation, Food and Fish

As discussed earlier in Section 7.1.4, AUC concludes from its preoperational vegetation-sampling program and through MILDOS modeling that the injection pathway for radiological dose is not significant. The MILDOS report is attached as Addendum 7-A of the TR. Therefore, AUC does not intend to conduct vegetation, food, or fish sampling because the predicted dose to an individual from these pathways will be less than five percent of the applicable radiation protection standard. No fish species occur within the Proposed Project area since surface water is ephemeral in nature and does not have sufficient volume to support fish.

7.3.2 Wildlife

During operations, AUC will continue to conduct annual raptor surveys using the survey methods described in Section 3.5.4.3 of this ER. In accordance with WDEQ/LQD requirements, a raptor nest survey is conducted in late April or early May each year to identify any new nests and assess whether known nests are being utilized. The survey covers all areas of planned activity for the life of the project (wellfields and CPP site) and a one-mile area around the activity. Status and production at known nests will be determined, if possible.

In the very unlikely event that it is necessary to disturb a raptor nest, a mitigation plan and appropriate permit will be acquired from the U.S. Fish and Wildlife Service, Wyoming Field Office, in Cheyenne, Wyoming.

Baseline monitoring studies have repeatedly demonstrated that sage grouse do not inhabit the Proposed Project area. As described previously in Section 3.5.4.3 of this ER, those surveys encompass the Proposed Project and its one-mile perimeter. No sage-grouse leks were observed in that region during any survey year. WGFD records and USDA/FS records also failed to document any sage-grouse leks within the approximate area that encompasses the general analysis area (i.e., Proposed Project boundary and a one mile perimeter). Given the lack of sage-grouse observations in the area, and the minimal quantity and marginal quality of potential sage-grouse habitat, AUC does not plan to conduct operational monitoring for sage grouse at this time.

Large game animals such as deer and pronghorn have extensive ranges and are not confined to the Proposed Project area. Therefore, the bioaccumulation of radionuclides in these animals would be limited since they would likely derive only a small fraction of total sustenance from the Proposed Project area.

7.4 Quality Assurance Program

AUC will make every reasonable effort to maintain radiation exposure, and releases of radioactive materials in effluents to unrestricted areas, as is reasonably achievable. To do this, AUC will implement a Quality Assurance (QA) program at the Proposed Project for all relevant operational monitoring and analytical procedures. The objective of the program will be to identify any deficiencies in the sampling techniques and measurement processes so that appropriate corrective actions can be implemented to obtain a level of confidence in monitoring programs results. The proposed QA program will cover radiological and non-radiological monitoring activities, and will help ensure that all radiological and non-radiological measurements and monitoring programs are reasonably valid and of a defined quality. The QA section will include both planned and systematic actions necessary to provide adequate confidence in the assessment of all monitored results. A Quality Control (QC) section will be included in the QA, and will include proposed actions to provide accepted measurement techniques, control the characteristics of measurement equipment, and proposed processes that will meet established standards.

The QA program will provide assurance to the regulatory agencies and to the public that the monitoring results are valid. The AUC QA Program will include the following criteria:

- Establish and apply all radiological, effluent and environmental programs to be consistent with RG 4.14 (Sections 3 & 6) (NRC 1980) and RG 4.15 (1979);
- Ensure all record keeping is in accordance with NUREG-1569 (Section 5.3.2); included will be the provision under 10 CFR 20 stating the licensee must retain survey and calibration records for three years instead of the two years mentioned in RG 4.15 (NRC, 1979); and

- Address all aspects of decommissioning including a confidence interval (or one to be specified) before collecting decommission samples. This data will be used to demonstrate compliance and that the QA procedures to verify the compliance data are precise and accurate.

Additionally, the QA program will address the following:

- Formal delineation of organizational structure and management responsibilities; responsibility for both review/approval of written procedures and monitoring data/reports will be provided;
- Minimum qualifications and training programs for individuals performing radiological monitoring and those individuals associated with the QA program;
- Written procedures for QA activities; these procedures will include activities involving sample analysis, calibration of instrumentation, calculation techniques, data evaluation, and data reporting;
- QC in the laboratory; procedures will cover statistical data evaluation, instrument calibration, duplicate sample programs and spike sample programs. Outside laboratory QA/QC programs are included; and
- Provisions for periodic management audits to verify that the QA program is effectively implemented, to verify compliance with applicable rules, regulations and license requirements, and to protect employees by maintaining effluent releases and exposures ALARA.

The QA Program will include the following procedures addressing:

- Environmental monitoring;
- Testing;
- Exposure monitoring;
- Equipment operation and maintenance;
- Environmental and Employee health and safety; and
- Incident response.

AUC has identified six key positions of the organization and their responsibilities in application Sections 5.1 and 5.2. These positions include the:

1) Board of Directors;
2) President and Chief Executive Officer;
3) Reno Creek General Manager;
4) Manager of Environmental Health and Safety / QA Manager;
5) Radiation Safety Officer; and
6) Radiation Safety Technician.

AUC has designated the Manager of Environmental Health and Safety to be responsible for all radiation protection, health and safety, environmental, and QA programs and for ensuring that AUC complies with all applicable regulatory requirements. The Manager of Environmental, Health and Safety (EHS) reports directly to the General Manager and supervises the Radiation Safety Officer (RSO) to ensure that the radiation safety and environmental monitoring and protection programs are conducted in a manner consistent with regulatory requirements.

The RSO is responsible for the development, administration, and enforcement of all radiation safety programs in accordance with the facility license, Regulatory Guide 8.31, Section 1.2 (NRC, 2002), and all other applicable regulations and guidance. The RSO is authorized to conduct inspections and to immediately order any change necessary to preclude or eliminate radiation safety hazards and/or maintain regulatory compliance. The RSO is also responsible for implementing all on-site environmental programs, including emergency procedures, training programs for both the staff and the Radiation Safety Technicians, and sampling and inspection processes. AUC will assure that all personnel performing quality-related activities are qualified to perform their assigned jobs and tasks through meeting basic job description requirements, education standards, experience, and ongoing performance reviews.

The AUC QA program will be audited periodically. Individuals qualified in radiochemistry and monitoring techniques will conduct the audits. However, the auditors will not have direct responsibilities in the areas being audited. An example of an appropriate auditor is an outside consultant. The results of the audits will be documented and provided to the NRC and made available to members of management with authority to enact any changes needed (i.e., RSO, General Manager, etc.).

7.5 Historic and Cultural Resource Monitoring

As noted in NUREG-1748 (Section 5.4.8), prior to construction there will be procedures in place such as an Unanticipated Discovery Plan (UDP) which define the mitigation of previously unidentified or undiscovered historical or cultural resources. AUC commits to ongoing monitoring of historic and cultural resources as project development progresses. After receiving its license, and prior to the commencement of construction, AUC will prepare, submit and implement a UDP. This plan will include mitigation measures, actions to be taken, and the process of notification of relevant authorities and retention of qualified experts should unanticipated cultural resources be encountered during construction or operations of the facility. Some of those measures outlined in the UDP will include but not be limited to:

- AUC may consult with a professional archaeologist to further identify any newly discovered historical or cultural resources;
- Depending upon the nature and location of the unanticipated discovery, AUC may halt construction in the vicinity of the discovery, fence off the discovery and/or buffer area to redirect vehicular traffic, or post a security guard;
- Depending upon the nature and location of the unanticipated discovery, AUC will notify in a timely manner the appropriate authorities or oversight agencies which may include the BLM and/or the SHPO;
- The discovery of known or suspected human remains at any time or anywhere on the project area will result in the immediate cessation of construction activity at the discovery location and immediate notification of the proper law enforcement authorities;
- If those law enforcement authorities conclude the remains are archeological in nature, the UDP will outline in detail the appropriate mitigation measures including those measures listed in the Memorandum of Agreement (MOA) with Native American tribes referenced in ER Section 3.8.4.

TABLE OF CONTENTS

8 BENEFIT-COST ANALYSIS 8-1
8.1 Benefit-Cost Analysis General Background 8-1
8.2 Alternatives and Assumptions 8-2
8.2.1 Development Alternatives 8-2
8.2.1.1 No Action Alternative 8-2
8.2.1.2 Proposed Action 8-2
8.2.2 Key Assumptions and Limitations 8-2
8.2.2.1 Operating Life of Proposed Project 8-3
8.2.2.2 Discount Rate 8-3
8.2.2.3 Scope of Potential Impacts 8-3
8.2.2.4 Potential Non-Monetary Impacts and Benefit-Cost Ratio 8-3
8.3 Potential Economic Benefits of Project Construction and Operation 8-4
8.3.1 IMPLAN Input Data 8-4
8.3.2 Potential Employment Benefits 8-5
8.3.3 Potential State and Local Tax Revenue Benefits 8-6
8.4 Potential External Costs of Project Construction and Operation 8-7
8.4.1 Short Term External Costs 8-8
8.4.1.1 Housing Shortages 8-8
8.4.1.2 Impacts on Schools and Other Public Services 8-9
8.4.1.3 Impacts on Noise and Congestion 8-9
8.4.2 Long Term External Costs 8-10
8.4.2.1 Impairment of Recreational and Aesthetic Values 8-10
8.4.2.2 Land Disturbance 8-10
8.4.2.3 Habitat Disturbance 8-11
8.4.3 Groundwater Impacts 8-11
8.4.4 Radiological Impacts 8-11
8.5 Benefit-Cost Summary 8-12

List of Tables

Table 8-1: Total Operations Direct AUC Staff Positions 8-14
Table 8-2: IMPLAN Input Data for Proposed Project Construction and Decommission 8-15
Table 8-3: Employment Effects of the Proposed Project 8-16
Table 8-4: State and Local Tax Revenue IMPLAN Projections 8-17
Table 8-5: Summary of Benefits and Costs for the Proposed Project 8-18

8 BENEFIT-COST ANALYSIS

8.1 Benefit-Cost Analysis General Background

Demand for uranium to fuel nuclear power plants is growing rapidly as the nuclear industry expands. The world's appetite for energy is expanding at a fast pace, driven largely by modernization of the developing nations. At the same time as total energy demand is growing, there is a growing impetus to reduce the burning of carbon-based fuels. Currently, nuclear energy provides six percent of the world's total energy supply, including 15 percent of the world's electricity. Some countries rely heavily on the nuclear industry. In the United States nearly 20 percent of the electricity is produced from nuclear power compared to France where it is 78 percent, according to the U.S. Energy Information Administration (EIA, 2011).

Approximately 80 percent of the uranium used for nuclear reactors comes from mines and mills, including nearly 30 percent from ISR. The long term need for production of uranium is strong for the operation of both current and future nuclear power reactors. In reactor licensing evaluations, the benefits of the energy produced are weighed against environmental costs, including a prorated share of the environmental costs of the uranium fuel cycle. This section summarizes costs and benefits of the proposed development of the Proposed Project. The Benefit-Cost Analysis (BCA) discussed in this section has established that the proposed development of a new uranium ISR facility at the Proposed Project is potentially a cost-effective effort to undertake and will provide a net economic benefit to the State of Wyoming.

The analysis described in this section has been tailored to meet the requirements established by the NRC in NUREG-1569 (Section 9). It includes a description of economic costs and benefits resulting from construction, operation, restoration, reclamation, and decommissioning of the proposed facility and a discussion of temporary and long-term external costs. Where possible, benefit and cost estimates are monetized; however, reliable monetary estimates for some potential impacts are not readily available so the narrative examines several factors in non-monetary or qualitative terms.

The following analyses use IMPLAN (IMpact Analysis for PLANning), a standard industry software package that models the economic impacts of capital intensive projects, to calculate the potential economic impacts. Results derived from IMPLAN software have been approved in applications for Uranium One's Moore Ranch ISR Project (Energy Metals Corporation, US, SUA-1596). This software was originally developed by the United States Department of Agriculture (USDA) in cooperation with the Federal Emergency Management Agency (FEMA) and the United States Department of the Interior (USDI) Bureau of Land Management (BLM) for land and resource management

planning and has been in use since 1979. In 1993, Minnesota IMPLAN Group, Inc was formed to privatize the data and software.

8.2 Alternatives and Assumptions

BCA is a widely used analytical tool to help decision makers determine whether the cost of a project today will result in sufficient benefits to justify expenditure on a capital intensive project. To provide value and to assist in the decision process, the BCA needs to be clear about the alternatives being considered and the underlying assumptions including quantities of goods, labor costs, market conditions and discount rates used to compute net present value. The following discussion briefly identifies alternatives and key assumptions used throughout the analysis.

8.2.1 Development Alternatives

This BCA evaluates the benefits and costs of building the Proposed Project and all the costs and benefits resulting from its ongoing operation in Campbell County, Wyoming. The BCA tradeoff under consideration involves comparing a future assuming the Proposed Project to a future that assumes the No Action alternative.

8.2.1.1 No Action Alternative

Under the No Action alternative, there would be no change in the current land cover or land and water uses at the site as described in Section 2.1.2 of this ER. No uranium would be recovered from the subsurface orebody. As a result, there would be no change in the existing underlying socioeconomic and demographic trends.

8.2.1.2 Proposed Action

The Proposed Action involves the construction and operation of a uranium ISR facility. ISR involves leaving the ore in the ground and using liquids which are pumped through it to recover the minerals out of the ore. A more detailed discussion of the Proposed Action is described in Section 1.2 and Section 2.1 of this ER. Consequently, the Proposed Action involves limited surface disturbance at the Proposed Project.

8.2.2 Key Assumptions and Limitations

Key assumptions about the costs and benefits associated with the Proposed Project involve: (1) The Operating Life of the project; (2) the Discount Rate used; (3) the

potential Scope of the Monetary Impacts; and (4) Potential Non-monetary Impacts. Each of these is described in more detail below.

8.2.2.1 Operating Life of Proposed Project

The Proposed Project will be a single unit of analysis including the production units, CPP, and outlying related structures. For this analysis, the total effective life of the Proposed Project is assumed to be approximately 16 years. Within this time frame, there are four distinct phases each with a distinct suite of costs and benefits:

- One year of initial site development and facility construction;
- Approximately 11 years of production unit and CPP operation
- Approximately 2 years of continued CPP operation after decommissioning and decontamination of the production units, including restoration of groundwater; and
- One year of decommissioning the CPP plant and disposal wells and one additional year of continued regulatory review.

8.2.2.2 Discount Rate

All monetary values were input as 2012 dollars, therefore no discount rate is applied to future benefits and costs, which are already expressed as 2012 dollars.

8.2.2.3 Scope of Potential Impacts

A critical step in any BCA is establishing a viable scope of potential impacts and thus establishing who or what will be affected by the Proposed Project. For purposes of quantifying direct, indirect, and induced economic effects, the state of Wyoming is the geographic area of analysis (see discussion of IMPLAN Input Data below). Other socio-economic analyses (e.g., effects on housing, schools, etc.) focus on the communities within the 50 mile (80 km) study area.

8.2.2.4 Potential Non-Monetary Impacts and Benefit-Cost Ratio

Conventional BCA uses monetary values to compare goods and services derived from a project or program. The values of goods and services represent their relative importance so that if the total value of the benefits is greater than the total value of the costs, the Proposed Project is desirable. The standard result is a quantified benefit-cost ratio (BCR), equal to a project's total net benefits divided by its total cost. BCR's above one have positive net economic impacts. While many inputs in the Proposed Project BCR are

goods and services (skilled labor, construction material) that are regularly traded in markets at well known and predictable prices, others (changes to land or water, aesthetic impacts) are not directly traded and are more difficult to value. Where reliable monetary values are not available a qualitative approach based on the best available information is required. Because there is a mix of quantifiable and qualitative variables in the BCA for the Proposed Project, no numeric Benefit-Cost ratio is calculated.

8.3 Potential Economic Benefits of Project Construction and Operation

This section considers the potential economic impacts resulting from construction and operation-related activities over the life of the Proposed Project. Economic benefits are those that have the potential to affect the local economy, including the number of jobs created and state and local tax revenues generated from project related business activities.

These analyses use IMPLAN to calculate the potential economic impacts. IMPLAN allows the user to build an input-output model tailored to model the potential impacts of a Proposed Project on a specific community or region. The system is flexible and contains a database of over 500 industrial sectors gathered from counties throughout the United States. By identifying the location and industrial sector of the project (i.e., construction and production), the analyst can therefore estimate the total potential economic impact of a given project. The model requires labor and capital expenditures data as inputs in order to evaluate the potential economic impacts of the project. The output is the potential direct, indirect, and induced employment impacts and generated tax revenue.

8.3.1 IMPLAN Input Data

Wyoming was selected as the study area for IMPLAN impact analysis for a number of reasons. Although the project is located in Campbell County, using only the county as the economic study area would result in an understatement of the overall economic impact of the project. This is because Campbell County, with a population (per 2010 census) of 46,133 is too small for economic impact analysis purposes. The project operator will necessarily look outside of the county for some of the goods and services needed to construct and operate the facility. Using the state of Wyoming (with estimated 2010 population of 563,626 and with several larger retail/business communities such as Casper, Gillette, and Cheyenne) provides a greater likelihood that more of the goods and services needed for the Proposed Project will come from the economic study area. The economic study area and detailed methodology for the Implan analysis were reviewed by MIG executive Doug Olson.

