U.S. NUCLEAR REGULATORY COMMISSION

OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS

DIVISION OF FUEL CYCLE SAFETY, SAFEGUARDS, AND ENVIRONMENTAL REVIEW

FINAL ENVIRONMENTAL ASSESSMENT FOR THE JANE DOUGH UNIT AT THE URANERZ'S NICHOLS RANCH IN SITU RECOVERY PROJECT, JOHNSON AND CAMPBELL COUNTIES, WYOMING

DOCKET NO. 40-9067

March 2017

CONTENTS

Section Page

FIGURES vii
TABLES ix
EXECUTIVE SUMMARY xi
ACRONYMS xix

1 INTRODUCTION 1-1
1.1 Background 1-1
1.2 Proposed Action 1-1
1.3 Purpose and Need for the Proposed Action 1-1
1.4 Review Scope 1-2
1.5 Structure of the EA 1-2

2 IN SITU URANIUM RECOVERY (PROPOSED ACTION) AND ALTERNATIVE 2-1
2.1 Description of the In-Situ Leach Process 2-1
2.2 Site Location 2-2
2.3 Proposed Action (Alternative 1) 2-4
2.3.1 Construction Activities 2-4
2.3.2 Wellfield Operations 2-8
2.3.3 Aquifer Restoration Activities 2-8
2.3.4 Decommissioning Activities 2-9
2.3.5 Effluents and Waste Management 2-11
2.3.6 Wastewater Disposal 2-13
2.4 No-Action Alternative 2-13

3 DESCRIPTION OF THE AFFECTED ENVIRONMENT 3-1
3.1 Introduction 3-1
3.2 Land Use 3-1
3.3 Transportation 3-2
3.4 Geology and Soils 3-3
3.4.1 Jane Dough Unit Geology 3-3
3.4.2 Jane Dough Unit Depositional and Stratigraphic Settings 3-3
3.4.3 Jane Dough Unit Ore Zones 3-3
3.4.4 Jane Dough Unit Soils 3-4
3.5 Water Resources 3-4
3.5.1 Surface Water 3-5
3.5.2 Groundwater 3-6
3.5.3 Water Uses 3-10
3.6 Ecology 3-11
3.7 Meteorology, Climatology, and Air Quality 3-13
3.7.1 Meteorology and Climatology 3-14
3.7.2 Air Quality 3-15
3.8 Noise 3-15
3.9 Cultural and Historical Resources 3-17
3.9.1 Cultural Resources Site Survey 3-17
3.9.2 Paleontological Resources Site Survey 3-20
3.10 Visual and Scenic Resources 3-20
3.11 Socioeconomics 3-20

CONTENTS (Continued)

Section Page

3.12 Public and Occupational Health 3-21
3.13 Waste Management 3-25

4 ENVIRONMENTAL IMPACTS 4-1
4.1 Introduction 4-1
4.2 Land Use 4-2
4.3 Transportation 4-3
4.4 Geology and Soils 4-4
4.5 Water Resources 4-7
4.5.1 Surface Waters and Wetlands Impacts 4-7
4.5.2 Groundwater Impacts 4-10
4.6 Ecology 4-13
4.7 Air Quality 4-18
4.8 Noise 4-19
4.9 Cultural and Historical Resources 4-20
4.10 Visual and Scenic Resources 4-22
4.11 Socioeconomics and Environmental Justice 4-23
4.12 Public and Occupational Health 4-26
4.13 Waste Management 4-28

5 CUMULATIVE IMPACTS 5-1
5.1 Introduction 5-1
5.1.1 Methodology 5-1
5.1.2 Other Past, Present, and Reasonably Foreseeable Future Actions 5-3
5.1.2.1 Uranium Recovery Sites 5-3
5.1.2.2 Coal Mining 5-5
5.1.2.3 Oil and Gas Production 5-5
5.1.2.4 Coalbed Methane Development 5-6
5.1.2.5 Energy Projects 5-6
5.1.2.6 Transportation Projects 5-7
5.1.2.7 Other Mining 5-8
5.2 Land Use 5-8
5.3 Transportation 5-9
5.4 Geology and Soils 5-10
5.5 Water Resources 5-11
5.6 Ecological Resources 5-13
5.7 Air Quality 5-17
5.8 Noise 5-23
5.9 Cultural and Historic Resources 5-24
5.10 Visual and Scenic Resources 5-25
5.11 Socioeconomics and Environmental Justice 5-26
5.12 Public and Occupational Health and Safety 5-28
5.13 Waste Management 5-30

CONTENTS (Continued)

Section		Page
6	MONITORING AND MITIGATION	6-1
	6.1 Wellfield and Pipeline Flow and Pressure Monitoring	6-1
	6.2 Groundwater and Surface Water Monitoring	6-2
	6.3 Preoperational Water Quality Monitoring	6-2
	6.4 Environmental Monitoring	6-2
	6.5 Mitigation	6-3
7	AGENCIES AND PERSONS CONSULTED	7-1
	7.1 Wyoming State Historic Preservation Office	7-1
	7.2 U.S. Fish and Wildlife Service	7-1
	7.3 Wyoming Department of Environmental Quality	7-1
8	CONCLUSION	8-1
9	LIST OF PREPARERS	9-1
	9.1 U.S. Nuclear Regulatory Commission Contributors	9-1
	9.2 Center for Nuclear Waste Regulatory Analyses (CNWRA®) Contributors	9-1
	9.3 CNWRA Consultants and Subcontractors	9-1
10	REFERENCES	10-1

APPENDIX A—CONSULTATION CORRESPONDENCE

APPENDIX B—EMISSION INVENTORY

1

FIGURES

Figure		Page
1-1	Map Location of Nichols Ranch ISR Project and Proposed Jane Dough Unit	1-3
2-1	Proposed Location of the Jane Dough Unit	2-3
2-2	Proposed Project Schedule for all Three Units of the Nichols Ranch ISR Project	2-5
5-1	Potential and Existing Uranium Milling and Mining Sites Within 80 km [50 mi] of the Jane Dough Unit	5-4

TABLES

Table		Page
E-1	Summary of Environmental Concerns	xvii
3-1	Jane Dough (or Nichols Ranch) Flow Unit Properties	3-8
3-2	Pre-Mining Groundwater Quality Given as Maximum Measured Concentrations on the Jane Dough Unit Relative to Water Quality Standards	3-9
3-3	Noise Abatement Criteria: 1-Hour, A-Weighted Sound Levels in Decibels (dBA)	3-16
3-4	Sites Within or Near the Proposed Jane Dough Unit	3-19
6-1	Summary of Mitigation Measures Identified by NRC	6-3
A-1	Chronology of Consultation Correspondence	A–1
B-1	Particulate Matter PM_{10} Annual Fugitive Dust Emission Estimates in Short Tons	B–2
B-2	Dewey-Burdock ISR Project Onsite Particulate Matter PM_{10} Annual Fugitive Dust Emission Estimates in Short Tons	B–3
B-3	Nichols Ranch SEIS Analyses Annual Combustion Emission Estimates in Short Tons	B–4
B-4	Peak Year Combustion Emission Estimates in Short Tons for the Jane Dough Amendment Analysis	B–5
B-5	Annual Estimated Emissions in Short Tons Used for the Jane Dough EA, Nichols Ranch SEIS, and GEIS Analyses	B–5
B-6	Nichols Ranch Meteorological Station Temperature Data	B–6
B-7	National Ambient Air Quality Standards (NAAQS)	B–6
B-8	Prevention of Significant Deterioration Classes I and II Standards	B–7
B-9	Ambient Air Quality Data for National Ambient Air Quality Standards (NAAQS) Pollutants from Monitoring Stations Inside the Region of Influence	B–8

EXECUTIVE SUMMARY

BACKGROUND

By letter dated May 8, 2014, Uranerz Energy Corporation (Uranerz, or the licensee) submitted a request to amend its U.S. Nuclear Regulatory Commission (NRC) Source Material License SUA-1597 for the Nichols Ranch In Situ Recovery (ISR) Project, located in Johnson and Campbell Counties, Wyoming (NRC, 2015e; Uranerz, 2015, 2014a,b). The licensee requested that the Nichols Ranch ISR Project permit be modified to include the Jane Dough Unit. The license amendment request, if granted, would authorize the construction and operation of two additional wellfields within the Jane Dough Unit. The Jane Dough Unit would be the third unit of the Nichols Ranch ISR Project, for which a license was issued in July 2011. The addition of the Jane Dough Unit would add approximately 1,489 hectares (ha) [3,680 acres (ac)] of privately-owned land to the NRC-licensed area. The NRC license issued for the Nichols Ranch ISR Project authorized the construction and operations of uranium recovery facilities within two noncontiguous areas: the Nichols Ranch Unit, which covers an area of about 453 ha [1,120 ac], which has been constructed and is operating; and the Hank Unit, which covers an area of about 911 ha [2,250 ac] and is approximately 9.7 kilometers (km) [6 miles (mi)] northeast of the Nichols Ranch Unit, which has not yet been constructed.

The NRC staff prepared this environmental assessment (EA) following NRC regulations at 10 CFR Part 51 that implement the National Environmental Policy Act of 1969 (NEPA), as amended (42 U.S.C. §4321), and the NRC staff guidance in NUREG–1748, "Environmental Review Guidance for Licensing Actions Associated with NMSS Programs" (NRC, 2003a). The purpose of this EA is to assess the potential environmental impacts of granting the proposed license amendment. Based on this EA, the NRC staff has determined that preparation of an Environmental Impact Statement (EIS) is not warranted and will therefore issue a Finding of No Significant Impact (FONSI) to be noticed in the *Federal Register*.

PURPOSE AND NEED FOR THE PROPOSED ACTION

The NRC regulates uranium milling, including the ISR process, under 10 CFR Part 40, "Domestic Licensing of Source Material." Uranerz is seeking an NRC license amendment to the Nichols Ranch ISR Project license for the construction, operations, aquifer restoration, and decommissioning of two additional wellfields within the Jane Dough Unit. The proposed federal action is the granting of the requested license amendment. The purpose and need for the proposed federal action is to provide an option that allows Uranerz to recover uranium within the proposed Jane Dough Unit. The licensee would process the recovered uranium into yellowcake at the existing central processing plant (CPP) currently located on the Nichols Ranch Unit. Yellowcake is the uranium oxide product of the ISR milling process that is used to produce various products, including fuel for commercially-operated nuclear power reactors.

This definition of purpose and need reflects the Commission's recognition that, unless there are findings in the safety review required by the Atomic Energy Act (AEA), the NRC has no role in a company's business decision to submit a license application to operate an ISR facility at a particular location.

THE PROJECT AREA

The Jane Dough Unit would be located in the southern portion of the Powder River Basin. The addition of the Jane Dough Unit to the Nichols Ranch ISR Project would be located in Township 43N, Range 76, portions of Sections 20, 21, 27, 28, 29, 30, 31, 32, 33, and 34. The Jane Dough Unit would consist of wellfields and header houses but no other surface facilities (e.g., no satellite facility, Central Processing Plant (CPP), Class I deep disposal wells, office buildings, or maintenance buildings). The licensee has proposed to connect all two wellfields in the Jane Dough Unit to the existing CPP in the Nichols Ranch Unit through buried trunklines. (Uranerz, 2014a)

SUMMARY OF ENVIRONMENTAL IMPACTS

This EA includes the NRC staff analysis that considers and weighs the environmental impacts from the construction, operations, aquifer restoration, and decommissioning of ISR operations at the proposed Jane Dough Unit and for the No-Action Alternative. This EA also describes mitigation measures for the reduction or avoidance of potential adverse impacts that (i) the licensee has committed to in its NRC license amendment request, (ii) would be required under other federal and state permits or processes, or (iii) are additional measures the NRC staff identified as having the potential to reduce environmental impacts but that the licensee did not commit to in its application. The EA uses the assessments and conclusions reached in the Nichols Ranch ISR Project SEIS (NRC, 2011b) in combination with site-specific information to assess and categorize impacts.

As discussed in the NUREG–1910, the Generic Environmental Impact Statement for In Situ Leach Uranium Milling Facilities (GEIS) (NRC, 2009) and consistent with NUREG–1748 (NRC, 2003a), the significance of potential environmental impacts is categorized as follows:

SMALL: The 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 environmental effects are sufficient to alter noticeably, but not destabilize, important attributes of the resource.

LARGE: The environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

Chapter 4 of this EA provides the NRC evaluation of the potential environmental impacts from the construction, operations, aquifer restoration, and decommissioning of the proposed Jane Dough Unit, as summarized below.

Land Use

The NRC staff concludes that impacts to land use from the construction, operations, aquifer restoration, and decommissioning of the proposed Jane Dough Unit would be SMALL.

This conclusion is based on the following factors: (i) the types of land use activities the licensee proposes are similar to those evaluated in the Nichols Ranch Supplemental Environmental Impact Statement (SEIS) (NRC, 2011b); (ii) the addition of the Jane Dough Unit would disturb 41 ha [101 ac] of land, which is at the small end of the 50 to 750 ha [120 to 1,860 ac] range analyzed in the Generic Environmental Impact Statement (GEIS) (NRC, 2009); (iii) all the land

within the proposed Jane Dough Unit is privately owned land with restricted access; (iv) impacts from road, wellfield, and pipeline construction would be temporary (i.e., the construction phase timeframe); (v) livestock grazing would continue to be restricted around each wellfield during the operations phase, but no additional land disturbance would occur from conducting operational activities; (vi) aquifer restoration activities would use the same infrastructure as during the operations phase; (vii) as aquifer restoration proceeds and wellfields are closed, with fewer wells and header houses being used, onsite activities would diminish; and (viii) during the decommissioning phase, the disturbed area would progressively decrease and the land would be reseeded and soil replacement would occur.

Transportation

The NRC staff concludes that impacts to transportation from the construction, operations, aquifer restoration, and decommissioning of the proposed Jane Dough Unit would be SMALL.

This conclusion is based on the following factors: (i) trip frequency to the Jane Dough Unit would be similar to the transportation parameters analyzed in the Nichols Ranch ISR SEIS (NRC, 2011b); (ii) the licensee anticipates using the same or similar numbers of workers for all phases of the Jane Dough Unit; (iii) workers would likely commute from the same locations as analyzed in the Nichols Ranch ISR SEIS (Uranerz, 2014a, 2016; NRC, 2011b); (iv) project activities would transition between the Nichols Ranch Unit and the Jane Dough Unit, resulting in consistent traffic volume for both construction and operations; (v) the Jane Dough Unit would contain only wellfields (i.e., no CPP); therefore, radiological traffic accidents would be associated with transportation activities at the Nichols Ranch Unit, and the risk associated with those accidents does not increase with the addition of the Jane Dough Unit; and (vi) reduced supply shipments and fewer workers as activities decrease would contribute to limited travel on access roads.

Geology and Soils

The NRC staff concludes that impacts to geology and soils from the construction, operations, aquifer restoration, and decommissioning of the proposed Jane Dough Unit would be SMALL.

This conclusion is based on the following factors: (i) the extent of the disturbed area is limited; (ii) topsoil stockpiling procedures are proposed for implementation; (iii) erosion control methods and BMPs (e.g., berms and seeding) would be implemented; (iv) the duration of mud pit usage and pipeline construction would be short (approximately 9 months per wellfield); (v) no significant matrix compression or ground subsidence is expected to result in collapse of overlying geologic units due to the uranium mobilization and recovery processes; (vi) it is unlikely that ISR operations could reactivate local faults and extremely unlikely for ISR operations to cause earthquakes; (vii) the licensee would be required to immediately report spills and establish spill-recovery actions and routine monitoring programs; and (viii) the licensee has stated a goal to decommission and reclaim the site to preproduction conditions.

Water Resources

Surface Water

The NRC staff concludes that impacts to surface water resources from the construction, operations, aquifer restoration, and decommissioning of the proposed Jane Dough Unit would be SMALL.

This conclusion is based on the following factors: (i) surface water and wetlands on the Jane Dough Unit are limited; (ii) surface water flow in drainages is ephemeral, resulting in minimal potential for water quality degradation from spills of fuels, lubricants, and process-related fluids; and (iii) the licensee's emergency response plan includes methods for clean-up of accidental spills and leaks and monitoring requirements to identify and control any surface water contamination.