Economic effects of operations were calculated using IMPLAN sector 24 (gold, silver or other metal ore mining) as there is no separate IMPLAN sector for uranium facilities. The

NAICS code for uranium-related industries (2212291) is included in IMPLAN sector 24. The IMPLAN data for Wyoming for Sector 24 was modified for the Ludeman Uranium Project analysis to better correspond to the project parameters as follows. The Wyoming state data included proprietary income as part of "Per worker Earnings" for Sector 24. Since proprietor income inflated per worker earnings in Sector 24 compared to payroll cost projections prepared by AUC, it was zeroed from the equation. This adjustment then brought the per worker earnings into better alignment with the Proposed Project payroll cost estimates. Once this adjustment was made, the number of employees directly employed for operations by AUC was used as the input to the IMPLAN model to predict the economic outputs of operating production units and the CPP (Table 8-1).

Economic effects of construction and decommissioning were calculated using two IMPLAN sectors – sector 36 (construct other non-residential structures) and sector 205 (construction machinery manufacturing). These sectors were arrived at by examining U.S. Bureau of Economic Analysis Capital Flow data. The Capital Flow data indicate that approximately 44 percent of metal mining commodity expenditures are spent on construction activities; 30 percent on equipment and machinery, and 15 percent on transportation equipment (e.g., vehicles). The remaining 11 percent is spread among a number of categories in small amounts. Projected construction and decommissioning costs are presented in Table 8-2. IMPLAN's Regional Purchase Coefficient (RPC) for sector 36 in Wyoming is 100 percent. RPC represents the proportion of goods and services purchased from local producers. IMPLAN's RPC for sector 205 (construction machinery manufacturing) was 2.6 percent, meaning that only 2.6 percent of the total amount would be spent on construction machinery and equipment produced in Wyoming and the other 97.3 percent of expenditures would go to firms outside of Wyoming. There was no comparable category for transportation equipment in the IMPLAN sectors for Wyoming—vehicle manufacturing occurs in other states.

To arrive at estimated impacts of construction and decommissioning, AUC's direct payroll and nonpayroll costs were input into the IMPLAN model as follows.Forty-four (44) percent of the total payroll and nonpayroll costs of construction was applied to sector 36 (construction) with an RPC of 100 percent. Thirty (30) percent of the total was applied to sector 205 (construction machinery) using the RPC of 2.6 percent. Much of the balance of 26 percent is assumed to be "leakage" from the state of Wyoming—costs going to goods produced elsewhere, such as purchase of vehicles. Still, the overall economic impacts of construction for this project are likely to be a conservative estimate, since some of the other goods and services that will be needed may be produced in Wyoming.

8.3.2 Potential Employment Benefits

Using the above inputs and assumption, Table 8-3 shows the potential direct, indirect, and induced effects on state-wide employment. Employment is expressed as numbers of

jobs. IMPLAN, like the Regional Economic Information System (REIS) of the US Bureau of Economic Analysis (BEA), measures an industry's employment as the average annual full and part-time number of employees. These numbers are estimates only. Actual numbers may vary based on a number of factors.

The direct employment effects refer to the employment directly generated by the project. Direct jobs include payroll positions with AUC as well as persons employed through contract on construction and decommissioning.

Indirect employment includes jobs resulting from increased demand for products or goods related to the direct effects of construction, operations, and decommissioning. Indirect employment would include jobs such as those needed to support the direct activities on site such as vehicle repair.

Induced employment is the result of expenditures caused by new household income generated by the direct and indirect effects. Food and beverage establishments, medical facilities, and retail businesses might likely require more employees to serve new residents or households with expanded incomes resulting from the increases in direct and indirect employment.

Total potential direct, indirect, and induced employment fluctuates from year to year because each year there is a different combination of construction, operations, and decommission activities.

Total direct, indirect and induced jobs created by the Proposed Project are estimated at 300 jobs during the first year of intensive construction. By the second year, the total jobs created by the project subside to approximately 155 as the CPP construction and deep disposal wells are completed. Total jobs hover between 143 and 145 for approximately the next six years. During the ninth year of the project, construction on the last of the production units is projected to be completed and total jobs declines to approximately 122, then is at 97 for four years. In year 14 there are 95 total jobs. I year 15, more jobs come on line as the CPP and deep disposal wells are decommissioned, resulting in a total of 121 jobs that year. In the 16th. final year, there are 41 total jobs.

8.3.3 Potential State and Local Tax Revenue Benefits

In addition to aggregate employment effects, IMPLAN provides an estimate of expected state and local tax revenue impacts over the life of the Proposed Project associated with ISR activities. In order to remain consistent with the scope of impact, Federal taxes are not included in this analysis.

Potential state and local tax implications associated with the Proposed Project are presented in Table 8-4 While IMPLAN includes employee and employer social insurance taxes as well as personal tax items like income tax, property tax and motor vehicle license tax, these tax revenues are not reported here because they are paid by county workers and their families and thus represent a transfer of wealth rather than a net economic gain. The state and local tax estimates in Table 8-4 are instead calculated only on non-payroll business taxes. These revenues stem directly from the construction and operation of the Proposed Project, are paid by the operator of the Proposed Project, and therefore can be counted as net economic gains when compared to the No Action alternative.

The IMPLAN tax results in Table 8-4 were adjusted as follows ---the estimated amount of severance taxes was subtracted from the total. IMPLAN results indicated a total severance tax of approximately $9.6 million over the 16-year projected life of the Proposed Project, but calculations run by Wyoming Department of Revenue's Mineral Tax Division indicate total production taxes at $41.5 million. (WDOR) The state would receive $16.4 million in severance taxes and Campbell County would receive $25.1 million in gross products taxes over the couse of the 16-year Proposed Project. These estimates were based on 10.99 million pounds of product sold at the current long-term market rate of $65 per pound.

As Table 8-4 shows, the results from the IMPLAN analysis show that the construction and operation of the Proposed Project is expected to generate annual state and local revenues of more than $1.5 million per year until the last year of the project. Total cumulative local and state tax revenues over the 16-year life of the project are estimated at $26.75 million (expressed as 2012 dollar equivalents). These taxes include property and sales taxes.

In sum, the results show the Proposed Project will result in $41.5 million in severance and production taxes and an additional $26.75 million in other state and local taxes, for a total of $68.2 million over the 16-year projected life of the project. It is noted that this figure represents a lower bound estimate as it excludes potential reserve resources and does not include potential benefits derived from taxes on royalties or lease payments to local landowners stemming from the operation of the Proposed Project.

8.4 Potential External Costs of Project Construction and Operation

In this section of the analysis, potential external costs of the Proposed Project are identified and compared to the No Action alternative. Both short-term and long-term external costs that may affect the interest of people other than the owners and operators of the Proposed Project are also identified and described.

8.4.1 Short Term External Costs

8.4.1.1 Housing Shortages

At its peak in the first year of the estimated life-span of the project, the Proposed Project is estimated to produce approximately 300 total jobs in Wyoming. This includes jobs created directly or indirectly by the project or induced by related household expenditures. Many of the jobs will be ongoing over the life of the project (such as the number of persons directly employed by the operator or its contractors for ongoing construction). Because the total number of jobs is estimated to fluctuate from year to year, some jobs will be short term rather than ongoing.

Unemployment rates are low in the seven counties surrounding the Proposed Project. In January 2012, unemployment rates ranged from 4.7 percent to 5.8 percent in all but Weston (6.5 percent) and Johnson (8.0 percent) Counties, compared to 8.8 percent for the entire United States (WDOW). It is anticipated that this area will continue to have relatively low unemployment rates. Consequently, it is assumed that the supply of available workers is limited locally and that many of the employees needed to fill the projected new local jobs will come from outside the seven county area.

At the peak of all direct, indirect, and induced employment, which falls in the first year of the project, a total additional estimated 300 jobs would be created. Although the IMPLAN analysis study area was for the entire state of Wyoming, for purposes of analyzing the range of impacts, all 300 jobs were projected to result in new demand for housing in communities within an 50 mile (80 km) radius of the Proposed Project. This overestimates the likely potential for impacts to this area because some of the indirect and induced jobs will be located outside of the 50 mile (80 km) study area and some of the jobs will be filled with current local residents who need no additional housing.

Assuming each job created a separate demand for housing, it would require 300 available housing units. In 2010, there were 661 vacant rental units and 209 houses for sale in the seven communities within 50 mile (80 km) of the Proposed Project area – Gillette, Wright, Sleepy Hollow, Antelope Valley, Kaycee, Edgerton and Midwest, with most of the available units located in Gillette. In addition, the Casper area, which is approximately 1.5 hours from the project site, has considerable housing stock. In 2010, Natrona County had 921 vacant rental units and 370 houses for sale. In the event that workers from out-of-state are hired for the short-term construction phase of the proposed project, the present available stock of motel/hotel rooms and RV sites will accommodate the temporary workers.

There is sufficient available housing in the 50 mile (80 km) study area to accommodate new residents taking jobs directly or indirectly related to the Proposed Project.

8.4.1.2 Impacts on Schools and Other Public Services

The estimated total of 300 new direct, indirect, and induced jobs of the peak employment year for the Proposed Project would result in a total population increase of 726 persons, based on average household size in Wyoming of 2.42 in 2010 (U.S. Census) and assuming that all of the jobs are filled with persons not already living in Wyoming.

As identified above in the discussion of housing, it is unlikely that all 300 new jobs will be based in the 50 mile (80 km) study area, but for analysis purposes it is assumed to be so to identify the highest potential impact. The addition of 726 persons would be an increase of approximately 1.5 percent to the total 2010 population of 45,807 living in the 50 mile (80 km) study area.

According to the 2010 U.S. Census, children between the ages of five and 19 comprised between 16.7 percent to 22.0 percent of the total county population in the seven counties included in the study area. The highest ratio was in Campbell County (22.0 percent). Using 22.0 percent as the ratio for school age children, there would be approximately 160 school age children anticipated from the projected increase in total direct, indirect, and induced employment.

All of the schools within the 50 mile (80 km) study area have some capacity for additional students, with the exception of the Kaycee Schools and the elementary school in Wright. Gillette schools are experiencing significant growth in student numbers, but are working to accommodate new students.

A total increase of approximately 1.5 percent to the total population of mile (80 km) study area is not likely to create a significant impact on other public services such as fire, police, water, and utilities. Actual population increases as a result of the Proposed Project are anticipated to be less than described here because not all jobs will result in new residents within the study area.

8.4.1.3 Impacts on Noise and Congestion

Currently there is one occupied housing unit located within the Proposed Project area, and it will be purchased by AUC prior to commencing construction activities. Open rangeland is the primary land use within and in the surrounding five-mile land use area. Other land uses include oil and gas production, CBM production, as well as livestock grazing. As a result of the remote location of the Proposed Project and the low population density of the surrounding area, impact to noise or congestion within the Proposed Project area or in the surrounding five mile land use area will be miminal. Additionally, given the maximum increase in population due to migrant workers is insignificant, noise and congestion impacts are not anticipated in Campbell or other neighboring counties.

8.4.2 Long Term External Costs

8.4.2.1 Impairment of Recreational and Aesthetic Values

While opportunities for developed and dispersed recreation exist throughout the seven-county region surrounding the Proposed Project, there is currently very limited recreational use within the Proposed Project area or in the surrounding review area. Most developed recreation opportunities offered by the private sector are community facilities in townships or urban areas for tourist services and facilities.

The physical remoteness of the Proposed Project and its lack of proximity to any well recognized federal or state sites of recreational interest indicated that there are no significant long-term impairments to recreational values from developing the Proposed Project.

8.4.2.2 Land Disturbance

The Proposed Project area has been used historically for grazing, oil and gas development, and CBM development; therefore, it is unlikely that any previously unaffected land area currently exists within the Proposed Project area. A significant, pre-existing human footprint on the landscape is evident in existing grazing activities and facilities (stock tanks, fences), oil production facilities, natural gas production facilities, and infrastructures that support these activities. Oil and gas field infrastructure within the Proposed Project area and the surrounding five mile land use review area includes access roads, overhead electric distribution lines, and cleared rights-of-way for underground utilities, which are generally found along access roads. There would be negligible changes in land cover or land use from existing conditions outside of the five mile land use review area.

As the Proposed Project will use in-situ recovery instead of conventional surface mining techniques, there will be limited land surface disturbance associated with the wellfield development and operation of the site. Land surface disturbance associated with wellfield development will also be short term as interim stabilization with native vegetation species is implemented as construction activities are complete and maintained through the life of the wellfield. No tailings and minimal byproduct material will be generated. The CPP and private access roads will be confined to clearly delineated areas within the Proposed Project area. While there will be some land use changes from the existing condition within the Proposed Project area, potential impacts will be minimal.

8.4.2.3 Habitat Disturbance

Currently, there is no Federal or State designated critical wildlife habitat located within the Proposed Project area. As the Proposed Project area has been historically used extensively for oil and gas production, CBM production, and livestock grazing there are no anticipated long-term losses to wildlife or wildlife habitat relative to the existing conditions resulting from the construction and operation of the Proposed Project.

8.4.3 Groundwater Impacts

It is unlikely that any future irrigation development will occur within the Proposed Project area due to limited water supplies, topography, and climate. Any irrigation within the five-mile land use review area is anticipated to be consistent with historic uses. Based on population projections, future water use within the five-mile land use review area will likely be a continuation of current practices; therefore, it is anticipated that there will be no significant changes from the existing conditions for public water supply in the area and the operation of the Proposed Project has a very limited potential to induce adverse affects.

Following standard ISR practice, any impacted water drawn from the groundwater on site will either be treated before re-injection or disposed through deep well injection. Upon decommissioning, wells will be sealed and remaining groundwater will be restored as discussed in Section 6.4 of this document.

Given the historically limited irrigation, the lack of domestic groundwater use, and the groundwater restoration program associated with the Proposed Project, there will be no permanent commitment of water resources required and any potential long-term changes from the No Action groundwater conditions will be limited to those identified and addressed in the groundwater restoration program.

8.4.4 Radiological Impacts

As the Proposed Project will be using ISR techniques, most of the identified radioactivity in the orebody will remain permanently underground. Following standard ISR procedures, routine operational monitoring of air, dust and surface contamination will be undertaken by AUC as discussed in Section 5 of the TR. Prior to the CPP decommissioning, a preliminary radiological survey will be conducted to identify any potential radiological hazards. The survey also will support the development of procedures for dealing with such hazards prior to commencement of decommissioning activities.

Decommissioning of Proposed Project process facilities will be scheduled only after agency approval. This will be accomplished in accordance with an approved decommissioning plan and the most current applicable USNRC rules and regulations, permit and license stipulations and amendments in effect at the time of the decommissioning activity.

All process or potentially contaminated equipment and materials at the process facility including tanks, filters, pumps, piping, etc., will be designated for one of the following removal alternatives:

- Removal to a new location within the Proposed Project area for further use or storage;
- Removal to another licensed facility for either use or permanent disposal; or
- Decontamination to meet unrestricted use criteria for release, sale or other non-restricted use by the landowners and others.

It is likely that process buildings will be dismantled and moved to another location or to a permanent licensed disposal facility. Cement foundation pads and footings will be broken up and trucked to a local disposal site or to a licensed facility if contaminated. The landowners may request that a building or other structures be left on site for future use. In that case, the building will be decontaminated to meet unrestricted use criteria. At the present time, burial of non-contaminated byproduct material on site is not anticipated.

Under the proposed operating and decommissioning conditions, the potential long-term external radiological impacts at the Proposed Project are anticipated to be negligible compared to the existing background No Action conditions.

8.5 Benefit-Cost Summary

A primary economic benefit of the Proposed Project is the creation of approximately 300 new job opportunities within the State of Wyoming, including the direct, indirect and induced employment effects over the construction and operating life of the Proposed Project (Table 8-5). Additionally, the Proposed Project may generate up to $68.2 million in total state and local business tax revenues over the life of the Proposed Project, which is a significant economic gain compared to the No Action alternative.

Table 8-5 further shows that the short-terms effects on housing, schools and public facilities and the increased potential for noise and congestion in the county involve little or no change compared to the current conditions. Based on the historic land uses, physical remoteness and proposed reclamation practices, no potential quantifiable long-term impairments appear to significantly offset the benefits of the Proposed Project.

The Proposed Project is likely to place negligible short-term or long-term cost burdens on the county, while providing increased revenue and employment opportunities; therefore, the development and operation of the Proposed Project will provide a net economic benefit to Campbell County and the State of Wyoming when compared to the No Action alternative.

Table 8-1: Total Operations Direct AUC Staff Positions

Year of Operation	AUC Employees
Year 1	38
Year 2	38
Year 3	44
Year 4	44
Year 5	44
Year 6	44
Year 7	44
Year 8	44
Year 9	44
Year 10	43
Year 11	43
Year 12	43
Year 13	43
Year 14	38
Year 15	38
Year 16	19

Table 8-2: IMPLAN Input Data for Proposed Project Construction and Decommission

	Total Costs of Construction Decommission	Non-eqmt costs (44% of total)	Eqmt and machinery (30%)
Year 1	$45,532,500	$20,034,300	$13,659,750
Year 2	$15,532,500	$6,834,300	$4,659,750
Year 3	$10,620,000	$4,672,800	$ 3,186,000
Year 4	$10,620,000	$4,672,800	$3,186,000
Year 5	$10,620,000	$4,672,800	$3,186,000
Year 6	$10,886,250	$4,789,950	$3,265,875
Year 7	$ 0,975,000	$4,829,000	$3,292,500
Year 8	$10,975,000	$4,829,000	$3,292,500
Year 9	$6,275,000	$2,761,000	$1,882,500
Year 10	$1,440,000	$633,600	$432,000
Year 11	$1,440,000	$633,600	$432,000
Year 12	$,440,000	$633,600	$432,000
Year 13	$,440,000	$633,600	$432,000
Year 14	$3,166,500	$1,393,260	$949,950
Year 15	$8,608,500	$3,787,740	$2,582,550
Year 16	$235,000	$103,400	$70,500

Table 8-3: Employment Effects of the Proposed Project

	Direct	Indirect	Induced	Total
Year 1 -Construction/Decommission	146.1	36.1	38.6	220.9
Year 1 - Operations	38	21.2	20.2	79.3
Subtotal	**184.1**	**57.3**	**58.8**	**300.2**
Year 2 - Construction/Decommission	49.8	12.3	13.2	75.3
Year 2 - Operations	38	21.2	20.2	79.3
Subtotal	**87.8**	**33.5**	**33.4**	**154.7**
Year 3 - Construction/Decommission	34.1	8.4	9	51.5
Year 3 - Operations	44	24.5	23.4	91.9
Subtotal	**78.1**	**32.9**	**32.4**	**143.4**
Year 4- Construction/Decommission	34.1	8.4	9	51.5
Year 4 - Operations	44	24.5	23.4	91.9
Subtotal	**78.1**	**32.9**	**32.4**	**143.4**
Year 5 - Construction/Decommission	34.1	8.4	9	51.5
Year 5 - Operations	44	24.5	23.4	91.9
Subtotal	**78.1**	**32.9**	**32.4**	**143.4**
Year 6 - Construction/Decommission	34.9	8.6	9.2	52.8
Year 6 - Operations	44	24.5	23.4	91.9
Subtotal	**78.9**	**33.1**	**32.6**	**144.6**
Year 7 - Construction/Decommission	35.2	8.7	9.3	**91.9**
Year 7 - Operations	44	24.5	23.4	53.2
Subtotal	**79.2**	**33.2**	**32.7**	**145.1**
Year 8 - Construction/Decommission	35.2	8.7	9.3	53.2
Year 8 - Operations	44	24.5	23.4	91.9
Subtotal	**79.2**	**33.2**	**32.7**	**145.1**
Year 9 - Construction/Decommission	20.1	5	5.3	30.4
Year 9 - Operations	44	24.5	23.4	91.9
Subtotal	**64.1**	**29.5**	**28.7**	**122.3**
Year 10 - Construction/Decommission	4.6	1.1	1.2	7
Year 10 - Operations	43	23.9	22.8	89.8
Subtotal	**47.6**	**25**	**24**	**96.6**
Year 11 - Construction/Decommission	4.6	1.1	1.2	7
Year 11 - Operations	43	23.9	22.8	89.8
Subtotal	**47.6**	**25**	**24**	**96.6**
Year 12 - Construction/Decommission	4.6	1.1	1.2	7
Year 12 - Operations	43	23.9	22.8	89.8
Subtotal	**47.6**	**25**	**24**	**96.6**
Year 13 - Construction/Decommission	4.6	1.1	1.2	7
Year 13 - Operations	43	23.9	22.8	89.8
Subtotal	**47.6**	**25**	**24**	**96.6**
Year 14 - Construction/Decommission	10.2	2.5	2.7	15.4
Year 14 - Operations	38	21.2	20.2	79.3
Subtotal	**48.2**	**23.7**	**22.9**	**94.8**
Year 15 - Construction/Decommission	27.6	6.8	7.3	41.8
Year 15 - Operations	38	21.2	20.2	79.3
Subtotal	**65.6**	**28**	**27.5**	**121.1**
Year 16 - Construction/Decommission	0.8	0.2	0.2	1.1
Year 16 - Operations	19	10.6	10.1	39.7
Subtotal	**19.8**	**10.8**	**10.3**	**40.9**

Table 8-4: State and Local Tax Revenue IMPLAN Projections

INDIRECT TAXES NOT INCLUDING SEVERANCE (In Dollars)					
	Enterprise Tax		Indirect Business Tax		
Year	Construction-Decom	Operations	Construction-Decom	Operations	TOTAL
1	36,621	278,774	365,147	1,205,555	1,886,097
2	12,492	278,774	124,563	1,205,555	1,621,384
3	8,541	322,791	85,167	1,395,905	1,812,404
4	8,541	322,791	85,167	1,395,905	1,812,404
5	8,541	322,791	85,167	1,395,905	1,812,404
6	8,756	322,791	87,302	1,395,905	1,814,754
7	8,827	322,791	88,014	1,395,905	1,815,537
8	8,827	322,791	88,014	1,395,905	1,815,537
9	5,047	322,791	50,323	1,395,905	1,774,066
10	1,158	315,455	11,548	1,364,180	1,692,341
11	1,158	315,455	11,548	1,364,180	1,692,341
12	1,158	315,455	11,548	1,364,180	1,692,341
13	1,158	315,455	11,548	1,364,180	1,692,341
14	2,547	278,774	25,399	1,205,555	1,512,275
15	6,924	278,774	69,035	1,205,555	1,560,288
16	189	139,387	1,884	602,777	744,237
Total	**120,485**	**4,775,840**	**1,201,374**	**20,653,052**	**26,750,751**

Table 8-5: Summary of Benefits and Costs for the Proposed Project

Benefits	Costs
• Tax revenue $68.2 million • Additional new jobs (peak year) 300 jobs	• Housing impacts -Little or no change • Schools and Public Facilities -Negligible • Noise and Congestion -Negligible • Impairment of recreational and Aesthetic values -Negligible • Land Disturbance -Minor • Groundwater impacts -Controlled through mitigation • Radiological Impacts -Controlled through mitigation

TABLE OF CONTENTS

9 Summary of Environmental Consequences..... 9-1

List of Tables

Table 9-1: Summary of Environmental Consequences of the Proposed Action..... 9-3

9 SUMMARY OF ENVIRONMENTAL CONSEQUENCES

This section summarizes the potential environmental impacts and consequences of the Proposed Action. Further discussion regarding the project resources and impacts can be found in:

- Section 1 of this Environmental Report outlines the operation plans and explains the purpose and need for the Proposed Project;
- The alternatives considered in the formulation of the Proposed Action are described in Section 2;
- Section 3 characterizes the existing baseline environment of the Proposed Project and the surrounding area;
- The potential environmental impacts (adverse and positive) of the Proposed Action are discussed in detail in Section 4;
- Cumulative impacts of the Proposed Project are discussed in Section 5;
- AUC's plan for mitigating potential impacts are discussed in Section 6;
- Section 7 describes the monitoring program for the Proposed Project lifecycle; and
- An analysis of the benefits and costs of the Proposed Project is included in Section 8.

The potential impacts and consequences of the Proposed Action are discussed in terms of 1) the unavoidable adverse environmental impacts, 2) the relationship between local short-term uses of the environment and the maintenance of long-term productivity, and 3) the irreversible and irretrievable commitment of resources. The information is presented for the Proposed Action for 12 resource areas and discussed by stage of the proposed facility lifecycle (i.e., construction, operation, aquifer restoration, and decommissioning). The impacts are described in Table 9-1. The following terms are defined in the U.S. Nuclear Regulatory Commission (NRC) NUREG–1748 (NRC, 2003).

- Unavoidable adverse environmental impacts: applies to impacts that cannot be avoided and for which no practical means of mitigation are available;
- Irreversible: involves commitments of environmental resources that cannot be restored;
- Irretrievable: applies to material resources and would involve commitments of materials that, when used, cannot be recycled or restored for other uses by practical means;
- Short-term: represents the period from preconstruction to the end of the decommissioning activities and therefore generally affects the present quality of life for the public; and

- Long-term: represents the period of time following the termination of the site license, with the potential to affect the quality of life for future generations.

Due to the benign nature of ISR uranium recovery and the lack of unique environmental resources in the area, the potential impacts of the Proposed Project are minor. Because of the relatively short duration of the Proposed Project (approximately 15 years from construction to decommissioning) environmental impacts are short-term. No significant impacts extending beyond the duration of the project have been identified.

Only a few resources are deemed irretrievable as a result of the Proposed Project. Those include irreversible and irretrievable commitment of resources for project construction, operation, aquifer restoration, and decommissioning are the chemicals used in the mineral recovery process (none of which are scarce), the fuel required to operate equipment and transport employees to and from the project, and the power consumed by the process (to run pumps and motors and to dry the yellowcake). The yellowcake produced will generate domestic energy far exceeding the energy resources utilized during the project.

Table 9-1: Summary of Environmental Consequences from the Proposed Action

Impact Category	Unavoidable Adverse Environmental Impacts	Irreversible and Irretrievable Commitment of Resources	Short-Term Impacts	Long-Term Impacts
Land Use	Under the Proposed Action, there will be a small impact on land use during the construction and decommissioning phases of the Proposed Project. During construction, approximately 481 acres at the Proposed Project combined would be either controlled (fenced) or disturbed during earth moving activities to construct the CPP, build access roads, and develop production units. This acreage is approximately 8 percent of the Proposed Project area. During decommissioning, land would be impacted by earthmoving activities to reclaim and reseed the affected areas.	No Impact	The Proposed Action will cause temporary alteration of rangeland, short-term resricted access to neighboring lands. Approximately 481 acres will be controlled and unavailable for other uses such as grazing. Other energy development could coexist with the Proposed Action.	No Impact. There would be no impact from the Proposed Action following license termination.

Table 9-1: Summary of Environmental Consequences from the Proposed Action (Continued)

Impact Category	Unavoidable Adverse Environmental Impacts	Irreversible and Irretrievable Commitment of Resources	Short-Term Impacts	Long-Term Impacts
Transportation	Under the Proposed Action, there would be a small impact. Increased truck and vehicle traffic along State Highway 387 and along Highway 50 to access the Proposed Project area, could result in small changes to the current uses of these local roads.	No Impact	Small increases in the number of traffic accidents resulting in injuries or fatalities could occur. The small increase in vehicular emissions will not degrade local air quality. The NRC's *Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities* (NUREG-1910, GEIS Section 10) concluded the risk from transporting yellowcake, ion exchange resin, byproduct material, and hazardous chemicals was small.	No Impact. There would be no impact from the Proposed Action following license termination

Table 9-1: Summary of Environmental Consequences from the Proposed Action (Continued)

Impact Category	Unavoidable Adverse Environmental Impacts	Irreversible and Irretrievable Commitment of Resources	Short-Term Impacts	Long-Term Impacts
Geology and Soils	Under the Proposed Action there would be a small impact to soils primarily from earthmoving activities associated with the construction and decommissioning phases of the Proposed Action. Approximately, 154 acres of the surface would be disturbed to construct the CPP, wellfields including header houses, and access roads. These impacts would be temporary and at the end of the decommissioning phase the topsoil would be replaced.	Under the Proposed Action soil layers would be disturbed during all phases which is irreversible however, topsoil salvaged during construction will be stored and reapplied during decommissioning. Reseeding and re-contouring would mitigate this impact	As noted in NUREG-1910 (GEIS, Section 10) there would be a small impact to soils primarily from earthmoving activities associated with the construction and decommissioning phases of the Proposed Action. These impacts would be for the duration of the Proposed Action and affect approximately 154 acres.	No Impact. There would be no impact from the Proposed Action following license termination

Table 9-1: Summary of Environmental Consequences from the Proposed Action (Continued)

Impact Category	Unavoidable Adverse Environmental Impacts	Irreversible and Irretrievable Commitment of Resources	Short-Term Impacts	Long-Term Impacts
Water Resources (Surface Water)	There would be a small impact on surface water from the construction of the CPP and the production units from increased sediment yield in the disturbed areas. No wetlands will be disturbed by the Proposed Action. However, AUC has proposed erosion control mitigation measures such as grading and contouring, and installing culverts to identify designated traffic routes to mitigate the potential impact on surface water.	No Impact	Normal construction activities at the CPP, produciton units, along pipelines and access roads have the potential to result in increased sediment yield in surface water runoff. However, given the ephemeral nature of the drainages and the small area to be affected, the potential impact on surface water during construction and decommissioning would primarily be limited to uncommon precipitation or runoff events. These impacts would be further mitigated by implementing the best management practices.	No Impact. There would be no impact from the Proposed Action following license termination

Table 9-1: Summary of Environmental Consequences from the Proposed Action (Continued)

Impact Category	Unavoidable Adverse Environmental Impacts	Irreversible and Irretrievable Commitment of Resources	Short-Term Impacts	Long-Term Impacts
Water Resources (Groundwater)	There would be a small impact on groundwater. Groundwater would be impacted from ISR by consumption of groundwater and degradation of water quality in the production zone	About 99 percent of the groundwater used during the ISR process would be treated and re-injected into the subsurface; however, about one percent of the groundwater used in the ISR process would be consumed.	Short-term impacts to groundwater would include degradation of the water quality within the production zone and the potential to drawdown the water level in neighboring private wells.	Both the State of Wyoming and NRC require restoration of affected groundwater following operations. The groundwater quality will be restored to ensure that adjacent groundwater will not be affected. After production and groundwater restoration are completed and groundwater withdrawals were terminated the groundwater levels will recover with time.

Table 9-1: Summary of Environmental Consequences from the Proposed Action (Continued)

Impact Category	Unavoidable Adverse Environmental Impacts	Irreversible and Irretrievable Commitment of Resources	Short-Term Impacts	Long-Term Impacts
Ecological Resources	Under the Proposed Action, the potential impact on ecological resources would be small. Construction and decommissioning of the Proposed Project would result in the short-term loss of vegetation and could stimulate the introduction and spread of undesirable and invasive, nonnative species.	Vegetative communities directly impacted by earthmoving activities and wildlife injuries and mortalities would be irreversible. However, the implementation of mitigative measures such as the use of fencing to limit wildlife movement and AUC's enforcement of speed limits would reduce the potential impact to wildlife. Furthermore, areas impacted by earthmoving activities would be reclaimed and reseeded.	During any of the ISR phases, direct impacts to ecological resources from the Proposed Action could include injuries and fatalities caused by either collisions with project-related traffic or habitat removal actions from the removal of topsoil. Most habitat disruption could consist of scattered, confined drill sites for wells and would not result in large transformation of the existing habitat. Wildlife could also be displaced by increased noise and traffic. The Federally listed candidate species, the Greater sage-grouse, is known to occur in the vicinity of the Proposed Project site: there are three known leks within a four mile radius of the Proposed Project area (none within the project boundary). AUC has committed to implement mitigative measures to reduce the potential impact on the Greater sage-grouse as well as other wildlife species.	Some of the vegetative communities that exist within the Proposed Project area could be difficult to reestablish through artificial plantings and natural seeding could take many years. Species associated with the affected vegetative communities could be reduced in number or replaced by generalist species. Several of the landowners have elected to reseed disturbed areas on their propoerty with a seed mix of their choice.