Groundwater

The NRC staff concludes that impacts to groundwater resources from the construction, operations, aquifer restoration, and decommissioning of the proposed Jane Dough Unit would be SMALL.

This conclusion is based on the following factors: (i) the Wyoming Pollutant Discharge Elimination System (WYPDES) permit would protect surficial aquifers by limiting the discharge volume and by prescribing concentration limits to discharged waters; (ii) surficial aquifers in the Jane Dough Unit area are not known to be hydraulically connected to significant local and regional water supply aquifers; (iii) required well mechanical integrity testing and implementation of the leak detection and spill correction program would mitigate potential impacts (i.e., through early detection and cleanup); (iv) hydraulic head would only be reduced by a small percentage as a result of consumptive water use; and (v) wells would be properly plugged, abandoned, and isolated from the overlying and underlying aquifer systems.

Ecology

The NRC staff concludes that impacts to ecology from the construction, operations, aquifer restoration, and decommissioning of the proposed Jane Dough Unit would be SMALL.

This conclusion is based on the following factors: (i) the licensee has committed to revegetation measures that would reduce the overall impacts; (ii) the Jane Dough Unit would not be uninhabitable to big game, and small and medium-sized mammals and some animals may return to their previously occupied habitats; (iii) the mitigations required by Wyoming Department of Environmental Quality (WDEQ) and the U.S. Fish and Wildlife Service (FWS) would limit the potential impacts to raptors and upland game birds; (iv) the limited and ephemeral nature of surface water within the Jane Dough Unit limits the occurrence of aquatic species; and (v) there are no federally listed threatened or endangered plant or animal species or critical species habitat known to occur within the Jane Dough Unit.

Air Quality

The NRC staff concludes that impacts to air quality from the construction, operations, aquifer restoration, and decommissioning of the proposed Jane Dough Unit would be SMALL.

This conclusion is based on the following factors: (i) the level and nature of PM_{10} emissions (i.e., fugitive dust from travel on unpaved roads) are similar to those analyzed in the Nichols Ranch ISR SEIS (NRC, 2011b); and (ii) all pollutants other than PM_{10} are lower than the emission levels estimated in the Nichols Ranch SEIS.

Noise

The NRC staff concludes that impacts to noise from the construction, operations, aquifer restoration, and decommissioning of the proposed Jane Dough Unit would be SMALL.

This conclusion is based on the following factors: (i) the closest residences are the Dry Fork and Rolling Pin Ranches located about 1.6 km [1 mi] west and east, respectively; (ii) the maximum sound level of 70 dBA on the shoulder of roads within the Jane Dough Unit would diminish approximately 480 m [1,575 ft] from the source; (iii) noise levels would be highest during construction, with a decrease during subsequent phases; (iv) noise levels are expected to be higher during daylight hours (during construction); (v) wellfield equipment (e.g., pumps, compressors) would be contained within structures (e.g., header houses), limiting the propagation of noise to offsite individuals (during operations); and (vi) traffic noise from commuting workers and truck shipments to and from the CPP would be localized and limited to highways in the vicinity of the Jane Dough Unit, and access roads on the Jane Dough Unit.

Historical and Cultural Resources

The NRC staff concludes that impacts to historic and cultural resources from the construction, operations, aquifer restoration, and decommissioning of the proposed Jane Dough Unit would be SMALL.

This conclusion is based on the following factors: (i) the two National Register of Historic Places (NRHP)-eligible sites are outside the area of direct impact from the project; (ii) the licensee has committed to fencing and avoiding the two eligible sites; (iii) if the licensee determined that it must conduct ground-disturbing activities within the boundaries of an eligible site, the licensee would notify NRC, Wyoming State Historic Preservation Office (WY SHPO), and WDEQ, and would prepare an appropriate cultural resource mitigation plan and submit the plan to NRC and WY SHPO for review and approval; (iv) if the licensee determines that they need to expand construction activities outside of the current area of direct impacts, they would be required to do through additional NHPA, Section 106 review, including consultation; and (v) no paleontological resources were identified within the Jane Dough Unit.

Visual and Scenic

The NRC staff concludes that impacts to visual and scenic resources from the construction, operations, aquifer restoration, and decommissioning of the proposed Jane Dough Unit would be SMALL.

This conclusion is based on the following factors: (i) because no CPP would be constructed, visual impacts would be similar to, but less than, those experienced from the extensive coalbed methane (CBM) and oil and gas development in the area and from ISR activities at the Nichols Ranch Unit; (ii) header houses would be painted to blend in with the natural landscape; (iii) power lines and pipelines would be buried where appropriate (NRC, 2011b; Uranerz, 2014b); (iv) surface disturbances that occur would be recontoured to blend in with the natural terrain; (v) dust suppressants would be used to minimize fugitive dust (NRC, 2011b; Uranerz,

2014b); and (vi) due to the greater distance and absence of a CPP, the potential effects on the Pumpkin Buttes TCP from the addition of the Jane Dough Unit would be less than those effects experienced from the Nichols Ranch ISR Project.

Socioeconomics and Environmental Justice

The NRC staff concludes that impacts to socioeconomics from the construction, operations, aquifer restoration, and decommissioning of the proposed Jane Dough Unit would be SMALL.

This conclusion is based on the following factors: (i) the licensee anticipates that the workers would most likely commute from the same locations as analyzed in the Nichols Ranch SEIS; (ii) the Jane Dough Unit is expected to start as activities at the Nichols Ranch ISR Project area decline, and is anticipated to have consistent employment numbers as in the Nichols Ranch SEIS analysis; and (iii) county jurisdictions would continue to benefit from the increased tax revenues from the Jane Dough Unit, either directly from increased property taxes or indirectly from worker spending and local purchases of goods and services. However, this benefit would be offset by maintaining public services (e.g. roads, schools, health care facilities, etc.).

The NRC staff considered whether this particular action would have any clear potential for offsite impacts to minority and low-income communities (69 FR 52040; NRC, 2003a). The NRC staff assessed minority and low-income populations within a 6.4-km [4-mi] radius of the Jane Dough Unit and determined that no minority or low-income populations are present. Nonetheless, because the Jane Dough Unit area is adjacent to the Nichols Ranch ISR Project area and would have fewer activities for construction, operations, aquifer restoration and decommissioning due to the absence of a CPP at the Jane Dough Unit, the NRC staff considers the analysis in the Nichols Ranch ISR SEIS as a bounding analysis for the addition of the Jane Dough Unit. Therefore, the NRC staff concludes that the Jane Dough Unit would have no disproportionately high and adverse effects on minority and low-income individuals in the area, and all populations would be exposed to the same health and environmental effects generated from construction, operations, aquifer restoration, and decommissioning activities.

Public and Occupational Health

The NRC staff concludes that impacts to public and occupational health from the construction, operations, aquifer restoration, and decommissioning of the proposed Jane Dough Unit would be SMALL.

This conclusion is based on the following factors: (i) the proposed activities (e.g., wellfield construction) and the environmental conditions (including measured background radiation and radionuclide concentrations in soils and water at the Jane Dough Unit wellfields) are comparable to those considered previously in the Nichols Ranch ISR Project; (ii) the licensee would assign radiation dosimetry badges to all employees with significant potential for exposure; (iii) the facilities would utilize ventilation designed to limit worker exposure to radon; (iv) the licensee would conduct regular monitoring of gamma radiation exposure, air particulates, and radon daughter products to verify that radiation levels are as low as reasonably achievable and in compliance with NRC regulations; and (v) the licensee would conduct work area radiation and contamination surveys to help prevent and limit the spread of contamination (Uranerz, 2014b).

Waste Management

The NRC staff concludes that impacts to waste management from the construction, operations, aquifer restoration, and decommissioning of the proposed Jane Dough Unit would be SMALL.

This conclusion is based on the following factors: (i) the primary waste produced during construction would be a small amount of nonhazardous solid waste which would be disposed at the Campbell County landfill; (ii) per WDEQ permits and regulations, the licensee would dispose of drilling fluids in mud pits and use their current WDEQ WYPDES permit to surface discharge well development water; (iii) for liquid byproduct material, the licensee would have to meet applicable U.S. Environmental Protection Agency (EPA), State of Wyoming, and NRC requirements before injection in a Class I deep disposal well; however, there will be no Class I deep disposal wells on the Jane Dough Unit; (iv) the licensee has already obtained a disposal agreement for solid byproduct material that ensures disposal capacity would be available for solid byproduct material generated by the Jane Dough Unit; and (v) the licensee would conduct radiological surveys of decommissioned facilities and equipment and classify materials in accordance with the applicable disposition of the materials, including decontamination, recycling and reuse.

Table E-1 compares the significant levels of potential environmental impacts of the proposed action and the No-Action Alternative.

Table E-1. Summary of Environmental Concerns

Resource Area	Proposed Action	No-Action
Land Use	SMALL	NONE
Transportation	SMALL	NONE
Geology and Soils	SMALL	NONE
Surface Water	SMALL	NONE
Groundwater	SMALL	NONE
Ecology	SMALL	NONE
Air Quality	SMALL	NONE
Noise	SMALL	NONE
Historic and Cultural	SMALL	NONE
Visual and Scenic	SMALL	NONE
Socioeconomics and Environmental Justice	SMALL	NONE
Public and Occupational Health	SMALL	NONE
Waste Management	SMALL	NONE

CUMULATIVE IMPACTS

Chapter 5 of this EA provides the NRC staff's evaluation of potential cumulative impacts from the construction, operations, aquifer restoration, and decommissioning of the proposed Jane Dough license amendment considering other past, present, and reasonably foreseeable future actions. Cumulative impacts from past, present, and reasonably foreseeable future actions were considered and evaluated regardless of what agency (federal or nonfederal) or person undertook the action. The NRC staff determines that the SMALL impacts from the proposed Jane Dough license amendment are not expected to contribute perceptible increases to the existing SMALL to MODERATE cumulative impacts, due primarily to ongoing uranium and oil and gas exploration activities, potential wind energy projects, and proposed infrastructure and transportation projects. Based on the currently available information and

known flaws in the available information (BLM, 2015) regarding the far-field cumulative impacts on air quality, the NRC staff acknowledge the possibility that impacts to air quality from foreseeable future actions could be LARGE.

SUMMARY OF COSTS AND BENEFITS OF THE PROPOSED ACTION

The proposed license amendment would generate primarily regional and local costs and benefits. The regional benefits of the proposed license amendment would be continued employment, economic activity, and tax revenues in the region around the Nichols Ranch ISR Project. Costs associated with the proposed license amendment are, for the most part, limited to the immediate area surrounding the proposed Jane Dough Unit. The NRC staff determines that the benefit from constructing and operating the proposed Jane Dough Unit would outweigh the economic, environmental, and social costs.

COMPARISON OF ALTERNATIVES

For the No-Action Alternative, Uranerz would not construct or operate ISR activities on the proposed Jane Dough Unit. As a result, no uranium ore would be recovered from the proposed Jane Dough Unit. This alternative would result in neither positive nor negative impacts to any resource area.

FINAL RECOMMENDATION

After weighing the impacts of the proposed license amendment and comparing to the No-Action Alternative, the NRC staff, in accordance with 10 CFR 51.91(d), sets forth its final NEPA recommendation regarding the proposed action (granting the request for an NRC license amendment for the proposed Jane Dough Unit). Unless safety issues mandate otherwise, the NRC staff recommendation related to the environmental aspects of the proposed action is that an NRC license amendment be issued. This recommendation is based on (i) the license application, including the environmental report and supplemental documents the licensee submitted and responses to the NRC staff requests for additional information; (ii) consultation with federal, state, tribal, and local agencies; (iii) the NRC staff independent review; and (iv) the assessments summarized in this EA.

ACRONYMS

ac	acres
ACHP	Advisory Council of Historic Preservation
ACL	alternate concentration limit
ALARA	as low as is reasonable achievable
amsl	above mean sea level
ape	area of potential effect
BGEPA	Bald and Golden Eagle Protection Act
BLM	Bureau of Land Management
BMPs	best management practices
CAB	Commission approved background
CBM	coalbed methane
CEQ	Council of Environmental Quality
CFR	Code of Federal Regulations
cm	centimeter
CPP	central processing plant
dBA	decibels
DM&E	Dakota Minnesota and Eastern
DOT	U.S. Department of Transportation
EA	environmental assessment
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
ER	environment report
FHWA	Federal Highway Administration
FONSI	Finding of No Significant Impact
ft	feet
FWS	U.S. Fish and Wildlife Service
gal	fallon
GCRP	U.S. Global Change Research Program
GEIS	Generic Environmental Impact Statement
gpm	gallons per minute
ha	hectares
HDPE	high density polyethylene
in	inch
IPaC	Information, Planning, and Conservation
IRs	isolated resources
ISR	In Situ Recovery
km	kilometers
Km/h	kilometers per hour

L	liter
Lpm	liters per minute
LQD	Land Quality Division
m	meters
MBTA	Migratory Bird Treaty Act
MCLs	maximum contaminant levels
mg/L	milligrams/liter
mi	mile
MIT	mechanical integrity test
mph	miles per hour
mrem	millirem
mSv	millisieverts
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
OSHA	Occupational Safety and Health Administration
PA	Programmatic Agreement
pCi/L	picocuries per liter
ppm	parts per million
PRB	Powder River Basin
PRI	Power Resources, Inc.
PSD	Prevention of Significant Deterioration
RMP	Resource Management Plan
ROI	region of influence
SEIS	Supplemental Environmental Impact Statement
SH	State Highway
SERP	Safety and Environmental Review Panel
STB	Surface Transportation Board
SWPPP	Storm Water Pollution Prevention Plan
t/yr	tonnes per year
T/yr	tons per year
TCP	traditional cultural property
TDS	total dissolved solids
TEDE	total effective dose equivalent
THPO	Tribal Historic Preservation Officer
TR	technical report
TSS	total suspended solids
UCLs	upper control limits
Uranerz	Uranerz Energy Corporation
UIC	Underground Injection Control
USACE	U.S. Army Corps of Engineers

WDEQ	Wyoming Department of Environmental Quality
WDOT	Wyoming Department of Transportation
WOGCC	Wyoming Oil and Gas Conservation Commission
WQD	Water Quality Division
WOTUS	Waters of the U.S.
WYPDES	Wyoming Pollutant Discharge Elimination System
WY SHPO	Wyoming State Historic Preservation Office

1

1 INTRODUCTION

By letter dated May 8, 2014, Uranerz Energy Corporation (Uranerz, or the licensee) submitted a request to amend its U.S. Nuclear Regulatory Commission (NRC) Source Material License SUA-1597 for the Nichols Ranch In Situ recovery (ISR) Project, located in Johnson and Campbell Counties, Wyoming (Uranerz, 2015, Uranerz, 2014a,b) Uranerz requested that the Nichols Ranch ISR Project permit area be modified to include the Jane Dough Unit, which encompasses approximately 1,489 hectares (ha) [3,680 acres (ac)] and is contiguous to the current southern boundary of the Nichols Ranch Unit. Uranerz would conduct ISR activities at the Jane Dough Unit.

1.1 Background

The Nichols Ranch ISR Project is a commercial ISR uranium recovery facility located in the Powder River Basin in Johnson and Campbell Counties, Wyoming. The central processing plant (CPP) is located within the Nichols Ranch Unit, approximately 74 km [46 mi] south-southwest of Gillette, Wyoming and approximately 98 km [61 mi] north-northeast of Casper, Wyoming (Figure 1-1). The NRC staff's environmental review was documented in NUREG-1910 Supplement 2, Environmental Impact Statement for the Nichols Ranch ISR Project in Campbell and Johnson Counties, Wyoming (SEIS), Supplement to the Generic Environmental Impact Statement for In Situ Leach Uranium Milling Facilities (NRC, 2011b).

In August 2011, the NRC issued Source Material License SUA-1597 to Uranerz for the Nichols Ranch ISR Project, which includes the Nichols Ranch Unit and Hank Unit (NRC, 2011a). At present, commercial ISR production of uranium is occurring at the Nichols Ranch Unit while production at the Hank Unit is planned to start in the year 2025 (see Figure 2-2). Commercial ISR uranium production began at the Nichols Ranch Unit in April 2014 (Uranerz, 2014c).