Table 9-1: Summary of Environmental Consequences from the Proposed Action (Continued)

Impact Category	Unavoidable Adverse Environmental Impacts	Irreversible and Irretrievable Commitment of Resources	Short-Term Impacts	Long-Term Impacts
Air Quality	There would be a small impact during implementation of the Proposed Action, there would be increased amounts of dust (particulates) from earthmoving activities to construct the CPP, production units, lay pipeline, and to build access roads. There would be a small impact from vehicular traffic on unpaved roads and from diesel emissions from construction equipment.	No Impact	There would be a temporary, short term impact on air quality primarily during the construction and decommissioning phases from earthmoving activities and from vehicle emissions. The effect would be highly localized and temporary. Use of mitigative measures such as applying water for dust suppression would limit fugitive dust emissions.	No Impact. There would be no impact from the Proposed Action following license termination
Noise	There would be a small impact under the Proposed Action. The nearest resident is located northwest of the Proposed Project boundary approximately 0.42 miles.	No Impact	The short-term impact under the Proposed Action would be small. Noise associated with the contruction and decomissioning of the CPP, production units, access roads, and pipeline trenching would have a small impact.	No Impact. There would be no impact from the Proposed Action following license termination

Table 9-1: Summary of Environmental Consequences from the Proposed Action (Continued)

Impact Category	Unavoidable Adverse Environmental Impacts	Irreversible and Irretrievable Commitment of Resources	Short-Term Impacts	Long-Term Impacts
Historical and Cultural	No Impact. As noted in NUREG-1910 (GEIS, Section 3.3.8.4) there are no identified historical or cultural resources eligible for listing on the National Register of Historic Places within the boundary of the Proposed Project.	No Impact	No short-term impact to historic or cultural resources would be expected. If any unidentified historic or cultural resources are encountered, work will stop and appropiate federal and state officials would be notified. Therefore, the potential impact to historic and cultural resources during operations will be small.	No Impact. There would be no impact from the Proposed Action following license termination
Visual and Scenic	There would be a small impact under the Proposed Action. The area surrounding the Proposed Project area has exisiting wellfields, pipelines, and utility lines associated with CBM and oil and Gas development.	No Impact	There would be a small short-term impact to the visual landscape from the proposed action. These activities would be consistant with the BLM visual resource classification of the project area and exisiting CBM and oil and gas infrastructure.	No Impact. There would be no impact from the Proposed Action following license termination

Table 9-1: Summary of Environmental Consequences from the Proposed Action (Continued)

Impact Category	Unavoidable Adverse Environmental Impacts	Irreversible and Irretrievable Commitment of Resources	Short-Term Impacts	Long-Term Impacts
Socioeconomic	The Proposed Action, for each phase of the Proposed Project, the socioeconomic impact would be small. Over the life of the operation, there could potentially be a moderate impact on housing availability.	Not Applicable	The Proposed Action would predominantly have a small impact on the local communities except for housing availability. Although jobs would be created and tax revenue would be generated to stimulate the local economy, implementation of the Proposed Action could potentially affect housing availability over the life of the operation and result in a moderate impact.	No Impact. There would be no impact from the Proposed Action following license termination

Table 9-1: Summary of Environmental Consequences from the Proposed Action (Continued)

Impact Category	Unavoidable Adverse Environmental Impacts	Irreversible and Irretrievable Commitment of Resources	Short-Term Impacts	Long-Term Impacts
Public and Occupational Health and Safety	Under the Proposed Action, there would be a small impact on public and occupational health. Construction and decommissioning would generate fugitive dust emissions that could result in a dose comparable to that from natural background exposure based on baseline radiological environmental monitoring which indicates radon in air and the average concentrations of uranium and radium in soils are comparable to those at background.	Not Applicable	Under the Proposed Action, there would be a small impact from radiological exposure. The radon dose calculations for the Proposed Project under normal operations showed that the potential dose would be less than the 1mSv [100 mrem] per year dose limit for a member of the public, as specified in 10 CFR 20.1301 and also within the range of doses reported in the GEIS. The radiological impacts from accidents will be small for workers if procedures to deal with accident scenarios are followed, and small for the public because of the facility's remote location. The nonradiological public and occupational health impacts from normal operations, accidents, and chemical exposures will be small if handling and storage procedures are followed.	No Impact. There would be no impact from the Proposed Action following license termination

Table 9-1: Summary of Environmental Consequences from the Proposed Action (Continued)

Impact Category	Unavoidable Adverse Environmental Impacts	Irreversible and Irretrievable Commitment of Resources	Short-Term Impacts	Long-Term Impacts
Waste Management	Waste generation and disposal from activities implemented during all phases of the Proposed Project under the Proposed Action would result in small impacts on available disposal capacity, since permitted and/or licensed facilities are available to accept 11e.(2) and non-11e.(2) byproduct material. Construction wastes will be mostly solid non-11e.(2) byproduct; operations wastes will include primarily solid municipal waste and liquid 11e.(2) byproduct; and decommissioning wastes would include a range of solid wastes including non-hazardous and hazardous wastes, and solid 11e.(2) byproduct material	The energy consumed during all phases, the construction materials used that could not be reused or recycled, and the space used to properly handle and dispose of all waste types (i.e., wells for liquid 11e.(2) byproduct and permitted disposal of soild 11e.(2) and non-11e.(2) byproduct) could represent an irretrievable commitment of resources, resulting in a small impact.	As noted in NUREG-1910 (GEIS, Section 10), during all phases, hazards associated with handling and transport of wastes would represent a short-term and small impact.	During all phases, the permanent disposal of wastes in on-site injection wells would represent a small impact on the longterm productivity of the land allocated for these wells.

10 ENVIRONMENTAL REPORT REFERENCES

Section 1 - Introduction of the Environmental Report

EIA (U.S. Energy Information Administration). "What is the status of the U.S. nuclear industry?" 2011. Website: http://www.eia.gov/energy_in_brief/nuclear-_industry.cfm. Accessed December 30, 2011.

EIA (U.S. Energy Information Administration). Summary Production Statistics of the U.S. Uranium Industry. 2011. Website: www.eia.doe.gov/cneaf/nuclear/dupr-/usummary.html. Accessed January 11, 2012.

EIA, (U.S., Energy Information Administration). Uranium Market Annual Report. 2010. Website: www.eia.gov/uranium/production/annual. Accessed August 11, 2011.

Geraghty and Miller, Inc. *Mechanical Integrity Testing of Injection Wells*. Final report prepared and submitted to the Environmental Protection Agency. Contract #68-01-5971. 1980.

Section 1 - Figure References

Figure 1-3: Surface Ownership Map. Website: http://www.blm.gov/wy/st/en/resources-/public_room/gis/datagis/state/state-own.html

Figure 1-4: Mineral Ownership Map. Website: http://www.blm.gov/wy/st/en/resources/-public_room/gis/datagis/state/state-own.html

Section 2 - Alternatives

EIA (U.S. Energy Information Administration). Summary Production Statistics of the U.S. Uranium Industry. 2011. Website: www.eia.doe.gov/cneaf/nuclear/dupr/-usummary.html. Accessed January 11, 2011.

EIA (U.S. Energy Information Administration). Uranium Market Annual Report. 2010. Website: www.eia.gov/uranium/production/annual. Accessed January 11, 2011.

EIA (U.S. Energy Information Administration). Quarterly Domestic Uranium Production Report. 2011. Website: www.eia.gov/uranium/production/quarterly. Accessed July 6, 2011.

IAEA (International Atomic Energy Agency). "Manual of Acid In Situ Leach Uranium Mining Technology."IAEA-TECDOC-1239. Vienna, Austria, August 2001.

Mudd, G.M. "Acid In Situ Leach Uranium Mining : 1 - USA and Australia." *Tailings & Mine Waste 2000*. Fort Collins, CO. January 2000.

NRC (U.S. Nuclear Regulatory Commission). *Draft Environmental Statement Related to the Operation of the Teton Project*. NUREG-0925, June 1982. Para. 2.3.5.

Section 3.1 - Land Use

NRC, (U.S. Nuclear Regulatory Commission). "Locations of Major U.S. Fuel Cycle Facilities". 2012. Websites: http://www.nrc.gov/infofinder/materials/fuel-cycle/ and http://www.nrc.gov/info-finder/materials/uranium/ur-projects-list-public.pdf. Accessed January 2012.

NRC (U.S. Nuclear Regulatory Commission). Regulatory Guide 3.8, *Preparation of Environmental Reports*, Revision 2, October 1982.

NRC (U.S. Nuclear Regulatory Commission). *Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities* (NUREG-1910). May 2009.Website: http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1910/v1/ch3-sec3-3-4.pdf. Accessed June 2010.

USDA/NASS (U.S. Department of Agriculture, National Agricultural Statistics Service). 2007 Census of Agriculture – County Profile for Campbell County, Wyoming. 2010. Website: http://www.agcensus.usda.gov/Publications/2007/Online_-Highlights/County_Profiles/Wyoming/index.asp. Accessed December 2010.

WOGCC (Wyoming Oil and Gas Conservation Commission). 2008. Website: http://wogcc.state.wy.us. Accessed Dec 2010.

WYDOT (Wyoming Department of Transportation). 2009 Automatic Traffic Recorder Report. Website: http://www.dot.state.wy.us/webdav/site/wydot/shared/Traffic/-trafficdata. Accessed December 2010.

Section 3.1 - Table References

Table 3.1-1: Land Use within Five Miles of the Proposed Project Area. Source: WYGISC (1998). Website: http://www.uwyo.edu/wygisc/

Table 3.1-2: Livestock Inventory for Campbell County for 2007. Source: USDA-NASS 2011. Website: http://www.agcensus.usda.gov/Publications/2007/Online_-Highlights/County_Profiles/Wyoming/index.asp

Table 3.1-3: Distance to the Nearest Residence and Site Boundary for Each Compass Sector. Source: WYGISC. Website: http://www.uwyo.edu/wygisc/

Table 3.1-4: Nearby Recreational Areas. Source: WYGISC (2011). Website: http://www.uwyo.edu/wygisc/

Section 3.1 - Table References (Continued)

Table 3.1-5: All Oil and Gas Wells within Five Miles of the Proposed Reno Creek Project. Source: WOGCC (2012). Website: http://wogcc.state.wy.us

Table 3.1-6: Producing Oil and Gas Wells within Five Miles of the Proposed Reno Creek Project. Source: WOGCC (2012). Website: http://wogcc.state.wy.us

Table 3.1-7: Historical Producing Wells within Five Miles of the Proposed Project. Source: WOGCC (2012). Website: http://wogcc.state.wy.us

Section 3.1 - Figure References

Figure 3.1-1: Land Use within Five Miles of the Proposed Project. Source WYGISC. Websites: http://wygl.wygisc.org/wygeolib/catalog/search/viewMetadataDetails.-page?uuid={A4C43297-0D67-4503-9075-7206B0C124C6} and: http://wygl.wygisc.org/wygeolib/catalog/search/viewMetadataDetails.page?uuid={32A36B9B-D351-4F6F-A53A-EB9CB37A4675}

Figure 3.1-4: Nearby Recreation Areas. Source WYGISC. Websites: http://www.fs.fed.us/r2/gis/datasets_unit.shtml and: http://www.fs.fed.us/r2/gis/r2/mrf/ThunderBasinBasicOwn_metadata.htm

Section 3.2 -Transportation

Wiseman,S. Telephone conversation with WYDOT spokesperson regarding formulas used to project future traffic volume. March 12, 2012.

WYDOT (Wyoming Department of Transportation). Automatic Traffic Recorder Report. 2010. Website: http://www.dot.state.wy.us/wydot/planning_projects/Traffic_Data. Accessed December 2011.

Section 3.2 - Table References

Table 3.2-1: Local and Regional Road Traffic Counts. Source: WYDOT. Website: http://www.dot.state.wy.us/wydot/planning_projects/Traffic_Data. Accessed September 2011.

Table 3.2-2: Pine Tree Junction Traffic Counter Yearly Analysis. Source: WYDOT. Website: http://www.dot.state.wy.us/wydot/planning_projects/Traffic_Data. September 2011.

Table 3.2-3: Reno Junction Traffic Counter Yearly Analysis. Source: WYDOT. Website: http://www.dot.state.wy.us/wydot/planning_projects/Traffic_Data. Accessed September 2011.

Table 3.2-4: Gillette South Traffic Counter Yearly Analysis. Source: WYDOT. Website: http://www.dot.state.wy.us/wydot/planning_projects/Traffic_Data. Accessed September 2011.

Table 3.2-5: Projected Traffic Volumes. Source: 2010 numbers from WYDOT then 1.5 percent annual increase. Website: http://www.dot.state.wy.us/wydot/planning_-projects/Traffic_Data. Accessed September 2011.

Section 3.2 - Figure References

Figure 3.2-1: Automated Traffic Counter Locations. Source WYDOT. http://www.dot.state.wy.us/wydot/planning_projects/Traffic_Data

Section 3.3 - Geology and Soils

ACOE (Army Corp of Engineers). HEC-RAS River Analysis System Hydraulic Reference Manual, Version 4.1. January 2010.

ACOE (Army Corp of Engineers). HEC-RAS River Analysis System User's Manual, Version 4.1. January 2010.

Algermissen, S.T., D.M. Perkins, P.C. Thenhaus, S.L. Hanson, and B.L. Bender. Probabilistic estimates of maximum acceleration and velocity in rock in the contiguous United States. 1982. U.S. Geological Survey Open File Report 82-1033, 99 p., scale 1:7,500,000.

Anderson, D.C. *Contributions to Geology, Wyoming Uranium Issue*. Laramie WY: University of Wyoming. 1969. Vol. 8, No. 2.1.

Case, James C. and J. Annette Green. Earthquakes in Wyoming. Wyoming State Geological Survey Information. 2000. Website: http://waterplan.state.wy.us/-BAG/snake/briefbook/eq_brochure.pdf. Accesed Octoboer 2010.

Clarey, Keith. Regional Groundwater Monitoring Report: Powder River Basin. Open File Report. Wyoming State Geological Survey. 2009.

Davis, J.F. "Uranium Deposits of the Powder River Basin." *Contributions to Geology, Wyoming Uranium Issue*. Laramie, WY: University of Wyoming. 1969. Vol. 8, No. 2.1. pp. 131-142.

Geomatrix Consultants, Inc. Seismotectonic evaluation of the Wyoming Basin geomorphic province. Prepared for the Bureau of Reclamation (US). Contract No. 6-CS-81-07310. 1988.

Harshman, E.N. "Uranium Deposits of Wyoming and South Dakota." *Ore Deposits in the United States 1933-1967*. New York City; American Institute of Mining, Metallurgical and Petroleum Engineers. 1968. Pp. 815-831.

Hodson, W.G., R.H. Pearl, and S.A. Druse. Water Resources of the Powder River Basin and Adjacent Areas, Northeastern Wyoming. 1973. USGS Hydrologic Investigations Atlas HA-465.

Seeland, David A. "Eocene fluvial drainage patterns and their implications for uranium and hydrocarbon exploration." Dept. of Interior *Geological Survey Bulletin.*1988. Volume 1446.

Section 3.3 - Geology and Soils (Continued)

Sharp, W.N. and Gibbons, A.B. *Geology and Uranium Deposits of the Pumpkin Buttes Area of the Powder River Basin, Wyoming*. U.S. Geological Survey Bulletin 1107H,. 1964. pp. 541-638.

USGS (U.S. Geological Survey). Quaternary Fault and Fold Database. 2009a. Website: http://earthquake.usgs.gov/hazards/qfaults/. Accessed September 2010.

Section 3.4 - Water Resources

Anna, L.O. *Geologic framework of the ground-water system in Jurassic and Cretaceous rocks in the Northern Great Plains, in parts of Montana, North Dakota, South Dakota, and Wyoming*. U.S. Geological Survey Professional Paper 1402-B. 1986.

Brown, Janet L. Sedimentology and Depositional History of the Lower Paleocene Tullock Member of the Fort Union formation, Powder River Basin, Wyoming and Montana. U.S. Geological Survey Bulletin-Evolution of Sedimentary Basins.1996.

Clarey, Keith. Regional Groundwater Monitoring Report: Powder River Basin. Open File Report. Wyoming State Geological Survey.2009.

Feathers, K.R., Libra, R., Stephenson, T.R., and Eisen, C. Occurrence and characteristics of ground water in the Powder River Basin, Wyoming. Laramie, WY: University of Wyoming, Water Resources Research Institute.1981.

Hsieh, Paul. Poroelasticity Simulation of Ground-Water Flow and Subsurface Deformation. U.S. Geological Survey Open-File Report 97-47.1996.

Hodson, W.G., Pearl, R.H., and Druse, S.A. *Water resources of the Powder River basin and adjacent areas, northeastern Wyoming*. U.S. Geological Survey Hydrologic Investigations Atlas HA- 465. Washington, D.C.: U.S. Geological Survey. 1973.

Hotchkiss, W. R., and J. F. Levings. *Hydrogeology and Simulation of Water Flow in Strata Above the Bearpaw Shale and Eqivalents of Eastern Montana and Northeastern Wyoming.* U.S. Geological Survey Water-Resources Investigations Report 85–4281. 72 pages. 1986.

HydroAnalysis, 2012. EnviroInsite 2012. [Software]. Downloaded from http://www.enviroinsite.com.

Kruseman, G.P.; de Ridder, N.A. *Analysis and Evaluation of Pumping Test Data* (Second ed.). Wageningen, The Netherlands: International Institute for Land Reclamation and Improvement. 1990.

Krumhansi, J.L., Brady, P.V., Beuheim, R.L., Kanney, J.F., McKenna, S.A. and Arnold, B.W., 2009. Inherently safe in situ uranium recovery. Sandia Report SAND2008-6688. Issued by Sandia National Laboratories, Albuquerque, New Mexico. May 2009. 87185. 18 p.

Section 3.4 - Water Resources (Continued)

Lowry, M.E. *Hydrology of the uppermost Cretaceous and lowermost Paleocene rocks in the Hilight oil field, Campbell County, Wyoming*: U.S. Geological Survey Open-File Report 73-161. 1973.

Lowry, M.E., et. al. *Hydrology of Area 50, Northern Great Plains and Rocky Mountain Coal Provinces, Wyoming and Montana*. U. S. Geological Survey Water Resources Investigations Open file Report 830-545. 1986.

NOAA (*National Oceanic and Atmospheric Administration)*. Precipitation Frequency Atlas of the Western United States. 1973: Atlas 2, Volume 2.

NRCS (Natural Resources Conservation Service) (formerly Soil Conservation Service). *Urban Hydrology for Small Watersheds.* Technical Release 55. 1986.

NRCS (Natural Resources Conservation Service). TR-55, Hydrology for Small Watersheds. 1986. Website: nrcs.usda.gov/wps. Accessed August 2011.

Parkhurst, D.L., and Appelo, C.A.J., 1999, User's guide to *PHREEQE* (version 2) - a computer program for speciation, batch-reaction, one-dimensional transport, and inverse geochemical calculations. U.S. Geological Survey Water Resources Investigation Report 99-4259, p.312.

Rankl, J.G. and M.E. Lowry. Ground-water Flow Systems in the Powder River Structural Basin, Wyoming and Montana. US Geological Survey Water-Resources Investigations Report 85-4229. 1990.

Riffenburg, H.B. *Chemical Character of Ground Waters of the Northern Great Plains*. Washington, D.C. U.S. Geological Survey; Water-Supply Paper 560-B. 1925.

RME (Rocky Mountain Energy), *Hydrogeologic Integrity Evaluation of the Reno Creek Project Area.* RME Technical Services. Broomfield, CO. 1982.

Robinson, C.S., W.J. Mapel, and M.H. Bergendahl. *Stratigraphy and Structure of the Northern and Western Flanks of the Black Hills Uplift*. Wyoming, Montana, and South Dakota. USGS Professional Paper 404. 1964.

Sharp, W.N., Gibbons, A.B. Geology and uranium deposits of the southern part of the Powder River basin, Wyoming. USGS Bulletin, 1147-D. 1964.

Section 3.4 - Water Resources (Continued)

Stone, Randolph, and D. F. Snoeberger. Cleat orientation and areal hydraulic anisotropy of a Wyoming coal aquifer. *Ground Water*. 1977: v. 15, no. 6.

Theis, Charles V. "The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using ground-water storage". *Transactions, American Geophysical Union*. 1935. 16: 519–524.

USGS. (U.S. Geological Survey). National Water Information System (NWIS) for USGS stream gages in Wyoming: 06652000, 06647000, 06646780, 06650000. 2008. Website: http://waterdata.usgs.gov/wy/nwis/sw. Accessed August 12, 2008.

USGS, (U.S. Geological Survey). *Guidelines For Determining Flood Flow Frequency.* Bulletin 17B. 1982.

USGS (U.S. Geological Survey). Biostratigraphy Powder River Basin. 1996. Website: usgs.gov/pp/p1625a. Accessed August 2011.

USGS (U.S. Geological Survey). Water Quality Characteristics. 2007. Website: usgs.gov.20075146/pdf. Accessed August 2011.

Wang, Herbert F. *Theory of Linear Poroelasticity with Applications to Geomechanics and Hydrogeology*. Princeton University Press.2000.

Whitcomb, H.A., Cummings, T.R., and McCullough, R.A. *Ground water resources and geology of northern and central Johnson County, Wyoming*: U.S. Geologial Survey Water-Supply Paper 1806. 1966. 99 p.

WRCC (Western Regional Climate Center). Glenrock 5 ESE, Wyoming 1941 – 2006. Website: http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?wy3950. Accessed August 2008.

Section 3.5 -Ecological Resources

Baxter, G.T. and M.D. Stone. Amphibians and Reptiles of Wyoming. Second Edition. Wyoming Game and Fish Department, Cheyenne. 1985: 137pp

BLM (U.S. Bureau of Land Management). BLM Manual H-8410-1, Visual Resource Inventory. 2010. Website: http://www.blm.gov/nstc/VRM/8410.html. Accessed March 2010.

BLM (U.S. Bureau of Land Management). Orchid Habitat Survey Decision Tree for the Buffalo Field Office. 2004. Buffalo Field Office, Buffalo, Wyoming.

BLM (U.S. Bureau of Land Management). Final EIS and Proposed Plan Amendment for the Powder River Basin Oil and Gas Project, Buffalo Field Office, January 2003

Cervoski, **A.O.,** Greinier, B. Oakleaf, L. Van Fleet, and **S.** Patla. *Atlas of birds, mammals, reptiles and amphibians in Wyoming*. Wyoming Game and Fish Department Nongame Program, Lander, Wyoming. 2004: 206 pp.

Chapman, S.S., Bryce, S.A., Omernik, J.M., Despain, D.G., ZumBerge, J., and Conrad, M. Ecoregions of Wyoming. U.S. Geological Survery, Reston, Virginia. 2004.

Clark, T. W. and Stromberg, M. R. *Mammals in Wyoming*. University Press of Kansas, Lawrence, Kansas. 1987: 314 pp

Dorn, R.D. *Vascular Plants of Wyoming*. 3rd Edition. Mountain West Publishing. Cheyenne, Wyoming.2001.

Grier, J. W., and R W. Fyfe. Preventing research and management disturbance. Natl. *Wildl. Fed. Sci. Tech. Ser*. 1987: 10:173-182.

Heidel, B., Fertig, W., Blomquist, F., and Abbott, T. *Wyoming's Threatened and Endangered Species: Blowout Penstemon*. Wyoming BLM. Cheyenne, Wyoming.2007.

Heidel, B., Fertig, W., Blomquist, F., and Abbott, T. *Wyoming's Threatened and Endangered Species: Ute Ladies'-tresses Orchid*. Wyoming BLM. Cheyenne, Wyoming.2008.

NRCS (USDA Natural Resources Conservation Service), 2006, Soil surveygeographic (SSURGO) database for Campbell County, Wyoming. 2011. Website: http://soils.usda.gov/survey/printed_surveys/state.asp?state=Wyoming&abbr=WY

Section 3.5 - Ecological Resources (Continued)

Peterson, Roger T. *A Field Guide to Birds of Western North America*. Houghton Mifflin. Boston. 1990.

Stebbins, Robert. *A Field Guide to Western Reptiles and Amphibians: Field Marks of All Species in Western North America*. Houghton Mifflin, Boston.1966.

Stokes, Donald, and Stokes, Lilian. *Stokes Beginner's Guide to Birds: Western Region*. Little Brown and Company. New York. 1996.

USACE (U.S. Army Corp of Engineers). Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Great Plains Region. 2008: ERDC/EL TR-08-12.

USFWS (U.S. Fish and Wildlife Service). Withdrawal of the Proposed Rule to List the Mountain Plover as Threatened. Federal Register. May 12, 2011: Vol. 76, No. 92.

USFWS (U.S. Fish and Wildlife Service). Threatened and Endangered Species Listings and Occurrences for Wyoming. 2010. Website: http://www.fws.gov/endangered

USFWS (U.S. Fish and Wildlife Service). Federally Listed, Proposed and Candidate Species: Blowout Penstemon. Wyoming Ecological Services. 2008. Website: http://www.fws.gov/wyominges/Pages/Species/Species_Listed/BlowPenst.html.

USFWS (U.S. Fish and Wildlife Service). Removing the Bald Eagle In the Lower 48 States From the List of Endangered and Threatened Wildlife. Federal Register. Vol. 72, No. 130. Monday, July 9, 2007.

USFWS, (U.S. Fish and Wildlife Service). Removal of Swift Fox from the Federal list of Endgangered Species. Press Release. 2001. Website: http://www.fws.gov/-northdakotafieldoffice/endspecies/species/swift_fox.htm. Accessed January 27, 2012.

USFWS, (U.S. Fish and Wildlife Service). Block Clearance for Black-Footed Ferret Surveys. Letter from B.T. Kelly, Field Supervisor, Wyoming Field Office, USFWS. February 2, 2004.

USFWS, (U.S. Fish and Wildlife Service). Recommendations and Guidelines for Ute Ladies' Tresses Orchid (*Spiranthes diluvialis*) Recovery and Fulfilling Section 7 Consultant Responsibilities. 1995.

Section 3.5 -Ecological Resources (Continued)

WDEQ/LQD (Wyoming Department of Environmental Quality, Land Quality Division). Rules and Regulations for Non-Coal Permitting Guideline 2 – Vegetation. 1997. (Updated 2004). Website: http://deq.state.wy.us/

WDEQ/LQD (Wyoming Department of Environmental Quality, Land Quality Division). Guideline 4. In-Situ Mining. 2000. Website: http://deq.state.wy.us/

WDEQ/LQD (Wyoming Department of Environmental Quality, Land Quality Division). Guideline 5 – Wildlife. 1994. Website: http://deq.state.wy.us/

WGFD (Wyoming Game & Fish). Sage-Grouse Executive Order 2011-5 DDCT. Website: http://gf.state.wy.us/web2011/wildlife-1000382.aspx

WGFD (Wyoming Game & Fish). Wyoming Sage Grouse Lek Viewing Guide. 2010a. Website: http://gf.state.wy.us/web2011/wildlife-1000382.aspx

WGFD (Wyoming Game & Fish). Wyoming Sage Grouse Leks. 2010b. Website: http://gf.state.wy.us/web2011/wildlife-1000382.aspx

WGFD (Wyoming Game & Fish). Strategic Habitat Plan. 2009. Website: http://gf.state.wy.us/web2011/wildlife-1000402.aspx

WGFD (Wyoming Game & Fish). Nongame Species of Special Concern. 2005. Website: http://gf.state.wy.us/wildlife/nongame/SpeciesofSpecialConcern/index.asp

WGFD (Wyoming Game and Fish Department). (Third Edition 2007) Handbook of Biological Techniques. Edited by Tessman, Stephen. 1982. Website: http://www.google.com/search?sourceid=navclient&aq=0&oq=Handbook+of+biological+t&ie=UTF8&rlz=1T4IRFD_enUS432US437&q=handbook+of+biological+techniques&gs_upl=0l0l0l3371785lllllllllll0&aqi=g3

Wyoming Weed and Pest Council. Weed and Pest Control Act Designated List. Wyoming Department of Agriculture. 2010a. Website: http://wyoweed.org. Cheyenne, Wyoming

Wyoming Weed and Pest Council. Weed and Pest List Declared List (By County) (Amended February 2010). Wyoming Department of Agriculture. 2010b. Website: http://wyoweed.org. Cheyenne, Wyoming

Section 3.5 - Figure References

Figure 3.5-1: Wildlife Features; Website: http://gf.state.wy.us/habitat/RemoteSensing/-index.asp

Section 3.6 - Meteorology, Climatology and Air Quality

EPA "Currently Designated Nonattainment Areas for All Criteria Pollutants As of July 20, 2012." Washington, DC: U.S. Environmental Protection Agency. 2012. Website: http://www.epa.gov/airquality/greenbook/ancl3.html (14 August, 2012).

NRC (U.S. Nuclear Regulatory Commission). NUREG-1910, Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities, Final Report, May 2009.

EPA (U.S. Environmental Protection Agency). On-Site Meteorological Program Guidance for Regulatory Modeling Applications. (Updated in 2000). EPA-454/R-99-005). 1987. Website: http://nepis.epa.gov

Holzworth, G. C. *Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States*. AP-101. U.S. Environmental Protection Agency, Office of Air Programs, Division of Meteorology. Research Triangle Park, NC. 1972.

Martner, B.E. *Wyoming Climate Atlas*, University of Nebraska Press Lincoln, NE. 1986.

NCDC (National Climatic Data Center). 2011. Website: http://gis.ncdc.noaa.gov.

WRCC (Western Regional Climate Center). Historical climatological data. 2011. Website: http://www.wrcc.dri.edu

WDEQ "Chapter 2, Ambient Standards" Cheyenne WY: Wyoming Department of Environmental Quality. 2012. Website: http://deq.state.wy.us/aqd/standards.asp

Section 3.6 -Table References

No table of figures entries found..

Section 3.6 -Figure References

Figure 3.6-1: NWS and Coal Mine Meteorological Stations; Source: National Climatic Data Center, 2011

Figure 3.6-2: Regional Average Monthly Temperatures; Sources: National Climatic Data Center, 2011; IML Air Science meteorological database, 2011

Figure 3.6-3: Antelope Mine Monthly Diurnal Temperature Variations; Source: IML Air Science meteorological database, 2011; Period: 1986-2011

Figure 3.6-4: Regional Annual Average Minimum Temperatures; Source: National Climatic Data Center, 2011

Figure 3.6-5: Regional Annual Average Maximum Temperatures; Source: National Climatic Data Center, 2011

Figure 3.6-6: Casper Airport Degree Days; Source: National Climatic Data Center, 2011; Period: 1948-2010

Figure 3.6-7: Mean Monthly Relative Humidity for Gillette and Casper; Source: National Climatic Data Center, 2011

Figure 3.6-8: Diurnal Average Relative Humidity for Gillette AP; Source: National Climatic Data Center, 2011; Period: 2005-2009

Figure 3.6-9: Regional Monthly Average Precipitation; Source: National Climatic Data Center, 2011

Section 3.6 -Figure References (Continued)

Figure 3.6-10: NWS Station Monthly Snowfall Averages; Source: National Climatic Data Center, 2011

Figure 3.6-11: Regional Annual Average Precipitation; Source: National Climatic Data Center, 2011

Figure 3.6-12: Regional Annual Average Snowfall; Source: National Climatic Data Center, 2011

Figure 3.6-13: Casper Airport 8-Year Wind Rose; Source: National Climatic Data Center, 2011; Period: 2004-2011

Figure 3.6-14: Antelope Mine 25-Year Wind Rose; Source: IML Air Science meteorological database; Period: 1986-2011

Figure 3.6-15: Glenrock Mine 14-Year Wind Rose; Source: IML Air Science meteorological database: Period: 1996-2010

Figure 3.6-16: Regional Wind Speeds by Month; Sources: National Climatic Data Center, 2011; IML Air Science meteorological database, 2011

Figure 3.6-17: Reno Creek Project 1-Year Meteorological Summary; Source: IML Air Science meteorological database, 2011; Period: Baseline monitoring year

Figure 3.6-18: Reno Creek vs. Antelope Monthly Average Temperatures; Source: IML Air Science meteorological database, 2011; Period: Baseline monitoring year

Figure 3.6-19: Proposed Project Diurnal Average Temperatures Source: IML Air Science meteorological database, 2011; Period: Baseline monitoring year

Figure 3.6-20: Proposed Project Diurnal Average Relative Humidity; Source: IML Air Science meteorological database, 2011; Period: Baseline monitoring year

Figure 3.6-21: Proposed Project vs. Antelope Monthly Precipitation; Source: IML Air Science meteorological database, 2011; Period: Baseline monitoring year

Figure 3.6-22: Proposed Project Monthly Evaporation; Source: IML Air Science calculations and meteorological database, 2011

Section 3.6 Figure References (Continued)

Figure 3.6-23: Reno Creek Project vs. Antelope Monthly Average Wind Speeds; Source: IML Air Science meteorological database, 2011; Period: Baseline monitoring year

Figure 3.6-24: Reno Creek Project Windrose; Source: IML Air Science meteorological database, 2011; Period: Baseline monitoring year

Figure 3.6-25: Proposed Project Wind Rose: 1st Quarter; Source: IML Air Science meteorological database, 2011; Period: Baseline monitoring year

Figure 3.6-26: Proposed Project Wind Rose: 2nd Quarter; Source: IML Air Science meteorological database, 2011; Period: Baseline monitoring year

Figure 3.6-27: Proposed Project Wind Rose: 3rd Quarter; Source: IML Air Science meteorological database, 2011; Period: Baseline monitoring year

Figure 3.6-28: Proposed Project Wind Rose: 4th Quarter; Source: IML Air Science meteorological database, 2011; Period: Baseline monitoring year

Figure 3.6-29: Proposed Project Wind Summary; Source: IML Air Science meteorological database, 2011; Period: Baseline monitoring year

Figure 3.6-30: Proposed Project Diurnal Average Wind Speeds; Source: IML Air Science meteorological database, 2011; Period: Baseline monitoring year, 2010-2011

Figure 3.6-31: Proposed Project Wind Speed Frequency Distribution; Source: IML Air Science meteorological database, 2011; Period: Baseline monitoring year

Figure 3.6-32: Reno Creek Stability Class Analysis; Source: IML Air Science meteorological database, 2011; Period: Baseline monitoring year, 2010-2011

Figure 3.6-33: Antelope Mine Short and Long-Term Wind Roses; Source: IML Air Science meteorological database, 2011;Period: 1986-2011

Figure 3.6-34: Antelope Short and Long-Term Wind Speed Distributions; Source: IML Air Science meteorological database, 2011; Period: 1986-2011

Figure 3.6-35: Antelope Short and Long-Term Wind Direction Distributions; Source: IML Air Science meteorological database, 2011;Period: 1986-2011

Section 3.6 - Figure References (Continued)

Figure 3.6-36: Antelope 25-Year vs Baseline Year Wind Speed Distributions; Source: Analysis by IML Air Science using hourly database from 1986 through 2011

Figure 3.6-37: Antelope 25-Yr vs Baseline Yr Wind Direction Distributions; Source: Analysis by IML Air Science using hourly database from 1986 through 2011

Figure 3.6-38: Antelope vs Reno Creek Baseline Yr Wind Speeds; Source: IML Air Science meteorological database, 2011; Period: Baseline monitoring year, 2010-2011

Figure 3.6-39: Antelope vs Reno Creek Baseline Yr Wind Directions; Source: IML Air Science meteorological database, 2011; Period: Baseline monitoring year, 2010-2011

Figure 3.6-40: Antelope vs Reno Creek Baseline Yr Wind Direction Distributions; Source: IML Air Science meteorological database, 2011; Period: Baseline monitoring year, 2010-2011

Figure 3.6-41: Antelope Short and Long-Term Monthly Average Temperatures; Source: IML Air Science meteorological database, 2011; Period: Baseline monitoring year, 2010-2011

Figure 3.6-42: Antelope Short and Long-Term Monthly Temperature Correlation; Source: IML Air Science meteorological database, 2011; Period: Baseline monitoring year, 2010-2011

Figure 3.6-43: Antelope and Reno Creek Baseline Yr Monthly Avg. Temperatures; Source: IML Air Science meteorological database, 2011; Period: Baseline monitoring year, 2010-2011

Figure 3.6-44: Spatial Correlation of Monthly Average Temperatures; Source: IML Air Science meteorological database, 2011; Period: Baseline monitoring year, 2010-2011

Section 3.7 - Noise

BLM, (U.S. Bureau of Land Mangagement). Final EIS and Proposed Plan Amendment for the Powder River Basin Oil and Gas Project, Buffalo Field Office. January 2003.