Under NRC Source Material License SUA-1597, Uranerz is authorized, through its ISR process, to produce up to 907,185 kilogram (kg) per year [2 million pounds (lbs)] per year of tri-uranium octoxide (U_3O_8), also known as "yellowcake." For 2016, Uranerz anticipates an annual production of less than half of the license limit (Energy Fuels, 2016).

1.2 Proposed Action

On May 8, 2014, Uranerz initiated the proposed federal action by submitting an application to amend their current NRC Source Material License SUA-1597 for the Nichols Ranch ISR Project to expand operations to the Jane Dough Unit. This amendment, if approved, would allow Uranerz to construct and operate the Jane Dough Unit and perform subsequent aquifer restoration and site decommissioning and reclamation activities. Based on the application, the NRC's proposed federal action is to grant the license.

1.3 Purpose and Need for the Proposed Action

The proposed action under consideration by the NRC in this EA is the modification of the Nichols Ranch ISR Project license SUA-1597 (NRC, 2015e) to include the Jane Dough Unit so that Uranerz could pursue ISR operations on the Jane Dough Unit.

Uranerz currently conducts commercial-scale ISR uranium milling as part of the Nichols Ranch ISR Project. Uranerz is proposing to expand its operations and to conduct ISR operations at the

Jane Dough Unit. This would allow Uranerz to continue to meet the current and future needs of its customers for producing yellowcake. Yellowcake is a semi-solid, uranium-oxide product of the uranium milling process. Yellowcake is subsequently processed to manufacture fuel for commercially operated nuclear power reactors.

The purpose and need for the proposed federal action is to provide an option that allows the licensee to recover uranium and produce yellowcake. This definition of purpose and need reflects the Commission's recognition that, unless there are findings in its safety review required by the Atomic Energy Act of 1954 (AEA), as amended, or findings in the National Environmental Policy Act of 1969, as amended, (NEPA) environmental analysis that would lead the NRC to reject a license amendment application, the NRC has no role in a company's business decision to submit a license amendment application to expand its operations at a current ISR facility.

1.4 Review Scope

The NRC staff is reviewing Uranerz's request in accordance with the NRC's environmental protection regulations in 10 CFR Part 51. Those regulations implement section 102(2) of NEPA. This document provides the results of the NRC staff's environmental review; the staff's radiation safety review of Uranerz request is documented separately in a Safety Evaluation Report.

The NRC staff has prepared this Environmental Assessment (EA) in accordance with NRC requirements in 10 CFR 51.21 and 51.30, and with the associated guidance in NRC report NUREG-1748, "Environmental Review Guidance for Licensing Actions Associated with NMSS Programs" (NRC, 2003a). In 40 CFR 1508.9, the Council on Environmental Quality defines an EA as a concise public document that briefly provides sufficient evidence and analysis for determining whether to prepare an environmental impact statement or a finding of no significant impact (FONSI).

1.5 Structure of the EA

NUREG-1910 Generic Environmental Impact Statement for Uranium Milling Facilities—Final Report (GEIS) (NRC, 2009) evaluated broad impacts for ISR projects. The Nichols Ranch ISR Project SEIS (NRC, 2011b) tiers off the GEIS and provided site-specific conclusions. In this EA, the NRC staff evaluated the extent to which information and conclusions in the GEIS and SEIS could be incorporated by reference for evaluation of impacts at the Jane Dough Unit. The NRC staff also determined whether site-specific information would change the expected environmental impact beyond that evaluated in the Nichols Ranch ISR Project SEIS (NRC, 2011b). EA Chapter 2 describes the proposed action and no action alternative; Chapter 3 describes the affected environment for the Jane Dough Unit; and Chapter 4 evaluates the potential environmental impacts from implementing the proposed action. Cumulative impacts are discussed in Chapter 5. Chapter 6 details Uranerz's monitoring and mitigation programs.



Figure 1-1. Map Location of Nichols Ranch ISR Project and Proposed Jane Dough Unit (Uranerz, 2014a,)

1

2 IN SITU URANIUM RECOVERY (PROPOSED ACTION) AND ALTERNATIVE

This chapter describes the proposed federal action, which is to grant a U.S. Nuclear Regulatory Commission (NRC) license amendment requested by Uranerz Energy Corporation (Uranerz, or the licensee), which would authorize the construction and operation of two additional wellfields (i.e., one wellfield in each of two adjacent production areas) within the Jane Dough Unit. The Jane Dough Unit would be the third unit of the Nichols Ranch In Situ Recovery (ISR) Project, for which a license was issued in July 2011. The Jane Dough Unit is contiguous to and south of the Nichols Ranch Unit. This chapter discusses the Proposed Action (Alternative 1), the No-Action Alternative (Alternative 2), as required under the National Environmental Policy Act (NEPA) of 1969.

The alternative is evaluated with regard to the four phases of a uranium recovery operation: construction, operations, aquifer restoration, and decommissioning. The alternative has been established based on the purpose and need statement described in Section 1.3 of this environmental assessment (EA).

The NRC staff used a variety of information sources for the analysis in this EA. These sources include (i) the application's environmental report (ER) (Uranerz, 2014a) and technical report (TR) (Uranerz, 2014b); (ii) the licensee's revision to the TR (Uranerz, 2015), (iii) the licensee's responses to the NRC staff's requests for additional information (Uranerz, 2016a); (iv) NUREG–1910, Generic Environmental Impact Statement for In Situ Leach Uranium Milling Facilities (GEIS) (NRC, 2009); (v) the information gathered during the NRC staff site visits in September 2015 (NRC, 2015a) and September 2016; and (vi) multidisciplinary discussions held among the NRC staff and various stakeholders.

2.1 Description of the In-Situ Leach Process

During the ISR process, an oxidant-charged solution, called a lixiviant, is injected into the production zone aquifer (uranium ore body) through dual-purpose injection/production wells. When used to introduce lixiviant into the uranium mineralization, a dual-purpose well is considered an injection well; when used to extract uranium-bearing solutions, it is considered a production well. Typically, a lixiviant uses native groundwater (from the production zone aquifer), carbon dioxide, and sodium carbonate/bicarbonate, with an oxygen or hydrogen peroxide oxidant. As it circulates through the production zone, the lixiviant oxidizes and dissolves the mineralized uranium, which is present in a reduced chemical state. The resulting uranium-enriched pregnant lixiviant is drawn to production wells by pumping, and then transferred to a processing facility via a network of pipes buried just below the ground surface for uranium extraction by ion-exchange. The uranium recovered from the solution is processed, dried into yellowcake, packaged into NRC- and U.S. Department of Transportation (DOT)-approved 205-liter (L) [55-gallon (gal)] steel drums, and trucked offsite to a licensed uranium conversion facility (NRC, 2009).

During production, the lixiviant continually moves through the production aquifer from outlying injection wells to internal production wells. These wells can be arranged in a variety of geometric patterns depending on ore body configuration, aquifer permeability, and operator preference. Wellfields are often designed in five or seven spot patterns, with each production well located inside a ring of injection wells. There are multiple five or seven spot patterns in a wellfield. Overlying and underlying aquifers are usually separated from the production zone

aquifer by aquitards, which reduce the potential for vertical lixiviant migration. Monitoring wells surround the wellfield pattern area, terminating in the production zone aquifer as well as in both the overlying and underlying aquifers. These monitoring wells are screened in appropriate stratigraphic horizons to detect lixiviant that could migrate out of the production zone. If lixiviant migrates out of the production zone, this is termed an excursion (NRC, 2009).

As described in GEIS Section 2.4.3 (NRC, 2009), the production wells at an ISR facility extract slightly more water than is reinjected into the host aquifer to create a net inward flow of groundwater into the wellfield, which minimizes the potential movement of lixiviant and its associated contaminants out of the wellfield (excursions). For the Jane Dough Unit, lateral confinement of ISR lixiviant would be accomplished by maintaining a 0.5 to 1.5 percent bleed (average bleed rate of 1 percent) from the production wells (Uranerz, 2015). Additionally, the NRC requires all licensees to have a set of corrective actions and reporting procedures that can be implemented in the event that an excursion is detected (10 CFR Part 40, Appendix A, Criterion 5D).

2.2 Site Location

The NRC license issued for the Nichols Ranch ISR Project authorized the construction and operations of uranium recovery facilities within two noncontiguous areas: the Nichols Ranch Unit, which covers an area of about 453 hectares (ha) [1,120 acres (ac)], which has been constructed and is operating; and the Hank Unit, which covers an area of about 911 ha [2,250 ac] and is approximately 9.7 kilometers (km) [6 miles (mi)] northeast of the Nichols Ranch Unit, which has not yet been constructed. The Nichols Ranch ISR Project is located in the Pumpkin Buttes Mining District of the Powder River Basin in Johnson and Campbell Counties, Wyoming. The Nichols Ranch Unit currently includes wellfields, header houses, a central processing plant (CPP), an office building, maintenance building, and two installed (out of 4 permitted) Class I deep disposal wells. The Hank Unit, a satellite facility, would include wellfields, header houses, a satellite ion exchange building, an office building, a maintenance building, and up to four Class I deep disposal wells. The Nichols Ranch ISR Project has been in operation since April 2014.

The addition of the Jane Dough Unit to the Nichols Ranch ISR Project would add approximately 1,489 ha [3,680 ac] to the NRC-licensed area, and would be located in Township 43N, Range 76, portions of Sections 20, 21, 27, 28, 29, 30, 31, 32, 33, and 34 (see EA Figure 2-1). The Jane Dough Unit would have wellfields and header houses but no other surface facilities (e.g., no satellite facility, CPP, Class I deep disposal wells, office buildings, or maintenance buildings). The licensee has proposed to connect both wellfields in the Jane Dough Unit to the existing CPP in the Nichols Ranch Unit through buried trunklines.

The Jane Dough Unit would be located in the southern portion of the Powder River Basin (Uranerz, 2014a). The vegetation is semi-arid grassland and shrublands with some minimal grazing. Elevation within the Jane Dough Unit and its immediate surroundings is approximately 1,414 m to 1,519 m [4,640 to 4,986 ft] above sea level (Uranerz, 2016a). The Jane Dough Unit, as with most landscapes in the Powder River Basin, is characterized by flat to gently rolling topography with small ephemeral drainages that drain toward Cottonwood Creek in the north and Seventeenmile Creek to the southwest of the Jane Dough Unit. The primary land uses within the Jane Dough Unit are oil and gas production, coalbed methane (CBM) production, livestock grazing, and wildlife habitat (Uranerz, 2014a).

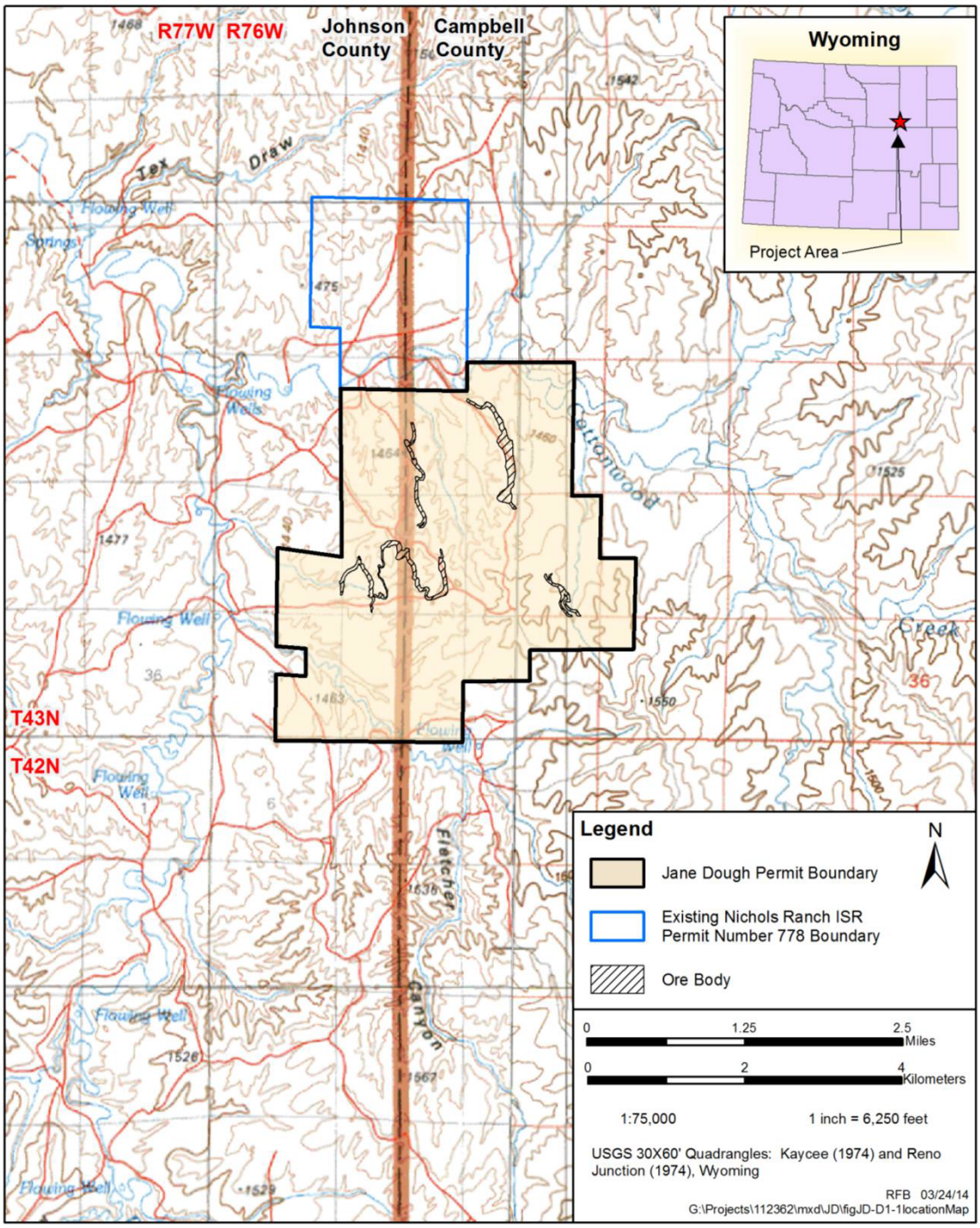


Figure 2-1. Proposed Location of the Jane Dough Unit (Uranerz, 2014a)

2.3 Proposed Action (Alternative 1)

Under the proposed action, the NRC would grant an amendment to the Nichols Ranch ISR Project license for the construction, operations, aquifer restoration, and decommissioning of two additional wellfields (i.e., one wellfield in each of two adjacent production areas) within the Jane Dough Unit.

Typically, ISR wellfield construction can take between 9 months and two years per wellfield. Based on the proposed schedule (Figure 2-2), each wellfield would operate for approximately 5 to 6 years, aquifer restoration would occur for 2 to 3 years, and decommissioning would take 1 to 2 years. Uranerz anticipates conducting ISR operations at the Jane Dough Unit for a total project life (including all ISR phases) of approximately 12 years (Uranerz, 2016a).

2.3.1 Construction Activities

Wellfields

The Jane Dough Unit includes approximately 1,489 ha [3,680 ac] of privately owned land. Land disturbance associated with ISR activities at the Jane Dough Unit would include wellfields, header houses, pipeline installation, and access roads (Uranerz, 2014a). The licensee plans to construct two wellfields in the Jane Dough Unit. Land disturbance would include similar activities for each wellfield (two in total) as each wellfield is sequentially constructed. The licensee estimates that the total disturbed area would be 40.8 ha [101 ac] (NRC, 2011b; Uranerz, 2014b). Wellfields would be fenced to exclude livestock and wildlife and control access during both the construction and operations phases. The licensee has stated that land disturbances associated with the wellfield drilling and pipeline installation would be reclaimed as soon as possible (Uranerz, 2014a).

The licensee may adjust the locations and boundaries of each wellfield as more detailed stratigraphic and ore-occurrence data are collected during wellfield construction. Uranerz may alter well patterns to fit the size, shape, and boundaries of individual ore bodies. Each well would be connected to the respective production manifold in a nearby header house. The actual number and location of header houses would depend on the well placement. The header house would have approximate dimensions of 12 × 6 m [40 × 20 ft] constructed on a 15-cm [6-in] concrete pad floor (NRC, 2011b). The manifolds move solution to the pipelines and then to and from the CPP. Meters and control valves in individual well lines would monitor and control flow rates and pressures for each well. The wellfield piping would be high-density polyethylene pipe, polyvinyl chloride, and/or steel. Individual well lines and trunklines to the CPP would be buried to prevent freezing of the transferred solutions (Uranerz, 2014a,b).

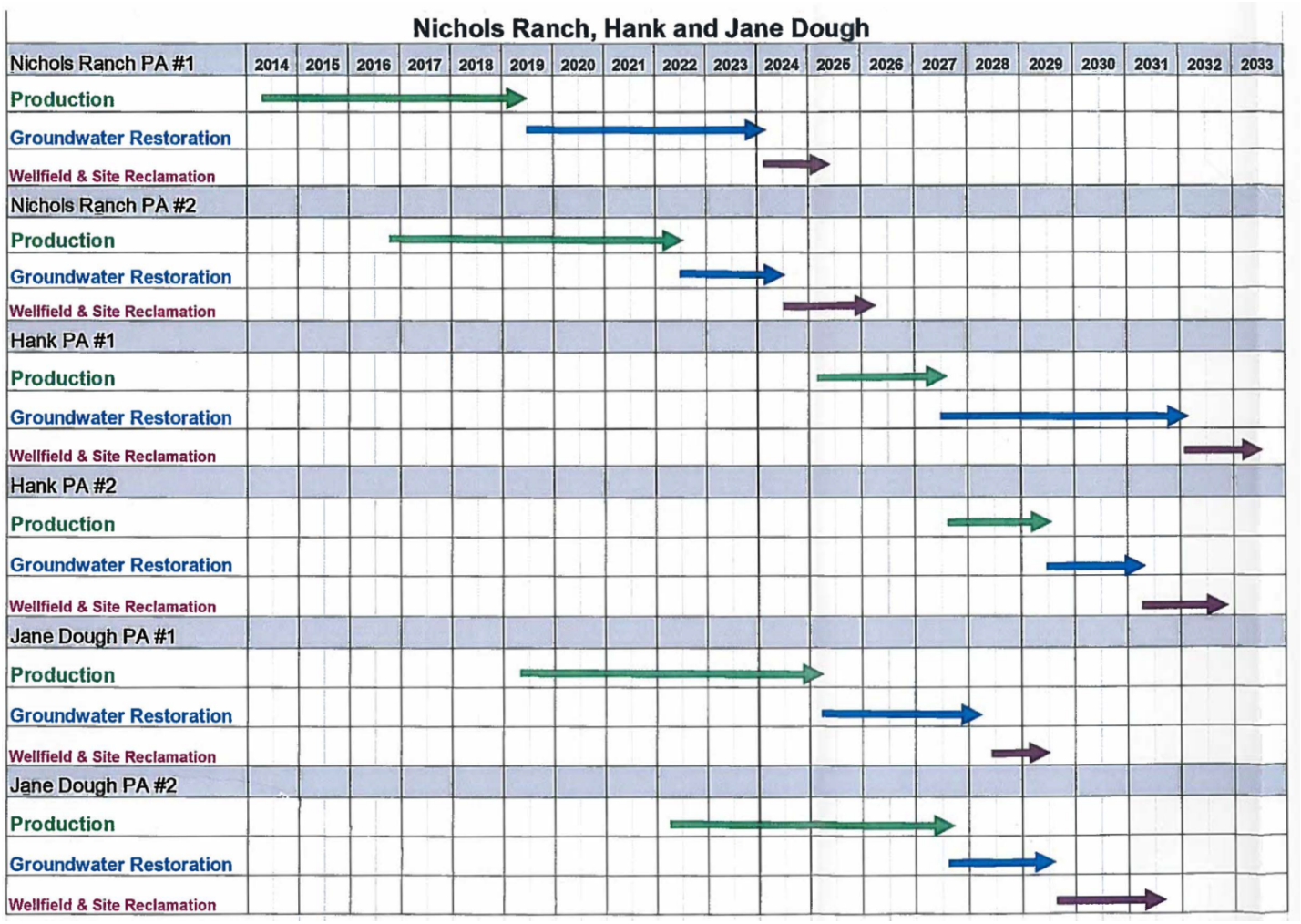


Figure 2-2. Proposed Project Schedule for all Three Units of the Nichols Ranch ISR Project (Uranerz, 2016a)

Production and Injection Wells

The production and injection wells would be spaced between 15 and 46 m [50 and 150 ft] apart, depending on the characteristics of the ore zone (NRC, 2011b). According to the Wyoming Department of Environmental Quality (WDEQ) Permit to Mine, the licensee estimates that Production Unit #1 would contain 337 production wells and 591 injection wells for a total of 928 wells. Production Unit #2 is anticipated to have 195 production wells and 356 injection wells for a total of 551 wells (WDEQ, 2015a).

Monitoring Wells

The licensee would install production zone monitoring wells at the periphery of each production wellfield area (Uranerz, 2014a). This perimeter monitoring well "ring" would be utilized for early detection of horizontal excursions from within the sand unit or aquifer where production is occurring. An excursion at a monitoring well is declared when the concentrations of certain indicator parameters exceed upper control limits (UCLs) established by the license and verified by the NRC or the state. The purpose of the monitoring well ring is to ensure that groundwater quality in aquifers outside exempted zones is not affected by ISR operations (NRC, 2009).

The licensee would install perimeter-monitoring well rings within the production zone aquifer, outside the production pattern area in a "ring" around the wellfield area, and in the overlying and underlying aquifers within the production well pattern area at a minimum density of one well per every 1.6 ha [4 ac] of pattern area (Uranerz, 2014b). Production zone monitoring wells would be installed before production activities begin; required groundwater sampling and hydrologic tests would be conducted on samples taken from the monitoring wells. The licensee proposes to install 119 horizontal monitoring wells, and 22 vertical monitoring wells (Uranerz, 2016a).

Well Completion

Production and monitoring wells in the Jane Dough Unit would be constructed using the same techniques. First, a pilot hole for the well would be drilled to the top of the target depth with a small rotary drilling unit using native mud and a small amount of commercial drilling fluid additive for viscosity control. The hole then would be logged and reamed, and the casing set and cemented to isolate the completion interval from all other aquifers. The cement would be placed by pumping it down the casing and forcing it out the bottom of the casing and back up the casing-drill hole annulus. The purpose of the cement is to stabilize and strengthen the casing and to plug the annulus of the hole to prevent vertical excursions. (Uranerz, 2014b)

After the well is cemented to the surface and the cement has set, the well would be drilled out and completed either as an open hole or fitted with a screen assembly (slotted liner), which may have a sand filter pack installed between the screen and the under reamed formation. The well would then be air lifted for about 30 minutes to remove any remaining drilling mud and/or cuttings. A small submersible pump is frequently run in the well for final clean-up and sampling. (Uranerz, 2014b).

Well Integrity Testing

The licensee would perform a mechanical integrity test (MIT) on each well prior to its use in the wellfield in accordance with WDEQ procedures (Uranerz, 2016a). The purpose of the MIT program is to ensure that fluids injected and recovered are not lost from the well due to casing failure. In the integrity test, the bottom of the casing adjacent to or below the overlying confining

stratigraphic layer is sealed with a plug, downhole packer, or other suitable device. The top of the casing is then sealed in a similar manner or with a threaded cap, and a pressure gauge is installed to monitor the pressure inside the casing (Uranerz, 2014b).

The well must maintain 90 percent of the maximum allowable injection pressure, which is based on the formation fracture pressure and pressure rating of the casing, for 10 minutes to pass the test. Wells not passing the MIT are reworked and tested again. Any failed well casing that cannot be repaired to pass the integrity test would be appropriately plugged and abandoned. In accordance with WDEQ and U.S. Environmental Protection Agency requirements, the licensee would repeat MITs once every 5 years for all wells used for injection of lixiviant, or injection of fluids for restoration operations. MITs on production area monitoring wells are also repeated every 5 years as required by NRC license condition for the Nichols Ranch ISR Project. Additionally, MITs would be conducted whenever a downhole drill bit or under reaming tool is used to repair an injection well. Also, if a well casing does not meet the MIT criteria, the well would be placed out of service and the casing would be repaired and the well re-tested or abandoned (Uranerz, 2014b).

Wellfield Hydrogeologic Data Packages

The licensee's delineation drilling results and pumping test data would be included in wellfield hydrogeologic data packages, which would be submitted for review and evaluation by the Safety and Environmental Review Panel (SERP). The wellfield hydrogeologic data package would describe the wellfield, including (i) production and injection well patterns and location of monitoring wells; (ii) documentation of wellfield geology (e.g., geologic cross sections and isopach maps of production zone sand and overlying and underlying confining units); (iii) pumping test results; (iv) sufficient information to demonstrate that perimeter production zone monitoring wells adequately communicate with the production zone; and (v) data and statistical methods used to compute Commission-approved background water quality.

With the exception of the first wellfield package, which would be submitted for review and verification to the NRC, the SERP would review the wellfield hydrogeologic test results and documentation to ensure that monitoring wells are hydrologically connected to the injection and production wells. The wellfield hydrogeologic data package and written SERP evaluation would be maintained onsite and available for NRC review during inspections.

Access Roads

Access roads would be constructed to wellfields to allow for monitoring and maintenance. Access road construction would consist of blading approximately 15 cm [6 in] of soil on each side of the proposed access road. In addition, a drain would be constructed on each side. Once the drains are constructed, topsoil would be placed at the bottom of each drain and seeded. Next, about 7 cm [3 in.] of gravel, conglomerate or scoria material would be placed on top of the bladed surface. Finally, an approximately 0.6 m [2 ft] buffer would be cleared on each side of the road where topsoil would not be placed. Due to the varying locations of the access roads, the total disturbed topsoil depths and volumes may vary. After all operations, aquifer restoration, and decommissioning activities are complete, the wellfield access roads would be either reclaimed or released to the landowner, if preferred (Uranerz, 2014a).

2.3.2 Wellfield Operations

Once wellfield operations begin, uranium-rich solution would be routed from the wellfields to the CPP. The CPP at the Nichols Ranch Unit includes ion exchange, resin elution, and the yellowcake drying and packaging systems (NRC, 2011b). In the CPP, the solution would be pumped into a series of ion exchange columns where the uranium (as uranyl carbonate complexes) would be adsorbed onto resin beads in the columns. The resulting uranium-poor (i.e., "barren") lixiviant would then exit the ion-exchange columns, be recharged with additional oxidizing and complexing agents, and then be reinjected in the wellfields (NRC, 2009).

Once the majority of the ion-exchange sites on the ion-exchange column resin are filled with uranium, the uranium-loaded resin would be stripped (i.e., eluted) from the resin beads with a concentrated solution of sodium chloride. The stripped resin beads would then be loaded back onto the ion-exchange columns.

Within Production Area #1 each well is anticipated to have a production rate of 39.4 liters per minute (Lpm) [10.4 gallons per minute (gpm)] with a total production rate for all wells of approximately 13,245 Lpm [3,499 gpm]. Production Area #2 wells are anticipated to have a production rate of 68 Lpm [18 gpm] each with a total production rate for all wells of approximately 13,249 Lpm [3,500 gpm]. Both production areas would have an approximate bleed rate of one percent (WDEQ, 2015a).

2.3.3 Aquifer Restoration Activities

The purpose of aquifer restoration is to return wellfield water quality parameters to the standards in 10 CFR 40, Appendix A, Criterion 5(B)(5) or another standard approved by NRC (NRC, 2009). Before ISR operations can begin, the portion of the aquifer designated for uranium recovery must be exempted as an underground source of drinking water, in accordance with the Safe Drinking Water Act. Groundwater adjacent to the exempted portion of the aquifer, however, must still be protected. Prior to conducting uranium recovery operations in a wellfield, Uranerz would be required by license condition to collect baseline groundwater quality data from the wells completed in the planned production zone, and from these data, to determine and set post-mining restoration criteria. Aquifer restoration criteria for the site-specific baseline constituents would be determined for each wellfield. As an NRC licensee, Uranerz would be required to return water quality parameters to the standards in 10 CFR Part 40, Appendix A, Criterion 5B(5) or to another standard approved in their NRC license (NRC, 2009).

To restore wellfield groundwater to acceptable levels, Uranerz would employ a series of techniques that include groundwater sweep, groundwater transfer, and ion exchange and reverse osmosis (i.e., groundwater treatment) (NRC, 2011b). Groundwater sweep involves pumping groundwater from a wellfield without injection. This pumping causes uncontaminated, native groundwater to flow into the ore body, thereby flushing the contaminants from areas that have been affected by the horizontal spreading of the lixiviant in the affected zone during uranium recovery resulting in a lowering of parameter concentrations. The water removed from the aquifer during the sweep first is passed through an ion-exchange system to recover the uranium (NRC, 2009). This water is then disposed of, in the case of the Jane Dough Unit, via a Class I deep disposal well located on the Nichols Ranch Unit (Uranerz, 2014a).

Groundwater transfer involves transferring water between a wellfield beginning aquifer restoration and a wellfield beginning the operations phase, or within the same wellfield if they

are at different stages. The water from the wellfield in aquifer restoration, which would have higher total dissolved solids (TDS), would be recovered and injected into the wellfield beginning operations. The direct transfer of water from the wellfield undergoing aquifer restoration, and the resultant influx of fresh groundwater, would act to lower the TDS in the wellfield being restored by displacing affected groundwater with pre-mining baseline water. The goal of the groundwater transfer is to blend the water in the two wellfields until they become similar in conductivity. The water recovered from the aquifer restoration wellfield may also be passed through ion exchange columns and/or filtered during this phase if suspended solids are sufficient in concentration to present a problem with blocking the injection well screens. The advantage of using the groundwater transfer technique is that it would reduce the amount of water that must ultimately be sent to the Class I deep disposal well (located on the Nichols Ranch Unit) during aquifer restoration activities (Uranerz, 2014a).

In association with or following groundwater sweep, Uranerz may conduct groundwater treatment. In this process, water recovered from the wellfield is processed by ion exchange to remove uranium, and then reverse osmosis treatment is used to remove other dissolved solids. The resulting purified water (i.e., the permeate), or other clean water, can then be injected into the wellfield. If required, this flushing process would be used in conjunction with the injection of a biological or chemical reductant. The reductant is intended to re-establish reducing conditions in the aquifer, thereby immobilizing metals like arsenic, molybdenum, selenium, uranium, and vanadium. Finally, clean water could again be circulated through the aquifer to reduce the dissolved solids introduced during the reductant phase. The success of restoration is determined following the completion of a stability monitoring period. Groundwater quality in the exempted ore-bearing aquifer is to be restored, in accordance with 10 CFR Part 40, Appendix A, Criterion 5B(5), to (i) a Commission approved background (CAB) concentration; (ii) the maximum contaminant levels (MCLs) listed in 10 CFR Part 40, Appendix A, Table 5C, for constituents listed in Table 5C and if the background level of the constituents fall below the listed value; or (iii) an alternate concentration limit (ACL) established by the Commission, if the constituent background level and the values listed in Table 5C are not reasonably achievable. These groundwater quality standards would be implemented, as part of the aquifer restoration phase, to ensure public health and safety.

In addition, the WDEQ Underground Injection Control (UIC) program would review aquifer restoration plans for compliance with the applicable terms and conditions of the UIC Class 1 deep disposal well permit (NRC, 2011b).

2.3.4 Decommissioning Activities

GEIS Section 2.6 describes the general process for decontamination, decommissioning, and reclamation of an ISR facility (NRC, 2009). A licensee would be required by 40 CFR Part 40.42(d) to submit a detailed decommissioning plan to the NRC staff for review and approval at least 12 months before the planned commencement of final decommissioning. When approved, this plan would amend the license and initiate the decommissioning process (NRC, 2011b).

Prior to release of the property for unrestricted use, the licensee would conduct a comprehensive radiation survey to establish that any contamination is within limits identified in 10 CFR Part 40, Appendix A. As part of the decommissioning process, activities would involve plugging and abandonment of the wells, disturbed lands would be reclaimed and recontoured, contaminated equipment and materials would be removed, appropriate cleanup criteria for structures would be determined, items to be released for unrestricted use would be

decontaminated to meet NRC requirements, and surveys would be performed to determine whether there was residual contamination in soils and structures (NRC, 2011b; Uranerz, 2014a).