FHWA, (Federal Highway Administration). Highway Traffic Noise: Analysis and Abatement Guidance. FHWA-HEP-10-02S. January 2011.

Section 3.7 - Table References

Table 3.7-1: 23 CFR Part 772, Procedures for Abatement of Highway Traffic Noise

Table 3.7-2: Relationship Between A-Scale dB Readings and Sounds of Daily Life; ABCs of Our Noise Codes published by Citizens Against Noise, Honolulu, Hawaii.

Section 3.8 - Historic and Cultural Resources

BLM (U.S. Bureau of Land Management). BLM Manual H-8270-1, General Procedural Guidance For Paleontological Resources Management. 2011. Website: http://search.usa.gov/search?utf8=%E2%9C%93&sc=0&query=H-8270-1

CCGov (Campbell County WY Government). "History of Campbell County". 2011. Website: http://www.ccgov.net/departments/museum/history/campbell_county_-history/index.html

Davis, Leslie B. Missouri River Breaks Area Archaeological and Historical Values, Montana: Recreational Implications. Montana State University for U.S. Bureau of Land Management, Montana State Office, Billings, Montana. 1976.

Deaver, Ken, and Aaberg, Stephen. Archaeological Survery of the Proposed National Guard Training Areas: Valley County, Montana. U.S. Bureau of Land Management, Denver Service Center. Pro-Lysts, Inc. 1977.

Deaver, Ken, and Deaver, Sherri. Prehistoric Cultural Resource Overview of Southeast Montana. Ethnoscience for U.S. Bureau of Land management, Miles City, Montana. 1988: Vol. 1.

Deaver, K., S. Deaver and M. Bergstrom *Onion Ring, 32ME166, A Tipi Ring Site in Central North Dakota*. Ethnoscience for the Coteau Properties Company, Bismarck, ND. 1989.

Francis, Julie E., and Loendorf, Lawrence L. *Ancient Visions: Petroglyphs and Pictographs from the Wind River and Bighorn Country, Wyoming and Montana*. University of Utah Press. Salt Lake City.2002.

Frison, George C. *Prehistoric Hunters of the High Plains*. Academic Press: New York, New York. 1991.

Frison, George C. The Buffalo Pound in North-Western Plains Prehistory: Site 48CA302. Wyoming. *American Antiquity*. 1971: 36:77-91.

Greiser, Sally T., et al. Eastern Powder River Basin Prehistory: Archeological Investigation at the Antelope Mine. Report to NERCO by Historical Research Associates, Missoula, Montana. 1983.

Husted, Wilfred. Bighorn Canyon Archeology. Publications in Salvage Archeology, Smithsonian Institution. River Basin Surveys. Smithsonian Institution. 1969: Vol. 12, No. 12.

Larson.T.A. *History of Wyoming*. University of Nebraska Press. 2d. edition. 1990.

Michlovic, Michael G. The Archaelology of the Canning Site. *Minnesota Archaelogist*. Prairie Smoke Press. Champlin, MN. 1986: Vol. 45, No. 1.

NRHP (National Register for Historic Places). Archeology and Historic Preservation: Secretary of the Interior's Standards and Guidelines. 2011a. Website: http://www.cr.nps.gov/local-law/arch_stnds_3.htm

NRHP (National Register for Historic Places). Criteria for Evaluation. Guidelines for Evaluating and Documenting Traditional Cultural Properties (TCP). 2011b. Website: http://www.nps.gov/history/nr/publications/bulletins/nrb38/nrb38%20-introduction.htm#tcp

Reeves, Brian O.K. The Southern Alberta Paleo-Cultural Paleo-Environmental Sequences. *Post Pleistocene Man and His Environment on the Northern Plains*. University of Calgary Archaeological Association. 1969.

WSGS (Wyoming State Geological Survey). Uranium Production History. 2011. Website: http://www.wsgs.uwyo.edu/

Section 3.9 - Visual and Scenice Resources

BLM, (U.S. Bureau of Land Management). Buffalo Resource Management Plan. Buffalo (WY) Field Office: Planning and Management Decisions: Visual Resources. Map 8. 2001.Website: http://www.blm.gov/rmpweb/application/rmp_browse.cfm?-rmpid=101&idref=30176#30216

BLM, (U.S. Bureau of Land Management). BLM Manual H-8400 Visual Resource Management. 2007. Website: http://www.blm.gov/nstc/VRM/8400.html

BLM, (U.S. Bureau of Land Management). BLM Manual H-8410 Visual Resource Inventory: Determining visual Resource Inventory Classes. 2007a. Website: http://www.blm.gov/nstc/VRM/8410f.html

Section 3.9 - Table References

Table 3.9-1: Determining BLM Visual Resource Inventory Classes; Source: BLM Manual H-8410 Visual Resource Inventory: Determining visual Resource Inventory Classes. Website: http://www.blm.gov/nstc/VRM/8410f.html

Section 3.9 - Figure References

Figure 3.9-1: Regional Visual Resource Management Classification; Website: http://wygl.wygisc.org/wygeolib/catalog/search/viewMetadataDetails.page?uuid={9ABE3679-1C6B-4B59-ACA8-08C26C512B4A}

Section 3.10 - Socioeconomics

CCGOV (Campbell County Government). Current Mill Levies. 2011. Website: http://www.ccgov.net/assessor/index.html. Accessed February 2012.

CCSD (Campbell County School District). 2012 and 2010. Website: http://www.-campbellcountyschools.net/district.cfm. Accessed December 2010 and January 2012.

City of Casper. Casper Area Convention and Visitor's Bureau. 2012. Website: http://www.casperwyoming.info/lodging.php. Accessed February 2012.

City of Gillette. Campbell County Convention and Visitor's Bureau. 2012. Website: http://visitgillette-wrightwyo.org/. Accessed February 2012.

DOL (U.S. Department of Labor). Bureau of Labor statistics. 2011. Website: http://beta.bls.gov/maps/cew/WY

FedStats (U.S. Federal Government Statistics). Statistical Profiles of States. 2010. Website: http://www.fedstats.gov. Accessed September 20, 2011

Maynard, Dale. Kaycee School Principal. Phone conversation with Anne Cossitt January 2011.

Natrona County Schools. Website: http://www.natronaschools.org/schools.php. Accessed December 2010.

Strahorn, Dr. Richard M. Campbell County School District No.1. 2010. Personal communication. Phone conversation with Anne Cossitt in June 2010 and in January 2011.

Tobin, Chris. Administrator, Midwest Schools. Phone conversation with Anne Cossitt in January 2011.

Town of Wright WY. 2012. Website: http://www.wrightwyoming.com. Accessed February 2012.

USCB (U.S. Census Bureau). Website: http://factfinder2.census.gov/faces/nav/jsf/pages/-index.xhtml Accessed October, 2011.

Section 3.10 - Socioeconomics (Continued)

USCB (U.S. Census Bureau). Census 2010. Table DP-1. Profile of General Demographic Characteristics. For various counties. Website: http://eadiv.state.wy.us/. Accessed October, 2011.

USCB (U.S. Census Bureau). Annual Estimates of the Population by Sex, Race, and Hispanic Origin for Wyoming: April 1, 2000 to February, 2011. (as released by Wyoming Department of Administration and Information). 2010. Website: http://eadiv.state.wy.us/. Accessed October, 2011.

WCDA (Wyoming Community Development Authority). The 2011 Wyoming Profile of Demographics, Economics and Housing. Semiannual report. June 2011. Website: http://www.wyomingcda.com/

WCDA (Wyoming Community Development Authority). Wyoming Rental Survey Summary. 2007. Website: http://www.wyomingcda.com

WDAI (Wyoming Department of Administration & Information-Economic Analysis Division). Economic Summary: 3Q2011. 2011a. Website: http://eadiv.state.wy.us/index.asp

WDAI (Wyoming Department of Administration & Information). Wyoming Occupational Projections, 2010 - 2020. 2011b. Website: http://doe.state.wy.us/lmi/

WDAI (Wyoming Department of Administration and Information). Various tables. 2011c; Website: http://eadiv.state.wy.us/. Accessed October and December, 2011.

WDAI (Wyoming Department of Administration & Information-Economic Analysis Division). 10-Year Outlook: Wyoming Economic and Demographic Forecast 2007 - 2016. 2007. Website: http://eadiv.state.wy.us/index.asp

WDOE (Wyoming Department of Education). 2011. Website: http://www.k12.wy.us. Accessed October, 2011.

WDOE (Wyoming Department of Employment. Research and Planning; Commuting In Wyoming. 2010. Website: http://doe.state.wy.us/lmi/commute/commute2010/-index.html

WDOR (Wyoming Department of Revenue). Department of Revenue: Excise Tax Division. 2011. Website: http://revenue.state.wy.us. Accessed February 2012.

Section 3.10 - Socioeconomics (Continued)

WDOR (Wyoming Department of Revenue). "State of Wyoming Department of Revenue Annual Report." 2009. Website: http://revenue.state.wy.us. Accessed October 10. 2011.

WDOR (Wyoming Department of Revenue). "State of Wyoming Property Tax System." 2007. Website: http://revenue.state.wy.us. Accessed September 25, 2011

Section 3.10 - Table References

Table 3.10-2: 1980-2010 Population Change for Counties and Communities within the 80 km Radius of the proposed Reno Creek Project. U.S. Census Bureau Decennial Census.

Table 3.10 -3: 2010 Population by Age and Sex for Wyoming and the Counties within the 80 km Radius of the proposed Reno Creek Project. U.S. Census Bureau Decennial Census.

Table 3.10-4: 2010-2030 Population Projections for Wyoming and the Counties within the 80 km Radius of the proposed Reno Creek Project. Source: Wyoming Dept. of Administration and Information, Economic Analysis Division, October, 2011.

Table 3.10-5: Annual Average Labor and Unemployment Rates for 2010 and Employment by Industry for 2009 Campbell, Johnson and Natrona Counties. Sources: U.S. Census Bureau, U.S. Bureau of Economic Analysis and Wyoming Department of Employment, Research and Planning.

Table 3.10-6: 2010 Housing Units: Total, Occupied and Vacant. U.S. Bureau of Census, 2010 Census Summary File 1.

Table 3.10-7: 2010 Occupied Housing Units by Owned or Rented. U.S. Bureau of Census, 2010 Census Summary File 1.

Table 3.10-8: 2010 Vacant Housing Units by Type. U.S. Bureau of Census, 2010 Census Summary File 1.

Table 3.10-9: Monthly Rental Costs: Fourth Quarter 2010. Wyoming Housing Database Partnership.

Section 3.10 - Figure References

Figure 3.10-1: Population Block Analysis. Website: http://www.census.gov/-geo/www/tiger/tgrshp2010/tgrshp2010.html Accessed October, 2011.

Section 3.11 - Public and Occupational Health

Brown, Steven H., *A Citizen's Guide to Uranium*, SENES Consultants Limited, Englewood CO, 2009.

Faillace E.R., LePoire D.J., Chen S.Y., and Y. Yuan. MILDOS-AREA: An Update with Incorporation of *In Situ* Leach Uranium Recovery Technology. Department of Energy Argonne National Laboratory. May 1997

United States Court of Appeals, Tenth Circuit. Morris V. U.S. Nuclear Regulatory Com'n. 11 598 F.3D 677. March 8, 2010.

NCRP (National Council on Radiation Protection and Measurement). *Report No. 160: Ionizing Radiation Exposure of the Population of the Unites States*, ISBN 13: 978-0-929600-98-7. 2009.

NRC (U.S. Nuclear Regulatory Commission). Standards for Protection Against Radiation, Dose Limits for Individual Members of the Public. 10 CFR Part 20.1301. 2002.

WDOE (Wyoming Department of Employment). Survey of Occupational Injuries and Illnesses for 2008. Wyoming Department of Employment, Research & Planning Division. September 2010, 2010c . Website: http://doe.state.wy.us/LMI/-0910/0910.pdf

Section 3.11 - Table References

Table 3.11-2: Natural Background Radiation Doses (mSv in a year); Sources: EPA 2006, Assessment of Variations in Radiation Exposure in the United States. Contract Number EP-D-05-002 (Revision 1). Washington, DC.; and NCRP 2009, Report No. 160, Ionizing Radiation Exposure of the Population in the United States. Bethesda, Maryland.

Table 3.11-3: Number and Rate of Nonfatal Occupational Injuries and Illnesses for the Mining Industry, Wyoming, 2010; Source: Wyoming Department of Employment, Number and rate of nonfatal occupational injuries and illnesses by 3-digit NAICS industry, Wyoming, 2010. Website: http://doe.state.wy.us/lmi/-osh/OSH_10/tA.htm. Accessed November 3, 2011.

Section 3.11 - Figure References

Figure 3.11-1: Gamma exposure rates in microroentgen per hour (µR/hr) from terrestrial sources of background radiation; Source: National Council on Radiation Protection & Measurement (NCRP) 2009.

Figure 3.11-2: Average annual radiation doses to the U.S. population; Source: National Uranium Resource Evalucation (NURE) aerial surveys, USGS, 1993.

Section 3.12 - Waste Management

EPA (U.S. Environmental Protection Agency). Technical Report On Technologically Enhanced Naturally Occurring Radioactive Materials from Uranium Mining. Vol. 2. Investigation of Potential Health, Geographic, And Environmental Issues of Abandoned Uranium Mines. EPA 402-R-08-005. 2008.

WDEQ/OOEA (Wyoming Department of Environmental Quality-Office of Outreach and Environmental Assistance). Proper Management of Farm and Ranch Wastes. 2010.
Website: http://deq.state.wy.us/out/downloads/farmrch.html

WDEQ/SHWD (Wyoming Department of Environmental Quality-Solid and Hazardous Waste Department). U-List Chemicals: List of Commercial Chemical Products/Ingredients. 2008.
Website: http://deq.state.wy.us/shwd/

Section 4 - Environmental Effects

APLIC (Avian Power Line Interaction Committee). Avian Protection Plan Guidelines. 2005. Website: http://www.aplic.org/mission.php

Boon, D.Y. Potential selenium problems in Great Plains soils: Seleiun in Agriculture and the Environment. *Soil Science Society of America*. 1989: No. 23, 107-21.

CC Gov (Campbell County Government) Public Works, Campbell County Landfill information. 2011. Website: http://www.ccgov.net/departments/-publicworks/Landfill/index.html

City of Gillette. Information about the City of Gillette's Curbside Recycling Program. 2010. Website: http://www.ci.gillette.wy.us

Cervoski, A.O., Greinier, B. Oakleaf, L. Van Fleet, and S. Patla. Atlas of birds, mammals, reptiles and amphibians in Wyoming. Wyoming Game and Fish Department Nongame Program, Lander, Wyoming. 2004: 206 pp.

EPA, (U.S. Environmental Protection Agency), Technical Report on Technologically Enhanced Naturally Occurring Radioactive Materials from Uranium Mining, Vo. 1, Mining and Reclamation Background, EPA 402-R-08-005. April 2008.

EPA (U.S. Environmental Protection Agency), 2002, Onsite Wastewater Treatment Systems Manual, EPA/625/R- 00/008. February 2002.

Fertig, W., R. Black, and P. Wolken. Rangewide Status Review of Ute ladies'-tresses (*Spiranthes diluvialis*). Prepared for the U.S. Fish and Wildlife Service and Central Utah Water Conservation District. 2005.

Heidel, B., Fertig, W., Blomquist, F., and Abbott, T. Wyoming's Threatened and Endangered Species: Blowout Penstemon. Wyoming BLM. Cheyenne, Wyoming. 2007.

Midwest Research Institute, Conversion factors for PM10 to PM2.5, Background Document for Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emission Factors: November 1, 2006.

Section 4 - Environmental Effects (Continued)

NMA (National Mining Association). Generic Environmental Report in Support of the Nuclear Regulatory Commission's Generic Environmental Impact Statement for In Situ Uranium Recovery Facilities, prepared for the National Mining Association by Thompson & Simmons, PLLC, Tetra Tech, Inc., and Katie Sweeney, National Mining Association. November 30, 2007

NRC (U.S. Nuclear Regulatory Commission). Environmental Impact Statement for the Moore Ranch ISR Project in Campbell County, Wyoming: Supplement to the Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities - Final Report (NUREG-1910, Supplement 1). August 2010

NRC (U.S. Nuclear Regulatory Commission). Environmental Impact Statement for the Nichols Ranch ISR Project, Supplement to the Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities - Final Report (NUREG-1910, Supplement 2). 2009

NRC (U.S. Nuclear Regulatory Commission). Environmental Impact Statement for the Lost Creek ISR Project in Sweetwater County, Wyoming: Supplement to the Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities. (NUREG-1910, Supplement 3). 2009.

NRC (U.S. Nuclear Regulatory Commission). NUREG-0706, Final Generic Environmental Impact Statement on Uranium Milling, Project M-25, Summary and Text. 1980.

Ramirez, P., and Rogers, B.P.. Selenium in a Wyoming grassland community receiving wastewater from an in situ uranium mine. Archives of Environmental Contamination and Toxicology. May 2002: 42(4). 431-6.

Thalheimer, Erich. Construction Noise Control Program and Mitigation Strategy at the Central Artery/Tunnel Project, Noise Control Engineering Journal. 1999:Volume 48,

USCB (U.S. Census Bureau). State and County Quick Facts. 2012. Website: http://quickfacts.census.gov/qfd/states/56/5613150.html/

USDOE (U.S. Department of Energy). Radiation Protection of the Public and the Environment Order No. DOE 5400.5. 2010. Website: http://www.directives.-doe.gov/directives/current-directives. Accessed December 2010.