Well Plugging and Abandonment

Following the completion of aquifer restoration and concurrence from NRC and WDEQ that the groundwater has been adequately restored, Uranerz would plug and abandon all production, injection, and monitoring wells in accordance with WDEQ rules and regulations (WDEQ, 2013a). Activities could include (i) removal of all pumps and tubing; (ii) plugging of the well with an appropriately formulated abandonment gel or slurry; (iii) cutting the well casing below the ground surface; (iv) placing a cement plug to seal the well; and (v) backfilling, smoothing, and leveling the area to blend in with the surrounding terrain.

In addition, buried wellfield lines and pipelines would be removed and the affected surface areas appropriately reclaimed. Affected areas would be leveled and re-seeded with a WDEQ-approved seed mixture (Uranerz, 2014a).

Surface Reclamation

Uranerz stated that all lands disturbed by the project would be restored to their pre-mining land use of livestock grazing and wildlife habitat unless an alternate use is approved by the State and the landowner (NRC, 2011b).

In compliance with the WDEQ permit requirements, the licensee would minimize soil disturbances caused by the addition of the Jane Dough Unit to the existing Nichols Ranch ISR license. Per WDEQ requirements, topsoil would be salvaged from access roads, header houses, and pipeline installation (Uranerz, 2014a). The salvaged topsoil would be stockpiled, seeded no later than the first fall or spring seeding season to minimize erosion, and later reapplied as needed. Uranerz estimates that a maximum of 54.6 ha [135 ac] of topsoil would be salvaged throughout the lifetime of the project (Uranerz, 2014a).

Revegetation practices would be conducted in accordance with WDEQ regulations and the WDEQ mine permit. Following replacement of the topsoil, an area would re-seeded with a permanent seed mix. If the area in question is to be disturbed again prior to final decommissioning, the licensee may apply a WDEQ-approved long-term temporary seed mix. Typical seed mixes contain of one or more native wheatgrasses (e.g., Western wheatgrass or thickspike wheatgrass) (Uranerz, 2014a; 2016).

Decommissioning and Disposal

The decommissioning plan for the Jane Dough Unit, as part of the Nichols Ranch ISR Project, would include the necessary plans for project closure, including all decommissioning and surface reclamation activities. The NRC staff evaluates a proposed decommissioning plan, and if approved, the plan becomes an amendment to the license. Only after receiving the NRC staff's approval of a plan may a licensee initiate the decommissioning process. Unless the Commission approves an alternative schedule for completion of decommissioning, pursuant to 10 CFR 40.42(i), the licensee would be required by 10 CFR 40.42(h)(1) to complete decommissioning as soon as practicable but no later than 2 years after approval of the decommissioning plan.

Radiation Surveys

Before the property is released for unrestricted use, the licensee would conduct a comprehensive radiation survey to establish that the levels of various constituents are within limits identified in 10 CFR Part 40, Appendix A. The goal of decontamination, decommissioning, and reclamation activities would be to return disturbed lands to unrestricted use, consistent with preoperational conditions or expected post-operations use. To achieve this goal, the licensee would (i) plug and abandon wells; (ii) establish appropriate cleanup criteria for structures; (iii) survey soils and structures to identify residual contamination, (iv) decontaminate items to be released for unrestricted use; (v) remove contaminated equipment and materials for disposal at a licensed facility; (vi) perform final status surveys to verify cleanup of soils; and (vii) reclaim disturbed lands, including reapplication of stockpiled soils and revegetation of disturbed areas, in accordance with WDEQ regulations and permits (NRC, 2011b).

After the equipment, header houses, piping, and associated infrastructure are removed, gamma radiation surveys would be conducted over the areas. In the wellfields, gamma surveys would also be conducted during the decommissioning of each wellfield. Equipment with contamination levels requiring disposal in a licensed facility would be removed, packaged as needed, and shipped to a NRC-approved disposal facility. The licensee would use the same disposal facility currently used as part of the Nichols Ranch ISR Project (NRC, 2011b).

2.3.5 Effluents and Waste Management

The processes associated with ISR operations generate airborne, liquid, and solid waste. The primary source of emissions from the ISR operations is from the CPP and associated equipment. However, the Jane Dough Unit would not have a CPP and would only contain wellfields and the associated infrastructure (e.g., header houses and trunklines). Currently, the licensee has two operational Class I deep disposal wells for wastewater disposal on the Nichols Ranch Unit, and is permitted by WDEQ for two additional Class I deep disposal wells on the Nichols Ranch Unit and four Class I deep disposal wells at the Hank Unit (not yet constructed).

Gaseous or Airborne Particulate Emissions

During construction, operations, aquifer restoration, and decommissioning, ISR facilities can produce airborne emissions including

- Fugitive dusts
- Combustion engine exhausts, and
- Radon gas emissions from various processing systems (i.e., processing at the CPP)

Fugitive dusts and engine exhausts are generated primarily during construction, transportation, and decommissioning activities. The fugitive dust is generated by travel on unpaved roads and from disturbed land associated with the construction of wellfields, roads, and support facilities.

The Jane Dough Unit would generate an estimated 122.4.3 metric tons [134.9 short tons] of fugitive dust annually during the construction and operations phases. The licensee expects that negligible amounts of fugitive dust would be generated from the soil disturbance during well construction based on its estimate that topsoil would be stripped from 54.6 ha [135 ac] or less (Uranerz, 2016a). The licensee proposes to maintain access roads, use dust suppression on

unpaved access roads, and to minimize disturbance of natural vegetation when possible to minimize wind erosion (NRC, 2011b; Uranerz, 2016a).

The vehicles workers use to commute to the CPP (at the Nichols Ranch Unit), wellfield infrastructure maintenance, or to transport product and wastes away from the Jane Dough Unit emit fuel combustion products. Diesel emissions originate from drill rigs, diesel-powered water trucks, and other equipment used during the construction phase. Operations rely on trucks for supply shipments and to transport product and some waste materials away from the Jane Dough Unit. Decommissioning activities produce emissions from construction equipment and from trucks used to haul waste materials offsite.

Radon gas is released during operations and aquifer restoration. Pressurized processing systems may contain most of the radon in solution; however, radon may escape from the processing circuit in the CPP (at the Nichols Ranch Unit) through vents or leaks, during wellfield operations, or during resin transfer when remote ion-exchange is used. Radon releases can migrate downwind from processing facilities and wellfields.

Appendix B provides information on the nature and duration of estimated nonradiological emission-generating activities during construction, operations, and decommissioning at the Jane Dough Unit.

Nonradiological Air Emissions

The following section focuses on updates to the fugitive dust and diesel emission estimates presented in the Nichols Ranch ISR Supplemental Environmental Impact Statement (SEIS) (NRC, 2011b). Updates to the air effluent information include the overall project schedule and the emission estimates. Descriptions of the activities and sources that generate the air emissions for the various ISR phases are available in Nichols Ranch SEIS Section 2.2.1.6.1.1 and Appendix D (NRC, 2011b).

The air quality analysis examines the nonradiological emissions for each project phase as well as for the peak year. With the addition of the Jane Dough Unit, the licensee has provided a revised schedule showing that phases would occur simultaneously. The peak year estimate represents the highest amount of emissions that the entire project (Nichols Ranch Unit, Hank Unit, and Jane Dough Unit) would generate in any one project year. Future revisions to the project schedule may change how phases overlap, and what emissions levels result for individual years. The updated project schedule in EA Figure 2-2 incorporates the Jane Dough Unit activities into the timeline for the activities for the Nichols Ranch and Hank Units.

Nonradiological emissions are classified into two main categories: combustion emissions and fugitive dust. Appendix B, Table B–5 contains the peak year emission estimates used for the analysis in this EA. Section B.1 of Appendix B describes how the Jane Dough ISR project emission estimates were determined, including the mitigation incorporated into the calculation.

Liquid Wastes

As previously stated, the licensee would dispose of liquid byproduct material generated during uranium recovery operations using permitted Class I deep disposal wells located in the Nichols Ranch Unit. Project-generated liquid byproduct material would include bleed water from the production wells, groundwater generated during aquifer restoration, process solutions (e.g., resin transfer water and brine generated from the elution and precipitation circuits), and plant washdown water (Uranerz, 2014a). Disposal of liquid wastes via the Class I deep disposal wells located on the Nichols Ranch Unit requires Uranerz to comply with their existing WDEQ UIC permit.

Solid Wastes

All phases of the ISR facilities lifecycle generate solid wastes. These separate waste streams can produce materials that can be classified as ordinary municipal solid waste (i.e., landfill waste), and byproduct material. However, because the Jane Dough Unit consists only of wellfields, waste streams would be limited.

Radioactive wastes generated by ISR facilities are defined as byproduct material by NRC. Unless suitable to remain onsite or to be released offsite for unrestricted use, byproduct material wastes (e.g., piping) must be disposed at a facility that is licensed to accept byproduct waste. Soils in areas where ISR operations occur would be included in decommissioning surveys when operations end, and any contaminated soils that exceed NRC release limits at 10 CFR Part 40, Appendix A, Criterion 6 would be removed and disposed as byproduct material. The largest volumes of solid wastes requiring disposal would be generated during facility decommissioning (NRC, 2009).

2.3.6 Wastewater Disposal

Liquid byproduct material is expected to be generated during the operations and aquifer restoration phases of the Jane Dough Unit. The licensee is required to manage and dispose of liquid byproduct material in compliance with applicable state and federal regulations and as established by license and permit. Wastewater generated by the Jane Dough Unit project would be disposed via the currently available Class I deep disposal wells located on the Nichols Ranch Unit.

2.4 No-Action Alternative

Under the provisions of NEPA, one alternative that must be considered in each environmental review is the No-Action Alternative. In this case, the No-Action Alternative would mean that the NRC would not approve the addition of the Jane Dough Unit to the existing Nichols Ranch ISR licensed permit area. In situ uranium recovery would not occur within the Jane Dough Unit and the associated environmental impacts also would not occur. In situ uranium recovery would continue to occur within the currently approved Nichols Ranch ISR licensed permit area. The No-Action Alternative is also discussed within each resource area section of Chapter 4.

Evaluation of the potential environmental impacts for the addition of the Jane Dough Unit to the Nichols Ranch ISR license can be found in EA Chapter 4. Although impacts may exist, they may not be significant. An impact that is not significant does not equate to no impact (NRC, 2003a).

3 DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1 Introduction

The Jane Dough Unit is a proposed expansion of the Nichols Ranch In Situ Recovery (ISR) Project, for which Uranerz Energy Corporation (Uranerz, herein referred to as the licensee) received its license in 2011. The Nichols Ranch ISR Project and the area covered in the Jane Dough amendment to the Nichols Ranch license are located in the Pumpkin Buttes Mining District of the Powder River Basin (PRB) in Johnson and Campbell counties, Wyoming. The Jane Dough Unit would add approximately 1,489 hectares (ha) [3,680 acres (ac)] of land for wellfields to the overall production area covered under the Nichols Ranch ISR Project license. Currently, the Nichols Ranch Unit has surface facilities including the central processing plant (CPP), wellfields, and deep disposal wells. The Jane Dough Unit would consist of two production areas, each with one wellfield, covering a total of four ore bodies with associated structures (e.g., header houses) but no processing facility, ancillary buildings, or deep injection wells.

This chapter describes the existing site conditions at the Jane Dough Unit. The resource areas described in this chapter include land use; transportation; geology and soils; water resources; ecology; meteorology, climatology, and air quality; noise; historic and cultural resources; scenic and visual resources; socioeconomics; public and occupational health; and waste management practices. The descriptions of the affected environment are based on information provided in the license application documents (Uranerz, 2014a,b; 2015) and responses to the U.S. Nuclear Regulatory Commission (NRC) requests for additional information (Uranerz, 2016a) and supplemented by additional information the NRC staff identified. The Nichols Ranch ISR Supplemental Environmental Impact Statement (SEIS) included descriptions of the affected environment, region, and ISR activities. Some of this information is also applicable to the Jane Dough Unit; therefore, where the characteristics of the Jane Dough Unit region and activities are the same as those described in the SEIS for the Nichols Ranch Project, the information will be referenced but is not repeated in this environmental assessment (EA). Only information that is unique to the Jane Dough Unit expansion will be discussed in detail. The description of the affected environment in this chapter forms the basis for assessing the potential impacts (see Chapter 4) of the Proposed Action (Alternative 1) and No-Action Alternative (Alternative 2).

3.2 Land Use

This section focuses on a description of land use within the Jane Dough Unit. Site-specific land use information which is different than that included in the Nichols ISR SEIS (NRC, 2011b) includes the township and range, terrain elevation, residents, and recreation and resource extraction. General descriptions of regional land use conditions are available in the Nichols Ranch SEIS Section 3.2.

The Johnson and Campbell County line runs north–south through the Jane Dough Unit passing through the two western ore bodies. Johnson County is to the west and Campbell County is to the east (see EA Figure 2-1). The Jane Dough Unit encompasses approximately 1,489 ha [3,680 ac] of land located in Township 43 North, Range 76 West, Township 43, including all or portions of Sections 20, 21, 27, 28, 29, 30, 31, 32, 33, and 34 (Uranerz, 2014a). The terrain is hilly with many large, deep drainages; elevation ranges from 1,414 m to 1,519 meters (m) [4,640 feet (ft) to 4,986 ft] above sea level (Uranerz, 2016a).

The Jane Dough Unit is in a rural area consisting of livestock grazing as the main land use activity. The nearest population center to the Jane Dough Unit is the town of Wright, Wyoming, which is located approximately 35 kilometers (km) [22 miles (mi)] to the east. Other towns located within 80 km [50 mi] of the Jane Dough Unit include Edgerton, Midwest, Kaycee, and Gillette, Wyoming (Uranerz, 2015).

Unlike the Nichols Ranch ISR Project site, all of the land within the Jane Dough Unit area is privately owned; therefore, access is limited or restricted. The mineral rights are owned by private entities, including oil and gas and mineral extraction companies (Uranerz, 2014a). In general, the primary recreational activities in the area mainly include outdoor activities, such as camping, hiking, fishing, and hunting. Public lands nearby, such as the Thunder Basin National Grassland, the Powder River, and the Bighorn Mountains are publicly accessible for recreational activities.

Within 8 km [5 mi] of the Jane Dough Unit, there are two ranches with a total of eight inhabitants. The ranches (Dry Fork and Rolling Pin Ranches) are located approximately 1.6 km [1 mi] west and east, respectively (Uranerz, 2015).

There are three oil and gas wells on the Jane Dough Unit and 18 more within a 4.8 km [3 mi] buffer area. Coalbed methane (CBM) extraction has been occurring in the region for approximately 15 years, but for about 9 years on land within the Jane Dough Unit (Uranerz, 2016a). There are currently 47 CBM wells uniformly distributed across the Jane Dough Unit as well as throughout most of the surrounding 4.8 km [3 mi] buffer area (Uranerz, 2014a).

3.3 Transportation

This section focuses on a description of transportation within the Jane Dough Unit. Site-specific transportation information which is different than that included in the Nichols ISR SEIS (NRC, 2011b) includes site access and traffic counts. General descriptions of regional transportation conditions are available in the Nichols Ranch SEIS Section 3.3.

Access to the Jane Dough Unit would be either via Wyoming State Highway 50 to Van Buggenum Road to T-Chair Livestock ranch roads, or from U.S. Highway 387 north on Iberlin Road (Uranerz, 2014a). Van Buggenum Road is a county-maintained gravel road that provides access to several ranches located in the region. The road is 7.3 m [24 ft] wide, which allows for two tractor-trailers to pass one another, and is crowned and ditched. Van Buggenum Road is currently being used as an access route for tractor-trailer traffic associated with CBM activities in the vicinity (Uranerz, 2014a). The speed limit is posted at 72 kilometers per hour (km/h) [45 miles per hour (mph)] (NRC, 2011b).

Ranch roads occurring on the T-Chair Livestock Company property are also crowned and ditched gravel roads. These roads range from 4.6 to 6.1 m [15 to 20 ft] wide and would accommodate both passenger cars and tractor-trailers. The speed limit on these roads is 50 km/h [30 mph] (NRC, 2011b).