Section 4 - Environmental Effects (Continued)

USFWS (U.S. Fish and Wildlife Service). Withdrawal of the Proposed Rule to List the Mountain Plover as Threatened. Federal Register. May 12: 2011: Vol. 76, No. 92.

USFWS (U.S. Fish and Wildlife Service). Threatened and Endangered Species Listings and Occurrences for Wyoming. United States Department of the Interior, United States Fish and Wildlife Service, Washington, D.C. 2010. Website: http://www.fws.gov/endangered

USFWS (U.S. Fish and Wildlife Service). Federally Listed, Proposed and Candidate Species: Blowout Penstemon. Wyoming Ecological Services. 2008. Website: http://www.fws.gov/wyominges/Pages/Species/Species_Listed/BlowPenst.html.

USFWS (U.S. Fish and Wildlife Service). Removing the Bald Eagle In the Lower 48 States From the List of Endangered and Threatened Wildlife. Federal Register. July 9, 2007: Vol. 72, No. 130.

USFWS (U.S. Fish and Wildlife Service). Black-tailed Prairie Dog Removed from Candidate Species List. News Release from the Mountain-Prairie Regional office in Lakewood, Colorado. August 12, 2004.

USFWS, (U.S. Fish and Wildlife Service). Removal of Swift Fox from the Federal list of Endgangered Species. Press Release. 2001.Website: http://www.fws.gov/-northdakotafieldoffice/endspecies/species/swift_fox.htm. Accessed January 27, 2012.

USFWS, (U.S. Fish and Wildlife Service). Block Clearance for Black-Footed Ferret Surveys. Letter from B.T. Kelly, Field Supervisor, Wyoming Field Office, USFWS. February 2, 2004.

WDEQ/SHWD (Wyoming Department of Environmental Quality-Solid and Hazardous Waste Division). Inspection & Compliance Guideline #1 "CESQG/SQG/Used Oil Self-Audit Checklist". 2011. Website: http://deq.state.wy.us/shwd/I_CPage(1).asp

WDEQ/AQD (Wyoming Department of Environmental Quality/Air Quality Division). Fugitive Dust Emission Factors, January 24, 1979.

WDEQ/AQD (Wyoming Department of Environmental Quality/Air Quality Division). 2010, 2008 Annual Minor Source Inventory. Website: http://deq.state.wy.us/-aqd/ei.asp. Accessed November 2010.

Section 4 -Environmental Effects (Continued)

WGFC (Wyoming Game and Fish Commission). Mitigation Policy. 2008. Pdf available on line: WFGC_Mitigation_Policy 0001532. November 17, 2008.

WGFD (Wyoming Game & Fish). Sage-Grouse Executive Order 2011-5 DDCT. Website: http://gf.state.wy.us/web2011/wildlife-1000382.aspx

WGFD. Wyoming Species of Greatest Conservation Need (Updated in 2010). 2005. Website: http://gf.state.wy.us/web2011/WILDLIFE-1000407.aspx

WGFD. Wyoming Sage Grouse Lek Viewing Guide. 2010a. Website: http://gf.state.wy.us/web2011/wildlife-1000382.aspx

WGFD. Bulletin Number 25: Habitat Needs and Development for Sharp-tailed Grouse. 2004. Website: http://wgfd.wyo.gov/-web2011/WILDLIFE-1000616.aspx

USGS (U.S. Geological Survey). Protocols for Geologic Hazards Response by the Yellowstone Volcano Observatory, USGS Circular 1351, prepared jointly by the USGS, the University of Utah, and Yellowstone National Park, 2010. Website: http://pubs.usgs.gov/circ/1351/.

USGS. Steam Explosions, Earthquakes, and Volcanic Eruptions - What's in Yellowstone's Future? USGS Fact Sheet 2005-3024, prepared jointly by the USGS, the University of Utah, and Yellowstone National Park. Website:http://pubs.usgs.gov/fs/2005/3024/fs2005-3024.pdf

US Environmental Protection Agency (EPA, 2004), Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling--Compression-Ignition; Final Rule Subpart IIII, April, 2004.

US Environmental Protection Agency (EPA, 1995), AP-42 Compilation of Air Pollutant Emission Factors, 5th Edition, Volume 1: Stationary Point and Area Sources; January 1995.

US Environmental Protection Agency (EPA, 2006), Standards of Performance for Stationary Compression Ignition Internal Combustion Engines; Final Rule Subpart IIII, July 11, 2006.

Section 5 - Cumulative Impacts

Becker, J.M., C.A. Duberstein, J.D. Tagestad, and J.L. Downs. "Sage-Grouse and Wind Energy: Biology, Habits, and Potential Effects of Development." Prepared for the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy Wind and Hydropower Technologies Program Under Contract DE-AC05-76RL01830. 2009. Website: http://www.pnl.gov/main/publications/external-/technical_reports/pnnl-18567.pdf

BLM (U.S. Bureau of Land Management). Powder River Basin Coal Review. Task Reports 1A through 3D. 2010a. Website: http://www.blm.gov/wy/st/en/-programs/energy/Coal_Resources/PRB_Coal/prbdocs.html

BLM. (U.S. Bureau of Land Management) "Powder River Basin Coal." 2010b. Website: http://www.blm.gov/wy/st/en/programs/energy/Coal_Resources/PRB_Coal.html

BLM. "Draft Reasonable Foreseeable Development Scenario for Oil and Gas Buffalo Field Office Planning Area, Wyoming." 2009a.

BLM. "Update of the Task 2 Report for the Powder River Basin Coal Review Past and Presentand Reasonably Foreseeable Development Activities." 2009b. Website:http://www.blm.gov/wy/st/en/programs/energy/Coal_Resources/PRB_Coal/prbdocs/coalreview/task_2_update_12.html

BLM. "Final Mineral Occurrence and Development Potential Report Buffalo Resource Management Plan Revision." BLM Buffalo Field Office. 2009c. Website:http://www.blm.gov/pgdata/etc/medialib/blm/wy/programs/planning/rmps/buffalo/docs.Par.90169.File.dat/RevisedFinalMineralReport_Part1.pdf.

BLM. "Update Of The Task 3D Report For The Powder River Basin Coal Review Cumulative Environmental Effects." Bureau Of Land Management High Plains District Office and Wyoming State Office. 2009d. Website:http://www.blm.gov/wy/st/en/programs/energy/Coal_Resources/PRB_Coal/prbdocs/coalreview/task_3d_update__12.html.

BLM. "Final Environmental Impact Statement for the South Gillette Area Coal Lease Applications." WYW172585, WYW173360, WYW172657, and WYW161248. 2009e.Website:http://www.blm.gov/pgdata/content/wy/en/info/NEPA/HighPlains/SouthGillette.html.

Section 5 - Cumulative Impacts (Continued)

BLM. "Update of Task 3A Report for the Powder River Basin Coal Review Cumulative Air Quality Effects for 2020." December. 2009f. Website:http://www.blm.gov/wy/st/en/programs/energy/Coal_Resources/PRB_Coal/prbdocs/coalreview/task_3a-2020.html

BLM. "Programmatic Agreement Between Bureau of Land Management and Wyoming State Historic Preservation Officer Regarding Mitigation of Adverse Effects on the Pumpkin." 2009g.

BLM. "Summary of the Analysis of the Management Situation Buffalo Resource Management Plan Revision." BLM, Buffalo Field Office. 2009h. Website:http://www.blm.gov/wy/st/en/programs/Planning/rmpsPlanning/rmps/buffalo/docs.html

BLM. "Fortification Creek Area Draft Resource Management Plan Amendment/Environmental Assessment." 2008a. Website:http://www.blm.gov/wy/st/en/info/NEPA/bfodocs/fortification_creek.Html.

BLM. "Final Environmental Impact Statement for the West Antelope II Coal Lease ApplicationWYW163340." 2008b. Website:http://www.blm/gov/wy/st/en/info/NEPA/cfodocs/West_Antelope_II.html

BLM. "Finding of No Significant Impact and Decision Record for Anadarko Petroleum Corp. DryWillow Phase II, Environmental Assessment." WY-070-07-148. Buffalo, Wyoming: Bureau of Land Management, Buffalo Field Office. 2007. Website:http://www.blm.gov/pgdata/etc/medialib/blm/wy/information/NEPA/bfodocs/pods/anadarko.Par.78198.File.dat/Dry%20Willow%20Phase%20II%20EA.pdf

BLM. "Task 3A Report for the Powder River Basin Coal Review Cumulative Air Quality Effects." 2006. Website:http://www.blm.gov/wy/st/en/programs/energy/Coal_Resources/PRB_Coal/prbdocs/coalreview/task3a.html

BLM. "Task 1D Report for the Powder River Basin Coal Review Current Environmental Conditions." 2005a. Website:http://www.blm.gov/wy/st/en/programs/energy/Coal_Resources/PRB_Coal/prbdocs/coalreview /Task1D.html

Section 5 - Cumulative Impacts (Continued)

BLM. "Task 2 Report for the Powder River Basin Coal Review Past and Present and Reasonably Foreseeable Development Activities." 2005b. Website:http://www.blm.gov/wy/st/en/programs/energy/Coal_Resources/PRB_Coal/prbdocs/coalreview/Task2.html

BLM. "Task 3D Report for the Powder River Basin Coal Review Cumulative Environmental Effects."2005c. Website:http://www.blm.gov/wy/st/en/programs/energy/Coal_Resources/PRB_Coal/prbdocs/coalreview/task3d.html2005c.

BLM. "Task 3C Report for the Powder River Basin Coal Review Cumulative Social and Economic Effects." 2005d. Website:http://www.blm.gov/wy/st/en/programs/energy/Coal_Resources/PRB_Coal/prbdocs/coalreview/task3c.html.

BLM. "Final Environmental Impact Statement and Proposed Plan Amendment for the Powder River Basin Oil and Gas Project." 2003. Website: http://www.blm.gov/wy/st/en/info/NEPA/bfodocs/prb_eis.html.

Braun, C. E., O. O. Oedekoven, and C. L. Aldridge. Oil and gas development in western North America: effects on sagebrush steppe avifauna with particular emphasis on sage grouse.Transactions North American Wildlife and Natural Resources Conference 67:337-349. 2002.

Connelly, J.W., C.A. Hagen, and M.A. Schroeder. "Ecology and Conservation of Greater Sage- Grouse: A Landscape Species and Its Habitats." Chapter 5, Characteristics and Dynamics of Greater Sage-Grouse Populations. Studies in Avian Biology, Prepublication Release. 2009. Website: http://sagemap.wr.usgs.gov/Docs/SAB/-Chapter05.pdf

Doherty, K.E., D.E. Naugle, H. Copeland, A. Pocewicz, and J. Kiesecke. "Ecology and Conservation of Greater Sage-Grouse: A Landscape Species and Its Habitats." Chapter 22, Energy Development and Conservation Tradeoffs: Systematic Planning for Sage-Grouse in Their Eastern Range." Studies in Avian Biology, Prepublication Release. 2009. Website: http://sagemap.wr.usgs.gov/Docs-/SAB/Chapter22.pdf

Doherty, K. E., D. E. Naugle, B. L.Walker, and J. M. Graham. Greater Sage-Grouse winter habitat selection and energy development. *Journal of Wildlife Management*. 2008: 72:187–195.

Section 5 - Cumulative Impacts (Continued)

Duke Energy Top of the World Windpower. 2011. Website: http://www.duke-energy.com/commercial-renewables/top-of-the-world-windpower.asp

EPA. "Protective Noise Levels, Condensed Version of EPA Levels Document." Washington, DC: EPA. Office of Noise Abatement and Control. 1978. EPA-55019-79- 100.

Garton, E.O., J.W. Connelly, C.A. Hagen, J.S. Horne, A. Moser, and M.A. Schroeder. "Ecology and Conservation of Greater Sage-Grouse: A Landscape Species and Its Habitats." Chapter 16, Greater Sage-Grouse Population Dynamics and Probability of Persistence. Studies in Avian Biology, Prepublication Release. 2009. Website: http://sagemap.wr.usgs.gov/Docs/SAB/Chapter16.pdf

Greystone Environmental Consultants, Inc. Surface Water Quality Analysis Technical Report. Surface Water Modeling of Water Quality Impacts Associated with Coal Bed Methane Development in the Powder River Basin.2003.

Holloran, Matthew J., Greater Sage-Grouse (*Centrocercus urophasianus*) Population Response to Natural Gas Field Development in Western Wyoming. PhD, Department of Zoology and Physiology, December, 2005. Website: http://gf.state.wy.us/downloads/pdf/sagegrouse/Holloran2005PhD.pdf

IHS Energy Services (IHS). Oil and Gas Production and Well History Database. 2008.

Mackin, P.C., D. Daruwalla, J. Winterle, M. Smith, and D.A. Pickett. NUREG/CR–6733, "A Baseline Risk-Informed Performance-Based Approach for In-Situ Leach Uranium Extraction Licensees." Washington, DC: 2008.

Naugle, D.E., K.E. Doherty, B. Walker, M.J. Holloran, and H.E. Copeland. "Ecology and Conservation of Greater Sage-Grouse: A Landscape Species and Its Habitats." Chapter 21, Energy Development and Greater Sage-Grouse. Studies in Avian Biology, Prepublication Release. 2009. Website: http://sagemap.wr.usgs.gov/-Docs/SAB/Chapter21.pdf

Naugle, D.E. , K.E. Doherty, And B.L. Walker. Sage-Grouse Winter Habitat Selection And Energy Development In The Powder River Basin: Completion Report. 2006. Website: http://www.voiceforthewild.org/SageGrouseStudies/Winter_-habitat_report.pdf

Section 5 - Cumulative Impacts (Continued)

NRC. (U.S. Nuclear Regulatory Commission). Memorandum to William D. Travers, Executive Director for Operations, from Annette L. Vietti-Cook, Secretary. Subject: Staff Requirements, SECY–99–0013: Recommendations on Ways to Improve the Efficiency of NRC Regulation at *In-Situ* Leach Uranium Recovery Facilities." 2009. Website: http://www.nrc.gov/readingrm/doccollections/-commission/srm/1999/1999- 013srm.html

Pacific Corp Renewable Energy Sources. 2011. Website: http://www.pacificorp.com/-index.html

Peterson, D.A., M.L. Clark, K. Foster, P.R. Wright and G.K Boughton. Assessment of ecological conditions and potential effects of water produced from coal bed natural gas development on biological communities in streams of the Powder River structural basin, Wyoming and Montana, 2005–08: U.S. Geological Survey Scientific Investigations Report 2010–5124, 84 p. 2011. Website: http://pubs.usgs.gov/sir/2010/5124/

Scire, J.S., D.S. Strimitis, and R.J. Yamartino. "A User's Guide for the CALPUFF Dispersion Model (Version 5.0)." Concord, Massachusetts: Earth Tech, Inc. October 1999a.

Scire, J.S., F.R. Robe, M.E. Fernau, and R.J. Yamartino. "A User's Guide for the CALPUFF Dispersion Model (Version 5.0)." Concord, Massachusetts: Earth Tech, Inc. September 1999b.

Stoeckenious, T., S. Lau, E. Tai, R. Morris, M. Jimenez, and J. Russell. "Final Report: Southwest Wyoming NO2 PSD Increment Consumption Modeling: Results for Sublette County." Novato, California: Environ International Corporation. 2006.

USFWS (U.S. Fish and Wildlife Service). Threatened and Endangered Species Listings and Occurrences for Wyoming. United States Department of the Interior, United States Fish and Wildlife Service, Washington, D.C. 2010. Website: http://www.fws.gov/endangered

Walker, B. L., D. E. Naugle, and K. E. Doherty. Greater Sage-Grouse population response to energy development and habitat loss. Journal of Wildlife Management. 2007: 71:2644- 2654.

WOGCC (Wyoming Oil and Gas Conservation Commission). Statistics. 2008. Website: http://wogcc.state.wy.us/

Section 5 - Cumulative Impacts (Continued)

WOGCC (Wyoming Oil and Gas Conservation Commission. Campbell County CBM production statistics for 2007. Website: http://wogcc.state.wy.us/StatsForCounty-2.cfm?oops=1. Accessed February 2012.

WOSLI (Wyoming Office of State Lands and Investments). "Wyoming Biomass Inventory: Animal Waste, Crop Residue, Wood Residue, and Municipal Solid Waste." Cheyenne, Wyoming: Office of State Lands and Investments, Wyoming State Forestry Division. 2007.

WSGS (Wyoming State Geological Survey). Uranium. 2010. Website; http://www.wsgs.-uwyo.edu/AboutWSGS/Uranium.aspx

Section 5 -Figure References

Figure 5-1 Energy Developments; Websites: http://wygl.wygisc.org/wygeolib/catalog-/search/viewMetadataDetails.page?uuid={73FD7610-B218-4102-83A3-29341C5588B7}and: http://wygl.wygisc.org/wygeolib/catalog/search/-viewMetadataDetails.page?uuid={4DBE9F9D-25FD-4676-A4FE-2FEFE918B8CE} and: http://wygl.wygisc.org/wygeolib/catalog/search/view-MetadataDetails.page?uuid={40D1D4E1-F83C-4A3E-953D-F4FC4D592872}

Figure 5-2 Regional Wells and Surface Ownership; Websites: http://www.blm.gov/wy/st-/en/resources/public_room/gis/datagis/state/state-own.html and: http://wogcc.state.wy.us/

Section 6 - Mitigation Measures

Case, James C., Rachel N. Toner, and Robert Kirkwood. Basic Seismological Characterization for Crook County, Wyoming. 2002. Website: http://www.geo.mtu.edu/UPSeis/Mercalli.html

CCGov (Campbell County Public Works). Campbell County Landfill information. 2010. Website: http://www.ccgov.net/departments/publicworks/Landfill/index.html

DOI (U.S. Department of Interior). Professional Qualification Standards. 48 FR 22716. 1983. Website: http://search.usa.gov/search?affiliate=doi.gov&-query=48+FR+22716

EPA (U.S. Environmental Protection Agency). Statistical analysis of Groundwater Monitoring Data at RCRA Facilities: Unified Guidance. EPA 530/R-09-007, 2009. Website: http://nlquery.epa.gov/epasearch/

Executive Order 2001-6, State of Wyoming, "Assignment of Duties and Responsibilities to the State Emergency Response Commission which include the Requirements of the 'Superfund Amendments and Reauthorization Act of 1986,' and the Assignment of Emergency Response, Preparedness and Recovery Functions for Radiological Materials Transportation Accidents which supercedes and replaces Executive Orders 1987-3, 1990-4, 1992-5, 1993-3, AND 1998-5," Website http://search.wy.gov/search?q=executive+order+20016&site=default_collection&client=default_frontend&output=xml_no_dtd&proxystylesheet=default_frontend&filter=0&ctl00%24btnG.x=0&ctl00%24btnG.y=0. Assessed March 2012.

LCI (Lost Creek ISR, LLC), 3rd Round WDEQ/LQD Comment Responses, October 22, 2009. NRC ADAMS Accession No. ML100610158. 2009.

NRC (U.S. Nuclear Regulatory Commission), NUREG-0706, Final Generic Environmental Impact Statement on Uranium Milling, Project M-25, Summary and Text. 1980.

WDEQ/LQD (Wyoming Department of Environmental Quality, Land Quality Division). Rules and Regulations for Non-Coal Permitting Guideline 2 – Vegetation. WDEQ-LQD District 3, Sheridan, Wyoming. 2004.

WDEQ/LQD (Wyoming Department of Environmental Quality, Land Quality Division). Guideline 4. In-Situ Mining. 2000. Website: http://deq.state.wy.us/

Section 6 - Mitigation Measures (Continued)

WGFD (Wyoming Gane and Fish Department). Bulletin Number 53: Fencing Guidelines for Wildlife. 2004. Website: http://wgfd.wyo.gov/web2011/WILDLIFE-1000616.aspx

Section 7 - Environmental Measurements and Monitoring

DOE/FEMP (U.S. Department of Energy). Environmental Management: Fernald Environemtnal Management Project (FEMP). 1995. Low-flow information on website: http://www.em.doe.gov/bemr/bemrsites/femp.aspx

NRC (U.S. Nuclear Regulatory Commission). Regulatory Guide 4.14. *Radiological Effluent and Environmental Monitoring at Uranium Mills*. Revision 1. Nuclear Regulatory Commission Office of Standards Development. Washington, D.C. 1980.

NRC (U.S. Nuclear Regulatory Commission). (Updated July 2007), Regulatory Guide 4.15, *Quality Assurance for Radiological Monitoring Programs (Inception through Normal Operations to License Termination) – Effluent Streams and the Environment,* Original February 1979.

NRC (U.S. Nuclear Regulatory Commission). (revised May 2002), Regulatory Guide 8.31, *Information Relevant to Ensuring that Occupational Radiation Exposures at Uranium Recovery Facilities will be As Low As is Reasonably Achievable,* Original May 1983.

NRC (U.S. Nuclear Regulatory Commission). (July 1993), Regulatory Guide 8.37, *ALARA Levels for Effluents from Materials Facilities,* Original February 1979.

NRC (U.S. Nuclear Regulatory Commission). NUREG-1910, Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities, Final Report, May 2009

NRC (U.S. Nuclear Regulatory Commission). Environmental Impact Statement for the Moore Ranch ISR Project in Campbell County, Wyoming: Supplement to the Generic Environmental Impact Statement (SEIS) for In-Situ Leach Uranium Milling Facilities - Final Report (NUREG-1910, Supplement 1), August 2010

Renken, K., Mchaina, D.M. and Yanful, E.K., 2005. Geosynthetics Research and Applications in the Mining and Mineral Processing Environment. North American Geosynthetics Society (NAGS)-Geosynthetic Institute (GSI) Conference, Las Vegas, Nevada. December 14-16, 2005

Section 8 - Benefit/Cost Analysis

EIA (U.S. Energy Information Administration). "What is the status of the U.S. nuclear industry?". 2011. Website: http://www.eia.gov/energy_in_brief/nuclear_-industry.cfm. Accessed December 30, 2011,

IMPLAN Professional 2.0 Software and IMPLAN data for state of Wyoming.

IMPLAN User Guide, 3rd edition. 2004.

U.S. Census. 2010

WDOR (Wyoming Department of Revenue). Calculations run by Cynthia Rice.

WDOW (Wyoming Department of Workforce Services, Research & Planning. Website accessed March 2012. http://doe.state.wy.us/lmi/news.htm

11 LIST OF PREPARERS

In support of the proposed Reno Creek Project, the organizations and individuals listed below contributed to the preparation of this Environmental Report as well as the Technical Report and WDEQ/LQD Permit to Mine Application.

AUC, LLC
1536 Cole Blvd.
Suite 330
Lakewood, CO 80401
(303) 953-7975

Jim Viellenave	President
Leland Huffman	Engineering and Operations Manager
Philip Cavendor	Project Development Manager
Dan Dowers	Chief Geologist
Josh Warriner	Data Operations Manager

BKS Environmental Associates, Inc.
P.O. Box 3467
Gillette, Wyoming 82718
(307) 686-0800

Brenda Schladweiler, Ph.D.	President/Senior Soil Scientist/Senior Vegetation Ecologist
Katie Wilson	Operations Manager/Wetland Specialist
Dawn Gardner	Vegetation Ecologist/Wetland and Soils Technician
Cody Bank	Soil Scientist
Tracy Spelts, GISP	GIS Designer

Greer Services, Archeology Consulting
2599 Paradise Drive
Casper, Wyoming 82604
(307) 473-2054

John Greer, Ph.D.	Principal Investigator
Mavis Greer, Ph.D.	Principal Investigator

ICF International
405 Boxelder Road, Suite A-5
Gillette, Wyoming 82718
(307) 687-4760

Jessica Maycock	Project Manager/Wildlife Biologist

Inter-Mountain Laboratories-Air Science
555 Absaraka Street
Sheridan, Wyoming 82801
(307) 674-7506

Ronn Smith, P.E.	Senior Engineer
Tim Mendenhall	Air Science Manager
Cory Medill	Cory Medill

Inter-Mountain Laboratories
1633 & 1673 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-8945

Kevin Chartier	Vice President
Tom Patten	Laboratory Manager
Wade Nieuwsma	Assistant Laboratory Manager/Rad Chem Supervisor
Michelle LaGory	Quality Assurance Manager
Lacey Ketron	Water Lab Supervisor
Karen Secor	Soil Laboratory Supervisor
Glenn Dorsch	Programmer/IT Support

Petrotek Engineering Corporation
10288 West Chatfield Avenue, Suite 201
Littleton, Colorado 80127
(303) 290-9414

Hal Demuth, M.S.	Senior Engineer/Project Manager
Ken Cooper, M.S., P.E.	Senior Engineer
Errol Lawrence, M.S., P.G.	Senior Hydrogeologist
Ken Schlieper	Project Hydrogeologist
Aaron Payne, P.G.	Geologist

R&D Enterprises, Inc.
Casper, WY 82604
(307) 237-4188

Roger A. Garling	Principal Consultant
Sheryl A. Garling	Principal Consultant/RSO

Tetra Tech
3801 Automation Way, Suite 100
Fort Collins, Colorado 80525
(970) 224-4612

H. Robert Meyer, Ph.D.	Senior Health Physicist

Thompson & Pugsley, PLLC
1225 19th Street NW
Washington, D.C. 20036
(202) 496-0780

Anthony Thompson, Esq.	Partner
Christopher Pugsley, Esq.	Partner

TREC, Inc.
900 Werner Court
Suite 150
Casper, WY 82601
(307) 265-0696

Doug Graves, P.E.	Principal/President
Matt Yovich, P.E.	Principal/Vice President
Wendy Stansbury, P.E.	Regional Manager
Ray De Luna	Permitting Manager/Project Manager
Jim Yocum	Permitting Support
Brian Pile	Engineer/Process
Eric Marvel	Engineer
Troy Kechley	Engineer
Ryan Muller	Environmental Scientist
Cameron Trembath	Environmental Scientist
Ross Klein	Environmental Scientist/GIS Designer
Wayne Cummings	Environmental Technician
Traci Nickerson	Environmental Technician

GLOSSARY

11e.(2) Byproduct Material: the tailings or byproduct produced by extracting or concentrating uranium or thorium from any ore processed primarily for its source material content. See also Source Material.

Backup Storage Pond: a lined containment pond to temporarily hold waste water as backup capacity to the deep disposal wells (DDW) during maintenance or repair

Bleed: a solution drawn to adjust production or to restore groundwater by pumping more fluids from the production zone than are injected, causing fresh groundwater to flow into the production area.

Brine: water with concentrated dissolved minerals generated from the production and restoration reverse osmosis units.

Buffer Area: area extending a specified distance outside the Proposed Project area for analyzing baseline conditions and potential impacts. The distance from the proposed project area varies by resource. Also refered to as "Review Area."

Central Processing Plant Area: the fenced area that will include the Central Processing Plant (CPP), storage facilities, office/warehouse facilities, backup storage pond, and other piping and equipment. The CPP area is proposed in portions of the SENE of Section 1, Township 42 North, Range 74 West.

Controlled Area: as defined by 10 CFR Part 20 is an area outside of a restricted area but inside the site boundary, access to which can be limited by the licensee for any reason.

Deep Disposal Well: a class I well that injects hazardous and non-hazardous wastes into deep, isolated rock formations that are below the lowermost USDW.

Effluent: a waste liquid, solid, or gas, in its natural state or partially or completely treated, that discharges into the environment.

Eluant: a substance used as a solvent in separating materials in elution

Elution: the process of extracting (or eluting) one material from another by washing with a solvent (eluant) to remove adsorbed material (such as uranium) from an adsorbent such as an ion exchange resin.

Ephemeral stream: a drainage feature that only carries surface runoff in direct response to precipitation. An ephemeral stream may or may not have a well-defined channel and the stream bed is always above the water table. An ephemeral stream lacks the biological, hydrological, and physical characteristics commonly associated with perennial or intermittent streams.

Excursion: the unintended spread, either horizontally or vertically, of recovery solutions beyond the production zone. Monitoring wells are installed to analyze for appropriate water quality parameters and detect excursions.

Flare: the undetected spread of recovery solutions between the well field and monitor wells of the production zone. Flare is also a proportionality factor that estimates the amount of aquifer water outside of the pore volume that has been affected by lixiviant flow during the recovery phase. The flare is usually expressed as a horizontal and vertical component to account for differences between the horizontal and vertical hydraulic conductivity of an aquifer material.

Feeder Pipelines: injection and recovery feeder pipelines will convey injection and recovery solutions between the main trunk lines which deliver solutions to and from the CPP and the header houses.

Groundwater: water beneath the surface in the saturated zone that is under atmospheric or artesian pressure.

Header House: will transfer injection and recovery solutions to and from individual wells in a wellfield. Each header house will have an injection and recovery manifold which are connected to the respective feeder pipelines.

Injection Zone: a geological formation, group of formations, or part of a formation that receives fluids through a well.

In Situ Recovery (ISR): the in-place recovery of a mineral resource without removing overburden or ore. This is typically accomplished by installing a well and recovering the resource directly from the natural deposit by exposing it to the injection and recovery of a fluid that causes the leaching, dissolution, or recovery of the mineral.

ISR GEIS: Generic Environmental Impact Statement for *In-Situ* Leach Uranium Milling Facilities, NUREG-1910.

Injection Well: a well or conduit through which lixiviant is introduced into the ore body.

Ion Exchange: a chemical process used to recover uranium from solution by the exchange of dissolved uranium ions between a lixiviant (leach solution) and a solid, either a mineral surface or, more commonly, a synthetic polymer resin.

Lixiviant: a leachate solution composed of native groundwater and chemicals (such as sodium carbonate/bicarbonate, ammonia, or sulfuric acid) added by the ISR facility operator. In the ISR process, the lixiviant is pumped underground for the purpose of mobilizing (dissolving) uranium from a uranium ore body.

Monitor Well: a well constructed or utilized to measure static water levels and/or to obtain liquid, solid, or gaseous analytical samples or other physical data that would be used for controlling the operation or to indicate potential circumstances that could affect the environment.

OM Wells: monitor wells completed in the Overlying Aquifer.

Overlying Aquifer: overlying aquifer relative to the production zone.

Overlying Aquitard (OA): confining unit providing isolation between the production zone and overlying aquifer

Permeate: nearly pure water generated from the production and restoration reverse osmosis units.

Pore Volume: a term used to define an indirect measurement of a unit volume of aquifer water affected by ISR recovery.

Pregnant Solution: a solution containing a dissolved, extractable mineral that was leached from the ore; uranium leach solution pumped up from the underground ore zone through a production hole. Also called "pregnant lixiviant."

Primary Access Road: an access road to provide access to the central plant area from the Clarkelen Road. The primary access road will include significant cut and fill and gravel surfacing and will be constructed for long-term use.

Proposed Action: the Proposed Action involves construction, operation, groundwater restoration, and decommissioning of an ISR uranium recovery facility in the Proposed Project Area.

Proposed Project Area: the area proposed for construction, operation, groundwater restoration, and decommissioning of an ISR uranium recovery facility.

Production Unit: an area made up of multiple well fields where each well field has its own header house.

Production Zone Aquifer (PZA): the uranium-bearing portion of a geological formation or part of a formation that is the target of ISR uranium recovery by underground injection and production of lixiviant.

PZM Well: monitor well completed in the Production Zone Aquifer.

Pumpkin Butte Uranium District: uranium ore-bearing area in the Powder River Basin (PRB) located in southwest Campbell and southeast Johnson counties.

Reclamation: the process of restoring the surface environment to acceptable pre-existing conditions. Reclamation includes activities such as surface contouring, equipment removal, well plugging, and revegetation.

Recovery Well: a well or a drill hole in an in situ leach operation through which pregnant (uranium-bearing) solutions are extracted from an underground stratum or uranium deposit.

Restoration: returning each constituent in the affected groundwater to its NRC-approved restoration target value or to an alternate standard approved by NRC.

Restricted Area: an area, access to which is limited by the licensee for the purpose of protecting individuals against undue risks from exposure to radiation and 11e.(2) byproduct material. Restricted area does not include areas used as residential quarters, but separate rooms in a residential building may be set apart as a restricted area.

Reverse Osmosis (RO): the act of reversing a diffusion through a semipermeable membrane, typically separating a solvent and a solution, that tends to equalize their concentrations. In ISR facilities, this process is used to treat wastewater to remove dissolved constituents and reduce total dissolved solids.

Review Area: area extending a specified distance outside the proposed project area for analyzing baseline conditions and potential impacts. The distance from the proposed project area varies by resource. Also refered to as “buffer area.”

Roll Front: a localized uranium deposit in the form of a roll or interface that separates an oxidized interior from a reduced exterior. The reduced side of this interface is significantly enriched in uranium.

Satellite Facility: a remotely located facility for initial processing of uranium bearing solutions.

Shallow Water Table Unit (SM unit): a perched shallow water table unit found in some locations of the Proposed Project area

TENORM: as defined by the EPA, is produced when activities such as uranium mining, or sewage sludge treatment, concentrate or expose radioactive materials that occur naturally in ores, soils, water, or other natural materials.

Tertiary Access Road: a road used within the Proposed Project area for access to monitor wells, injection wells, and recovery wells. Tertiary access roads are used for limited travel and consist of designated two-track trails where the land surface is not modified to accommodate the road. They are used until they are no longer needed to access the desired location within the project area.

Trunkline: a buried pipeline conveying lixiviant from the central processing plant to feeder lines or recovery solution from a feeder line to the central processing plant.

Underground Source of Drinking Water (USDW): an aquifer or portion of an aquifer that supplies any public water system or that contains a sufficient quantity of groundwater to supply a public water system, and currently supplies drinking water for human consumption, or that contains fewer than 10,000 mg/I total dissolved solids and is not an exempted aquifer.

Underlying Aquitard (UA): confining unit underlying the Production Zone Aquifer

UM Well: montior well completed in the Underlying Unit.

Underlying Unit: discontinuous underlying sand unit relative to the production zone. Based on geologic and hydrologic data, this unit does not meet the requirements of an aquifer in the Proposed Project area.

Unrestricted Areas: means an area, access to which is neither limited nor controlled by the licensee.

Wellfield: the area of an ISR operation that encompasses the array of injection, recovery and monitoring wells and interconnected piping employed in the ISR recovery process.