The State of Wyoming Department of Transportation (WDOT) has taken traffic counts at State Highway 387 (Pine Tree Junction) and State Highway 59 North of Wright (Reno Junction North). In 2014, vehicles, including motorcycles, cars, pickups, buses, delivery trucks, and single- and multi-trailer trucks were recorded. The annual average daily traffic recorded was 1,058 and 4,352, respectively (WYDOT, 2014).

After decommissioning, wellfield access roads within the Jane Dough Unit would be reclaimed or remain in place at the discretion of the landowner (Uranerz, 2014a).

3.4 Geology and Soils

This section focuses on a description of geology and soils within the Jane Dough Unit. Site-specific geology and soils information which is different than that included in the Nichols ISR SEIS (NRC, 2011b) includes site geology and soils, ore bodies, and coal-bearing units. General descriptions of regional geological characteristics and features are available in the Nichols Ranch SEIS Section 3.4.

3.4.1 Jane Dough Unit Geology

The affected geologic resources of the Jane Dough Unit in Wyoming's PRB are Holocene alluvium and terrace deposits and Tertiary-age sediments and rocks of the Wasatch and Fort Union Formations (Uranerz, 2014b). The 480 m [1,575 ft] thick Eocene Wasatch Formation (Sharp and Gibbons, 1964) is composed of interbedded mudstones, carbonaceous shales, silty sandstones, and relatively clean sandstones with lithification varying from noncemented to moderately well-cemented sandstones, and from weakly compacted and cemented mudstones to fissile shales. The underlying 915-m [3,000-ft]-thick Paleocene Fort Union Formation is composed of interbedded silty claystones, sandy siltstones, relatively clean sandstones, and coal with varying degrees of lithification ranging from non-lithified sands to moderately well-cemented siltstones and sandstones (Uranerz, 2014a).

3.4.2 Jane Dough Unit Depositional and Stratigraphic Settings

The Wasatch Formation was deposited in a fluvial, multi-channel cut-and-fill environment with overbank and crevasse splay deposits formed in a wet, tropical-to-subtropical climate. Medium stream and river sediment loads dropped medium-grain-sized particles, on average. Based on abundant feldspar grains in its sands, the sediment sources were the Laramie and Granite Mountains. Fine-grained particles were deposited on floodplains and within shallow ponds and swamps surrounding broad meander-belt channel systems. Successive layers of 1.5 to 9 m [5 to 30ft] thick meander belt systems formed during the Eocene as stream channels wandered during episodes of subsidence. As a result, the stratigraphy of the Wasatch Formation consists of alternating layers of gently west-dipping sands, including the ore-bearing sand, and mudstone or carbonaceous shales with lignite marker beds (Uranerz, 2014b). The uranium ore-bearing host sand consists of a package of three or four stacked meander belts in the lower Wasatch Formation at an approximate depth of 104 m [342 ft]. The host sand is arkosic, dominated by quartz and feldspar with accessory biotite and muscovite mica, and trace carbon fragments; it is weakly to moderately cemented and friable. Locally sandy mudstone or siltstone intervals occur within the sands, which may thicken in some areas and pinch out in others. This meander-belt cut-and-fill depositional environment yields the heterogeneous groundwater resources that are discussed in EA Section 3.5.2 (Uranerz, 2014a).

3.4.3 Jane Dough Unit Ore Zones

The Wasatch Formation contains significant uranium resources. At the Jane Dough Unit, it hosts four roll-front ore body deposits at depths of 90 to 200 m [300 to 700 ft] below the land surface. Ore-grade uranium (i.e., 0.1 percent U_3O_8) formed when solubilized uranium in groundwater encountered a reducing, oxygen-deficient environment (Uranerz, 2014b). When uranium-charged groundwater in the aquifer system flowed north to northwest into

this geochemically reducing environment, oxidized uranium precipitated out of solution along the interface between the naturally occurring geochemical facies, leaving a yellow-to-red-to-brown-colored uranium oxide stain deposited upon individual detrital sand grains and within minor clays (Uranerz, 2014a). Uranium was deposited in 1.5 to 9 m [5 to 30 ft] thick, C-shaped rolls on the Jane Dough and Nichols Ranch Units. The uranium mineralization zones on the east and west sides of the Jane Dough Unit, comprising amorphous uranium oxide, sooty pitchblende, and coffinite, are located on the opposite end of the same chemical cell being mined on the Nichols Ranch Unit. Between these mineralized zones is an oxidized sandstone facies associated with hematite or limonite stains from pyrite, as well as montmorillonite and kaolinite clays from oxidized feldspars; external to this area is a reduced sandstone facies associated with pyrite and calcite (Uranerz, 2014b). The four Jane Dough Unit ore bodies are hereafter referred to directionally as the northeastern, southeastern, southwestern, and northwestern ore bodies (EA Figure 2-1). The southwestern ore body exhibits two significant sub-noses that are illustrative of lateral permeability variations in the host rock (Uranerz, 2014a). The two western ore-body deposits principally occupy a single roll front that occasionally splits into three subrolls, whereas the two eastern ore-body deposits are spread across two to three vertically stacked roll fronts caused by vertical permeability variations in the host rock (Uranerz, 2014a,b).

The Jane Dough roll-front uranium system is one of eleven identified in Wasatch Formation sand horizons. In planview (i.e., map view), roll fronts may be a few to 150 m [500 ft] wide and tens of kilometers [miles] in length (Uranerz, 2014a).

3.4.4 Jane Dough Unit Soils

In 2010, the licensee described and categorized the physical and chemical characteristics of 54 soil profiles across the Jane Dough Unit; and in 2011, the licensee distributed these profiles into 16 soil map units (Uranerz, 2014a) based on National Cooperative Soil Survey standards (USDA, 1993). Descriptions included assessments of wind and water erodibility. The soils are generally loamy or fine loamy. Patches of sandy loam occur on upland areas and fine soils occur in and near drainages. The Jane Dough Unit has deep soils on lower toe slopes and in flat areas near drainages and moderately deep soils located on upland ridges and shoulder slopes (Uranerz, 2015). The licensee also estimated depths of salvageable topsoil; only two soil map units, consisting of less than 25 percent of the Jane Dough Unit, would yield impractically salvageable topsoil due to the presence of rock outcrops or extensively gullied slopes (Uranerz, 2015). A reconnaissance survey conducted by the Natural Resource Conservation Service identified no prime farmland on the Jane Dough Unit (Uranerz, 2015).

3.5 Water Resources

This section focuses on a description of water resources within the Jane Dough Unit. Site-specific water resource information which is different than that included in the Nichols ISR SEIS (NRC, 2011b) includes drainage basins and slopes, flooding potential, surface-water quality, CBM discharges, local groundwater resources, uranium- and coal-bearing aquifer(s) and confinement, hydrogeologic characteristics, groundwater quality, and current groundwater uses. General descriptions of regional water resources and water uses are available in the Nichols Ranch SEIS Section 3.5.

3.5.1 Surface Water

Surface water bodies within the Jane Dough Unit are mostly CBM ponds and several intermittent ephemeral (i.e., intermittent) drainages. The northeast part of the Jane Dough Unit lies within the Cottonwood Creek drainage basin and the southwest part lies within the Seventeenmile Creek drainage basin (Uranerz, 2016a). Cottonwood and Seventeenmile Creeks are tributaries to the Dry Fork of the Powder River. The Dry Fork of the Powder River flows northward west of the Jane Dough Unit (Uranerz, 2016a). Stream flow in Cottonwood and Seventeenmile Creeks is ephemeral and occurs only after heavy snow melt during the spring and early summer or after large rain storms.

Cottonwood Creek has a 30 m [100 ft] wide, relatively flat channel within the Jane Dough Unit, with elevation varying from 1,414 to 1,426 m [4,640 to 4,680 ft] above mean sea level (amsl) (Uranerz, 2014a). Seventeenmile Creek has a 6 m [20 ft] wide, relatively steep channel within the Jane Dough Unit, varying from 1,417 to 1,609 m [4,650 to 5,280 ft] amsl (Uranerz, 2014a). Four minor, 1.5 m [5 ft] wide drainages have slopes that vary from 1.5 to 4.5 percent and their shallow to moderately incised channels generally flow north on the Jane Dough Unit into Cottonwood Creek (Uranerz, 2014a,b). A minor 1.5 m [5 ft] wide drainage that flows into Seventeenmile Creek has a slope of 3 percent, and its shallow to moderately incised channels flow southwest to west (Uranerz, 2014a,b). The sandy bed widths of two tributaries to this drainage range from 0.9 to 2.4 m [3 to 8 ft], and the banks range from 0.3 to 0.9 m [1 to 3 ft]. Additionally, a minor 1.5 m [5 ft] wide drainage lies above the southwestern ore body; it has a slope of 2 percent, and its incised channels flow west as tributaries to the Dry Fork of the Powder River (Uranerz, 2014a). These bedrock-, sand- and gravel-bedded channels have geomorphic characteristics that suggest small-scale, focused downcutting from recently initiated groundwater throughflow.

The licensee performed a flood inundation analysis assuming the channels are straight, full stage, with no rifts or deep pools to determine the extent of potential flooding on the Jane Dough Unit from a 25-year flood (Uranerz, 2016a). Figure JD-D6-1 in Uranerz (2016) shows the surface drainage areas within the Jane Dough Unit, and Table JD–D6–1 in Uranerz (2016) lists surface drainage properties, estimated peak discharges, and flow velocities for the aforementioned ephemeral drainages, which the licensee used to estimate flood inundation areas. The estimated 25-year flood velocity for Cottonwood Creek was 2.19 m/sec [7.20 ft/sec], and the estimated 25-year flood velocities for Seventeenmile Creek and minor drainages ranged from 3.15 to 4.47 m/second [10.35 to 14.66 ft/sec]. Results of the analysis, which yielded flow depth and inundated area for the 25-year peak flow, indicated that significant inundation within the Jane Dough Unit would be limited to the wide floodplain of Cottonwood Creek along the northern boundary of the Jane Dough Unit, particularly north of the northeastern ore body (Uranerz, 2014a). All other floodwaters within the Jane Dough Unit during a 25-year flood would be confined to narrow, shallow to moderately incised channels (Uranerz, 2014a).

A survey identified a single jurisdictional wetland crossing the western boundary of the Jane Dough Unit on the Seventeenmile Creek drainage; 0.5 ha [2.1 ac] of this wetland lies within the Jane Dough Unit (Uranerz, 2014a). CBM ponds filled with produced water and very little precipitation are also scattered across the Jane Dough Unit but have no associated wetlands (Uranerz, 2014a, 2016a). There are several CBM ponds within or adjacent to proposed wellfields (Uranerz, 2016a). A groundwater-well-supplied wetland {0.04 ha [0.1 ac]} and associated stream has headwaters in a series of small retention ponds and weirs that empty into a buried pipe drain and, from there into an ephemeral drainage (Uranerz, 2014a). When the well, located above the center of the southwestern ore body, is flowing, this is the only

persistently flowing stream on the Jane Dough Unit. USACE would make the wetland determination after wellfields have been delineated. Other Waters of the U.S. (WOTUS) were also delineated on the Jane Dough Unit totaling 3,959 meters [12,989 feet] of drainages with defined beds and banks, including two tributaries to Seventeenmile Creek and an ephemeral stream (Uranerz, 2014a). A system of irrigation ditches and spreader dikes lies adjacent to Cottonwood Creek to deliver water to crops of hay (Uranerz, 2014b). Drainage is via ephemeral, moderately to deeply incised channels having 0.3 to 4.6 m [1 to 15ft] banks that range in width from 0.3 to 4.6 m [1 to 15 ft] (Uranerz, 2014b).

The licensee reported surface water quality from two self-samplers located on Seventeenmile Creek and north of the northeastern ore body on Cottonwood Creek, and from 13 CBM ponds scattered within and adjacent to the Jane Dough Unit (Uranerz, 2016a). Surface water quality in Cottonwood and Seventeenmile Creek drainages is generally very good and dominated by bicarbonate in the upper channel reaches {e.g., total dissolved solids (TDS) ranging from 112 to 232 milligrams/liter (mg/L) [112 to 232 parts per million (ppm)] in Seventeenmile Creek}. Water quality in Cottonwood and Seventeenmile Creeks deteriorates further downstream with increasing concentrations of calcium and sulfate {e.g., TDS values of 197 to 1,800 mg/L [197 to 1,803 ppm]} where water has been in contact with the streambed for a longer period (Uranerz, 2016a). TDS values for sampled CBM ponds are considerably higher than those from the stream channels, ranging from 382 to 2,930 mg/L [382 to 2,935 ppm]. The CBM pond samples for surface water quality came from locations near Wyoming Pollutant Discharge Elimination System (WYPDES)-permitted outfalls for CBM dewatering activities (Uranerz, 2016a). As such, samples from CBM ponds are almost exclusively produced water and are not representative of natural surface water runoff. Surface water quality in CBM ponds is dominated by bicarbonate, carbonate, sulfate, and sodium (Uranerz, 2016a).

CBM-produced water discharges were or are monitored through seven WYPDES permits issued to CBM operators located inside and within 1.6 km [1 mi] of the Jane Dough Unit (Uranerz, 2014b). Five permits are for total containment within nondischarging impoundments that drain to the surficial aquifer, the only exception being rare overtopping events caused by heavy precipitation. Of the other two permits, discharges from one would have no impact on the Jane Dough Unit, while the other is for produced water discharged via Anadarko E&P Onshore, LLC's Dry Willow Permit #WY0094536 for an outfall located southeast of the Jane Dough Unit on a drainage that flows across the Jane Dough Unit after a stream reach length of approximately 3.2 km [2 mi] (Uranerz, 2015).

3.5.2 Groundwater

The Nichols Ranch ISR SEIS (NRC, 2011b), Section 3.5.2.1 described the major regional aquifer system in the Wyoming East Uranium Milling Region. This section focuses on site-specific aquifer system characteristics and associated water resources at the Jane Dough Unit that may affect or be affected by project activities. Sporadic Quaternary alluvium in some drainages and terrace deposits overlie the shallow aquifers of the Eocene Wasatch Formation beneath the surface of the Jane Dough Unit. The Wasatch Formation is composed of a series of alternating sand aquifers and fine-grained aquitards. From top to bottom, its aquifers are the H, G, F, C, B, A, and 1 Sands. Sands underlying the unconfined G Sand (or the F Sand near drainages) are generally confined aquifers. Flow within the topographically controlled G Sand aquifer on the Jane Dough Unit generally diverges west and north toward the alluvial aquifer surrounding major drainages. The H Sand occurs above the G Sand only at a local topographic high in one west-central zone of the Jane Dough Unit and is hydrologically unconnected to ISR activities associated with the Jane Dough Unit,; as such, the H Sand is not discussed further.

The A Sand hosts the four ore bodies mapped at the Jane Dough Unit making it the production aquifer (Uranerz, 2014a, 2015).

The A Sand is up to 35 m [115 ft] thick, occurring at depths from 72 to 122 m [235 to 400 ft] below ground level at the Jane Dough Unit. The A Sand is consistently thicker in the east than in the west. In the southern part of the Jane Dough Unit, water in the A Sand naturally flows north-northwest; in the eastern part of the Jane Dough Unit, water in the A Sand flows west-northwest (Uranerz, 2014a, 2015). The A Sand is occasionally separated in the vertical direction by finite lenses of mudstone or siltstone up to 4.5 m [15 ft] thick. Identifying the aquifer overlying the A Sand is complex because the AB Mudstone aquitard is typically absent in the eastern and northern parts of the Jane Dough Unit (Uranerz, 2016a). When absent, the aquifer is locally a relatively thick AB Sand aquifer (i.e., an aquifer composed of the combined A and B Sands) within which water naturally flows west-northwest (Uranerz, 2014a). The A and B Sands thin toward the southwest, and the B Sand pinches out completely. The A and B Sands range from fine- to coarse-grained, but are mostly medium-grained. The body of the B Sand, which is up to 71 m [234 ft] thick, is occasionally separated in the vertical direction by finite to laterally extensive lenses of mudstone, siltstone, and carbonaceous shale up to 7.6 m [25 ft] thick. Additionally, the C and F Sands are discontinuous on the Jane Dough Unit with the C Sand only occasionally present and the F Sand being generally absent on the eastern portion of the Jane Dough Unit (Uranerz, 2014a,b; 2016b). The underlying very fine- to coarse-grained aquifer is the 1 Sand, which occupies two incised channel valleys that cut into the 1A Mudstone. The eastern channel is 0.4 to 0.8 km [0.25 to 0.5 mi] wide and up to 20 m [66 ft] thick; the western channel is approximately 0.3 km [0.2 mi] wide and up to 23 m [75 ft] thick. Water flows to the northwest in the 1 Sand (Figure JD–D6–6) (Uranerz, 2014a, 2015).

Average properties, gradients, and calculated linear groundwater flow rates in the sand aquifers and aquitards of the Wasatch Formation are given in EA Table 3-1. No onsite tests of aquitard properties were undertaken on either the Jane Dough or Nichols Ranch Units, with the licensee relying on regional, historical PRB aquitard properties, as discussed in the Nichols Ranch SEIS (NRC, 2011b). The thickness of the AB Mudstone ranges from 0 to 46 m [0 to 150 ft] within the Jane Dough Unit (Uranerz, 2016a). The thickness of the AB Mudstone is greatest {e.g., greater than 30.5 m [100 ft]} in the southwestern part of the Jane Dough Unit (Uranerz, 2016a). The thickness of the 1A Mudstone aquitard ranges from 9.1 to 30.5 m [30 to 100 ft] within the Jane Dough Unit (Uranerz, 2016a). The 1A Mudstone is thinnest {e.g., 9.1 m [30 ft]} along two north-to-south–trending channels cut into the 1A Mudstone by the underlying 1 Sand (Uranerz, 2016a).

Uranerz conducted five multi-well pump tests in the Jane Dough Unit to define local transmissivities in the A and AB Sand aquifers and to determine whether hydraulic connection exists between overlying and underlying aquifers (Uranerz, 2014a). Results of the multi-well pump tests found no indication of hydraulic connection between the production zone aquifers and the underlying and overlying aquifers (Uranerz, 2014a,b). Confinement of the production zone aquifers would be further verified by Uranerz as part of the hydrologic wellfield package, which would be prepared for each proposed wellfield prior to wellfield operations.

The ore-bearing A Sand is separated from the underlying, actively producing coal-bearing unit on the Jane Dough Unit by a minimum thickness of 90 m [300 ft] of mudstones and impermeable shales interspersed with fine-grained sands and siltstones (Uranerz, 2016a). As observed in one deep drillhole located in Section 29, the separation distance between the southwestern ore body and this coal-bearing unit is 205 m [671 ft], (Uranerz, 2016a).

Table 3-1. Jane Dough (or Nichols Ranch) Flow Unit Properties					
Groundwater Unit	**Effective Porosity**	**Hydraulic Conductivity (m/d)**	**Gradient**	**Average Linear Velocity (m/d)**	**Average Direction**
G Sand*	0.05	1.5×10^{-3}	0.01	10^{-4}	North
FG Aquitard			1.1		Down
F Sand	0.14	0.67	0.011	0.05	Northwest
BCF Aquitard	0.22	2.9×10^{-5}	0.37		Down
B Sand	0.05	0.05	0.008	0.008	West-Northwest
AB Mudstone	0.19	9.4×10^{-5}	0.15		Up
A/AB Sand	0.05	0.08	0.0064	0.01	Northwest
1A Mudstone	0.24	6.0×10^{-5}	0.24		Up
1 Sand	0.05	0.046	0.008	0.007	Northwest

Based on information given in Appendix JD-D6 (2016) and Response to RAI-GW 1 (also page TR-110i, 2016)
*Properties derived from Hank Unit investigations (Uranerz, 2014b) with the exception of gradient

The licensee does not propose to install Class I deep disposal wells within the Jane Dough Unit, so aquifers underlying the Fort Union Formation are not part of the affected environment of the Jane Dough Unit (Uranerz, 2014a, 2015) and were addressed previously in the Nichols Ranch ISR SEIS (NRC, 2011b).

Groundwater quality is measured against either U.S. Environmental Protection Agency (EPA) Drinking Water Standards (40 CFR Parts 142 and 143), which establish Maximum Contaminant Levels (MCLs) for specific chemical constituents, or Wyoming Department of Environmental Quality (WDEQ) Groundwater Quality standards. A discussion of groundwater quality standards was presented in the Nichols Ranch ISR SEIS (NRC, 2011b). These groundwater quality standards would also apply to the Jane Dough Unit (as an amendment to the Nichols Ranch ISR license) and are therefore not repeated here. The licensee assumes that in locations where stacked uranium ore bodies are present in the A Sand, baseline water quality is essentially the same for each mineralized zone (Uranerz, 2016a). Uranerz evaluated pre-mining groundwater quality at the Jane Dough Unit by sampling wells screened in the alluvial and Wasatch Formation aquifers. Wells used to evaluate groundwater quality included one each screened in the Cottonwood, Dry Fork, and Seventeenmile alluviums, two in the G Sand, three in the F Sand, one in the C Sand, four in the B Sand, eight in the A Sand, and three in the 1 Sand (Uranerz, 2014b; 2015). Groundwater quality parameters and constituent concentrations for each aquifer are presented in the ER (Uranerz, 2014a).

Because a limited number of wells have been sampled to date, maximum measured values of constituents present in the production zone aquifer (A Sand and AB Sand), surficial aquifer (F and G Sands), and underlying aquifer (1 Sand) are presented in EA Table 3-2 (Uranerz, 2014b). Included in this table are EPA Drinking Water Standards (40 CFR Parts 142 and 143) and Wyoming Class I, Domestic Ground Water Quality standards. Maximum background concentrations for various constituents in the Wasatch Formation aquifers is important for enabling the licensee and the NRC staff to distinguish between CBM-produced water infiltration to the surficial aquifer from surface impoundments and impacts from surface spills, well and pipeline leaks, or excursions from ISR operations (Uranerz, 2015). General groundwater quality for the aquifers relative to groundwater quality standards is summarized in the following paragraphs (Uranerz, 2014a).

Table 3-2. Pre-Mining Groundwater Quality Given as Maximum Measured Concentrations on the Jane Dough Unit Relative to Water Quality Standards

Water Quality Parameter	F & G Sand Surficial Aquifers	A & AB Sand Ore Zone Aquifer	1 Sand Underlying Aquifer	Water Quality Standards*
Total Dissolved Solids (mg/L)†	**2000**‡	**715**	281	500
Conductance (µmhos)	2350	789	430	
pH	**11.10**	**9.94**	**9.62**	6.5–8.5
HCO_3 Bicarbonate (mg/L)	*229*‡	*177*	*273*	
CO_3 Carbonate (mg/L)	35	41	36	
Aluminum (mg/L)	**1.2**	0.1	<0.1	0.05–0.2
Arsenic (mg/L)	0.002	0.006	<0.001	0.01
Barium (mg/L)	<0.1	<0.1	<0.1	2.0
Boron (mg/L)	0.2	<0.1	<0.1	
Cadmium (mg/L)	0.005	0.005	<0.005	0.005
Calcium (mg/L)	*328*	29	5	
Chloride (mg/L)	9	113	5	250
Chromium (mg/L)	<0.05	<0.05	<0.05	0.1 (total)
Copper (mg/L)	<0.01	<0.01	<0.01	1.0
Fluoride (mg/L)	0.5	0.4	0.7	2.0–4.0
Iron (mg/L)	**92.8**	0.03	**0.44**	0.3
Lead (mg/L)	<0.001	0.001	0.001	0.015
Magnesium (mg/L)	78	4	<1	
Manganese (mg/L)	**0.24**	0.04	<0.01	0.05
Mercury (mg/L)	<0.001	<0.001	<0.001	0.002
Molybdenum (mg/L)	<0.1	<0.1	<0.1	
Nickel (mg/L)	<0.05	<0.05	<0.05	0.1
Nitrogen, NH_3 (mg/L)	0.19	0.07	0.08	0.5
Nitrogen, NO_2 + NO_3 (mg/L)	2.4	0.1	<0.1	10
Potassium (mg/L)	46	13	4	
Radium 226+228 (pCi/L)§	**209.7**	**247.7**	1.1	5.0
Selenium (mg/L)	0.04	0.003	0.003	0.05
Sodium (mg/L)	*269*	*127*	*107*	
Sulfate (mg/L)	***1260***	*156*	4	250
Uranium (mg/L)	**0.1990**	**0.0495**	0.0004	0.03
Vanadium (mg/L)	<0.1	<0.1	<0.1	
Zinc (mg/L)	0.04	0.05	0.01	5.0

Source: Uranerz, 2016a

*EPA Drinking Water Standards - 40 CFR Part 142 and 40 CFR Part 143, Wyoming Water Quality, Rules and Regulations, Chapter 8, Class I, Domestic Ground Water

†To convert mg/L to oz/gal, multiply by 1.34×10^{-4}

‡**Bold values** exceed EPA or Wyoming Class I Groundwater Standards; *italic values* indicate major constituents

§To convert pCi/L to Bq/m^3, multiply by 37

Groundwater in Wasatch Formation aquifers tends to be alkaline (pH ranging from 7.5 to 11.1), whereas groundwater in Quaternary, shallow alluvial aquifers is near-neutral (pH ranging from 7.2 to 7.9). Some or all of the groundwater samples from the Wasatch Formation and shallow alluvial aquifers exceed the Wyoming Class I (suitable for domestic use) groundwater quality standards for pH (maximum pH 8.5), TDS {500 mg/L [501 ppm]}, sulfate {250 mg/L [250 ppm]}, iron {0.3 mg/L [0.3 ppm]}, and manganese {0.05 mg/L [0.05 ppm]} (Uranerz, 2016a).

The surficial F and G Sand aquifers at the Jane Dough Unit have high levels of TDS {ranging from 678 to 2,000 mg/L [679 to 2,004 ppm]} due in part to evaporative concentration; sulfate, calcium, sodium, and bicarbonate are their major dissolved constituents (EA Table 3-2). All groundwater samples from the F and G Sands exceed the Wyoming Class I standard for TDS and sulfate, and some samples exceed the Wyoming Class I standards for iron, pH, and manganese. Some samples also exceed the EPA Secondary Drinking Water Standard for aluminum and the EPA MCLs for uranium and combined radium-226/228.

Constituent concentrations from the surficial alluvial aquifers located outside of the Jane Dough production units but within the Jane Dough Unit boundary, are not included in EA Table 3-2. For the surficial aquifers outside the production units, major dissolved constituents are sulfate, calcium, sodium and bicarbonate (Uranerz, 2016a), and all alluvial groundwater samples exceed the Wyoming Class I groundwater quality standards for TDS and sulfate. In addition, most samples exceed the Wyoming Class I standard for manganese and a couple of samples exceed the standard for iron. Alluvial groundwater samples all exceed the EPA MCL for uranium (Uranerz, 2016a). In contrast, CBM-produced water has relatively high concentrations of chloride, iron, and barium but low TDS and sulfate concentrations (Uranerz, 2015), enabling the influence of produced waters to be distinguished from background groundwater concentrations in surficial aquifers.

The A, B and C (where present) Sands have low to occasionally moderate levels of TDS {ranging from 251 to 715 mg/L [251 to 716 ppm]}, with major components being bicarbonate, sulfate, and sodium (EA Table 3-2). Groundwater samples from the A, B, and C Sands typically exceed the Wyoming Class I groundwater quality standard for pH, rarely exceed the standard for TDS, and sometimes exceed the EPA MCLs for uranium and combined radium-226/228 (particularly in the ore-bearing A and uneconomically mineralized B Sands).

The underlying 1 Sand has very low TDS {ranging from 218 to 281 mg/L [218 to 281 ppm]}, with major cations and anions being bicarbonate and sodium (EA Table 3-2). This groundwater meets the Wyoming Class I groundwater quality standards for all constituents with the exceptions of pH and sometimes iron. Uranium and radium-226/228 in the 1 Sand are at very low levels that do not exceed EPA MCLs (Uranerz, 2016a).

3.5.3 Water Uses

Water uses near the Jane Dough Unit include those associated with irrigation, stock and storage ponds, oil and gas extraction, CBM extraction, and uranium recovery activities. Surface water rights on the Jane Dough Unit are for ephemeral creeks and stock and storage ponds. CBM-produced water from the 300 m [1,000 ft] deep coal beds of the Fort Union Formation is discharged at the surface into impoundments that are designed to infiltrate into the surficial aquifer. One fully adjudicated surface water right for a reservoir is located adjacent the Jane Dough Unit near the southwestern corner of the Jane Dough Unit boundary, within a 0.8 km [0.5 mi] buffer zone as recommended by NRC guidance in NUREG–1569 (NRC, 2003b). Groundwater rights are associated with stock and groundwater monitoring wells. Livestock, wildlife, and the Rolling Pin and Dry Fork ranch houses are the primary users of groundwater pumped from this region (Uranerz, 2016a).

Groundwater wells and drillholes on the Jane Dough Unit include numerous wells installed for uranium exploration and CBM extraction, a few for oil and gas extraction, and more than 30 wells for groundwater quality baseline characterization and monitoring (Uranerz, 2014a).

Excluding mining and monitoring wells, local groundwater use primarily involves supplying domestic well water to ranch houses and to livestock and wildlife via windmill-driven or electrically pumped wells (Uranerz, 2014a). Only three domestic groundwater wells occur within 4.8 km [3 mi] of the Jane Dough Unit boundary. These are Dry Fork #1, Garden Well, and Doughstick #3 (Uranerz, 2014b). Seventeen stock wells are located on or within 0.8 km [0.5 mi] of the Jane Dough Unit boundary. Six wells are completed below the 1 Sand. Uranerz sampled the constituents of groundwater from seven water-supply wells within a 0.8 km [0.5 mi] radius of the Jane Dough boundary: Seventeen Mile #1, Pug #1, Pug #2, Pats #1, NQ–4, N1, and Dry Fork Flowing #5 wells (Table JD–D6E.1–1), at irregular intervals.

3.6 Ecology

This section focuses on a description of the ecological environment within the Jane Dough Unit. The site-specific ecological environment information which is different than that included in the Nichols ISR SEIS (NRC, 2011b) includes the results of vegetation and wildlife surveys conducted by the licensee for the Jane Dough Unit, Bureau of Land Management (BLM) raptor nest survey data, Wyoming Game and Fish Department (WGFD) Greater sage-grouse (*Centrocercus urophasianus*) survey data, recent changes to the U.S. Fish and Wildlife Service (FWS) status of the Greater sage-grouse, and state Greater sage-grouse management efforts. General descriptions of ecologic conditions are available in the Nichols Ranch SEIS Section 3.6.

In June and July 2010, TRC Environmental Corporation, a licensee contractor, conducted baseline vegetation studies of the Jane Dough Unit in accordance with a vegetation study plan approved by the WDEQ for noncoal permit areas (Uranerz, 2014a). The baseline studies found that the sagebrush grassland vegetation community occupies approximately 73 percent of the Jane Dough Unit, and mixed grassland vegetation community occupies approximately 20.5 percent. Bottomland and hay meadow communities, wetlands, and rock outcrops occupy the remaining 6.5 percent of the Jane Dough Unit.

The sagebrush grassland community is dominated by perennial grasses and annual grasses. Sagebrush species make up approximately 11 percent of the sagebrush grassland community. The primary sagebrush species is Wyoming big sagebrush (*Artemisia tridentata wyomingensis*). Perennial grasses include needle-and-thread (*Stipa comata*), prairie junegrass (*Koeleria macrantha*), and blue grama (*Bouteloua gracilis*), and annual grasses include Sixweeks grass (*Vulpia octoflora*) and Japanese and downy brome (*Bromus japonicus* and *B. tectorum*). Several scattered plains cottonwood trees (*Populus deltoides*) were found growing along the drainages. The mixed grassland community contains mostly perennial grasses such as needle-and-thread, Sandberg bluegrass (*Poa secunda*), blue grama, western wheatgrass (*Elymus smithii*), bluebunch wheatgrass (*Elymus spicatus*), and grasslike species such as threadleaf sedge (*Carex filifolia*). Wyoming sagebrush and subshrubs occur throughout this community. The bottomland community occurs along the drainages of both Cottonwood Creek and Seventeenmile Creek and is vegetated by hay and grasses with scattered mature or dead plains cottonwood trees. One state designated noxious weed, Canada thistle (*Cirsium arvense L.)*, was observed during baseline vegetation surveys within the Jane Dough Unit (Uranerz, 2014a,b; Wyoming Weed and Pest Council, 2016). Japanese brome and cheatgrass (*Bromus tectorum*), introduced and invasive annual grasses, were also found in each plant community within the Jane Dough Unit.

The FWS indicated that Ute ladies'-tresses (*Spiranthes diluvialis*), a federally threatened plant species, has the potential to occur in the Jane Dough Unit, based on geographic location and elevation (Uranerz, 2014a; FWS, 2016). In July and August 2012, an assessment of suitable

habitat for the Ute ladies'-tresses was conducted in conjunction with the wetland inventories for the Jane Dough Unit (Uranerz, 2014a). TRC Environmental Corporation determined that no suitable habitat for the Ute ladies'-tresses occurs within the Jane Dough Unit, and therefore, no site-specific surveys were conducted. Also, this species was not identified during vegetation inventories that TRC Environmental Corporation conducted as part of the Nichols Ranch ISR license application, nor is it known to occur in Johnson or Campbell Counties (Uranerz, 2007; NRC, 2011b; Heidel, 2007).

The licensee conducted baseline wildlife surveys for the Jane Dough Unit in April and May 2012. Baseline wildlife surveys were only conducted for raptor nests, Greater sage-grouse leks, and federally-listed species and species of concern; however, observations were made of other wildlife during the wildlife and vegetation surveys (Uranerz, 2014a). The baseline wildlife survey area includes the Jane Dough Unit and a 1.6 km [1 mi] buffer for raptor nests and a 3.2 km [2 mi] buffer for Greater sage-grouse leks. In 2006 and 2007, prior to licensing, Uranerz also conducted baseline wildlife surveys for the then-proposed Nichols Ranch ISR Project and a surrounding 3.2 km [2.0 mi] radius (Uranerz, 2007), which partially overlaps the Jane Dough Unit. The licensee has also conducted annual wildlife surveys (raptor nest and lek activity monitoring) at the adjacent Nichols Ranch Unit between 2006 and 2015 (Uranerz, 2014b; 2016a).

Mammal species (i.e., individuals) observed within the Jane Dough Unit during baseline wildlife surveys include pronghorn, mule deer, bobcat, badger, coyote, desert cottontail rabbits, white tailed jackrabbits, 13-lined ground squirrels, and black-tailed prairie dogs (Uranerz, 2014a). The Jane Dough Unit and surrounding area lies within habitat designated by the WGFD as winter/yearlong and yearlong range for pronghorn (Uranerz, 2014a; NRC, 2011b). The Jane Dough Unit also lies within habitat designated as winter/yearlong and yearlong range for mule deer (Uranerz, 2014a; NRC, 2011b). However, there are no crucial pronghorn or mule deer ranges on or within the Jane Dough Unit or vicinity. Although white-tailed deer (*Odocoileus virginianus)* and elk (*Cervus elaphusi)* could be present in the Jane Dough Unit, it does not provide optimal habitat for these species (WGFD, 2014). White-tailed deer in Wyoming are concentrated in areas with rivers and streams such as the foothills of the Big Horn Mountains, and are not usually found in expansive grasslands such as those that cover the Jane Dough Unit (BLM, 2015). Elk in northeast Wyoming are concentrated in the foothills of the Big Horn Mountains and other locations west of Gillette and southeast Campbell County.

No black-tailed prairie dog (*Cynomys ludovicianus*) or white-tailed prairie dog (*Cynomys leucurus)* colonies occur within the Jane Dough Unit; however, approximately 381 ha [942 ac] of black-tailed prairie dog colonies occur within a 2 km [1.25 mi] radius (one colony to the north and one colony to the west) of the Jane Dough Unit boundary (Uranerz, 2014a; NRC, 2011b). Both black-tailed prairie dogs and white-tailed prairie dogs are FWS species of concern (FWS, 2016). In addition, a swift fox (*Vulpes velox*), a WGFD species of greatest conservation need (WGFD, 2016), was observed approximately 8 km [5 mi] east of the Jane Dough Unit crossing Van Buggenum Road (Uranerz, 2014a) and swift foxes were observed during the wildlife inventories the licensee conducted in the adjacent Nichols Ranch Unit (Uranerz, 2007). The FWS identified two federally threatened mammal species, Canada lynx (*Lynx canadensis*) and northern long-eared bat (NLEB) (*Myotis septentrionalis*), that may occur in the Jane Dough Unit (FWS, 2015); however, these species have not been reported on or in the vicinity of the Jane Dough Unit (WGFD, 2010).

Mountain plover (*Charadrius montanus),* a WGFD (2016) species of greatest conservation need and FWS (2016) bird species of concern that relies on black-tailed prairie dog burrows for

nesting areas, are known to reside in the area around the Nichols Ranch Unit and therefore, some areas within the Jane Dough Unit (NRC, 2011b; WYNDD, 2010). Potential mountain plover nesting habitat exist adjacent to the Jane Dough Unit, and plover have been observed approximately 6.4 km [4 mi] from the Jane Dough Unit (Uranerz, 2014b). However, mountain plover were not observed during wildlife surveys conducted as part of the license application for the Nichols Ranch ISR Project, nor the license amendment application for the Jane Dough Unit (Uranerz, 2007, 2014a). There are no recorded occurrences of mountain plover on the Nichols Ranch or Jane Dough Units (Uranerz, 2014b; WYNDD, 2010).

During the 2012 baseline wildlife surveys, 79 raptor nests were found within the Nichols Ranch Unit and a 1.6 km [1.0 mi] buffer around the Nichols Ranch Unit, of which seven nests were determined to be active (Uranerz, 2014a). Three of the seven nests were great-horned owl (*Bubo virginianus*) nests, two were red-tailed hawk (*Buteo jamaicensis*) nests, and two were golden eagle (*Aquila chrysaetos*) nests. All of the active nests were located in cottonwood trees growing in drainages. During the 2015 annual wildlife survey conducted for the Nichols Ranch Unit, an additional active long-eared owl nest was observed just within the Jane Dough Unit's northern boundary (boundary abutting the Nichols Ranch Unit) (Uranerz, 2016a). There are no bald eagle (*Haliaeetus leucocephalus*) roosts within 1.6 km [1.0 mi] of the Jane Dough Unit (Uranerz, 2014a; 2016).

The Greater sage-grouse, a WGFD (2016) species of greatest conservation need, has the potential to occur within the Jane Dough Unit (Uranerz, 2014a). Four occupied Greater sage-grouse leks occur within 3.2 km [2 mi] of the Jane Dough Unit (Cottonwood Creek 1, Cottonwood Creek 1 Satellite, Cottonwood 2, and Cottonwood) (WGFD, 2015). A satellite lek of the Cottonwood Creek 1 lek was recorded in 2006. During years of relatively high grouse numbers, a satellite lek may be observed where a relatively small number of birds strut (usually less than 15 males) within about 500 m [0.3 mi] of a main lek (WGFD, 2015). Birds observed on the satellite lek are added to the main lek bird count during years where the satellite is used. The three main leks were reported as inactive in the spring of 2012 through 2015 (WGFD, 2015; Uranerz, 2016a). The Jane Dough Unit is located outside the Greater sage-grouse core population areas and connectivity corridors (Mead, 2015). The BLM identifies core population areas or connectivity corridors as priority habitat management areas (PHMAs).

There are no perennial streams within the Jane Dough Unit; however, the Jane Dough Unit is located in an active CBM field with scattered ponds; one pond located in Production Area #1 originates from a developed groundwater well (see EA Section 3.5.1). As described in Section 3.5.1 of this EA, surface water at the Jane Dough Unit is ephemeral and seasonal in nature and does not provide a year-round source of surface water sufficient to maintain a population of aquatic species. The lack of sufficient deep-water habitat and perennial water sources decreases the potential for many aquatic species to exist. Approximately 0.9 ha [2.2 ac] of designated wetlands within Production Area #1 occur within the Seventeenmile Creek drainage and downslope from the developed groundwater well (Uranerz, 2014a). Approximately 3,959 m [12,989 ft] of designated WOTUS occur in the southwest portion of the Jane Dough Unit along Seventeenmile Creek drainage and an unnamed drainage. Wetlands are further discussed in EA Section 3.5.1.

3.7 Meteorology, Climatology, and Air Quality

The following sections focus on updates to the description of the meteorology, climatology, and air quality presented in the Nichols Ranch ISR SEIS (NRC, 2011b) that are applicable to the

Jane Dough Unit. In addition, this section includes a discussion of climate change and greenhouse gases.

3.7.1 Meteorology and Climatology

Updates to the meteorological and climate information from the Nichols ISR SEIS include temperature, wind speed, wind direction, and climate change data. Descriptions of the regional precipitation, evaporation, and general conditions are available in the Nichols Ranch SEIS Section 3.7.1.

As described in the Nichols Ranch SEIS (NRC, 2011b), there was no onsite meteorological station when the NRC staff reviewed the license application for the Nichols Ranch ISR Project. During the safety review, the NRC staff concluded that the local topography at the Nichols Ranch ISR Project warranted onsite meteorological measurements. To address this concern, the NRC staff added a license condition requiring that the licensee collect onsite temperature, wind speed, and wind direction data for a minimum of 1 year prior to operation. Onsite data was collected over a 2-year period from June 2011 to July 2013. The average annual temperature at Nichols Ranch was 8.89 °C [48.0 °F] (Uranerz, 2014a). The mean monthly temperature ranged from -3.12 °C [26.4 °F] in December to 23.5 °C [74.3°F] in July (Uranerz, 2014a). EA Appendix B Table B–6 contains the mean monthly temperatures for each month. Average wind speed was 17.1 km/h (10.6 mph) with a maximum recorded wind speed of 82.6 km/h [51.3 mph] (Uranerz, 2014a). The most noticeable distinction between the onsite data and the data from the surrounding meteorological stations pertains to the wind direction. Based on data from the Antelope Coal Company meteorological station, the Nichols Ranch SEIS reports that the predominant wind direction is from the west with a strong west-southwest component (NRC, 2011b). The Nichols Ranch SEIS reports that the nearest residence along the path of the predominant wind direction is the T-Chair Ranch located approximately 3.0 km [1.9 mi] east of Nichols Ranch Unit. In contrast, the Nichols Ranch Unit onsite wind direction is predominately from the east with strong components also coming from the southwest and south-southwest (Uranerz, 2014a). Based on the onsite information, the nearest residence along the path of the predominant wind direction is Dry Fork Ranch approximately 1.5 km [0.9 mi] to the west.

Climate change data has been updated using information from the most recent National Climate Assessment by the U.S. Global Change Research Program (GCRP, 2014). Average U.S. temperatures have increased between 0.72 to 1.06 °C [1.3 to 1.9 °F] since 1895, and temperatures in the U.S. are expected to continue to rise (GCRP, 2014). From 1991 to 2012, the average temperature in the region of Wyoming where the Jane Dough Unit is located increased by approximately 0.83 °C [1.5 °F] when compared to the 1901 to 1960 baseline (GCRP, 2014). The average temperature in this region is projected to increase between 2.22 and 5.00 °C [4 and 9°F] by the latter part of this century (GCRP, 2014). Average U.S. precipitation has increased since 1900; however, some areas experienced increases greater than the national average while other areas experienced decreased precipitation levels. From 1991 to 2012, the annual precipitation totals in the region of Wyoming where the Jane Dough Unit is located increased between zero and 15 percent when compared to the 1901 to 1960 baseline (GCRP, 2014). By the latter part of this century, GCRP forecasts a zero to 10 percent decrease in precipitation during the summer and a zero to 20 percent increase in precipitation for the fall, winter, and spring for this region (GCRP, 2014).

3.7.2 Air Quality

Updates to the air quality information from the Nichols Ranch ISR SEIS include federal and state ambient air quality standards, National Ambient Air Quality Standards (NAAQS) attainment status for areas within Wyoming, and ambient air monitoring data. Descriptions of the Class I areas and sensitive class II areas are available in the Nichols Ranch SEIS Section 3.7.2.

EPA revised the NAAQS since publication of the Nichols Ranch ISR SEIS. The NAAQS for sulfur dioxide (24-hour and annual) are no longer applicable. A new sulfur dioxide 1-hour standard has been enacted and the ozone 8-hour standard has been lowered. The particulate matter $PM_{2.5}$ annual primary standard was lowered while the secondary standard remained the same level. Primary NAAQS are established to protect public health, and secondary NAAQS are established to protect welfare by safeguarding against environmental and property damage. EA Table B–7 contains the updated NAAQS. States may develop standards that are stricter or that supplement the NAAQS. The State of Wyoming revised their ambient air quality standards since publication of the Nichols Ranch ISR SEIS. Following EPA's example, the sulfur dioxide 24-hour and annual standards were revoked, a new sulfur dioxide 1-hour standard was enacted, and the ozone 8-hour standard was lowered (WDEQ, 2012b). The WDEQ has proposed revising the particulate matter $PM_{2.5}$ annual standard to match the NAAQS (WDEQ, 2015b). EPA has also revised the Prevention of Significant Deterioration (PSD) standards since publication of the Nichols Ranch ISR SEIS. New particulate matter $PM_{2.5}$ standards have been added for two different time frames: annual and 24-hours. EA Table B-8 contains the updated PSD standards.

The NAAQS attainment status for Wyoming is found in 40 CFR 81.351. At the time the Nichols Ranch ISR SEIS was published, the only nonattainment area in Wyoming was the City of Sheridan, located about 142 km [88 mi] northwest of the Jane Dough Unit. Since the publication of the Nichols Ranch ISR SEIS, the Upper Green River Basin Area has been classified as a nonattainment area for the ozone 8-hour NAAQS. This basin is located in southwestern Wyoming and consists of portions of Lincoln and Sweetwater Counties and all of Sublette County. Sheridan is still in a nonattainment area for the particulate matter PM_{10} 24-hour NAAQS and is the nearest nonattainment area to the Jane Dough Unit.

The air quality monitoring data from the Nichols Ranch Project has been updated using information from the 2016 Wyoming Ambient Air Monitoring Annual Network Plan (WDEQ, 2016). EA Table B–9 contains the updated monitoring results for a 3-year period from 2013 to 2015.

3.8 Noise

This section focuses on updates to the description of the noise resources information presented in the Nichols Ranch ISR SEIS (NRC, 2011b) that are applicable to the Jane Dough Unit. Updates to the noise resource area information include residence location information and ecological resources. Additional descriptions of regional noise resources as described in the GEIS (NRC, 2009) are available in the Nichols Ranch SEIS Section 3.8.

Due to the rural location of the Jane Dough Unit, the most significant ambient noise (i.e., background noise) would be from traffic along access roads through and surrounding the Jane Dough Unit (see EA Section 3.3).

Ambient noise measurements were not part of the licensee's prelicensing studies. In undeveloped rural areas of the Wyoming East Uranium Milling Region, existing ambient noise levels range from 22 to 38 decibels (dBA) depending on wind and traffic. Within and adjacent to the Jane Dough Unit, noise-sensitive receptors include residences, nesting raptors, and Greater sage-grouse. Information on raptors and Greater sage-grouse can be found in EA Section 3.6. Temporary noise sources in the immediate vicinity of the Jane Dough Unit would include high winds, trucks, and traffic (ranging from 50 to 60 dBA), agricultural equipment, and oil and gas drilling (ranging from 70 dBA to 100 dBA) (NRC, 2009).

Noise is a concern to the areas surrounding the Jane Dough Unit because it could interfere with surrounding residential neighborhoods. Within 8 km [5 mi] of the Jane Dough Unit, there are two ranches with a total of eight inhabitants. The ranches (Dry Fork and Rolling Pin Ranches) are located approximately 1.6 km [1 mi] west and east, respectively, of the Jane Dough Unit (Uranerz, 2015).

The Federal Highway Administration (FHWA) and the Wyoming Department of Transportation (WYDOT) have noise-impact-assessment procedures and criteria to help protect the public health and welfare from excessive vehicular traffic noise. FHWA-established Noise Abatement Criteria (i.e., 1-hour, A-weighted sound levels) are described according to land use, recognizing that different areas are sensitive to noise in different ways. The criteria, as described in 23 CFR Part 772, are shown in EA Table 3-3.

A person is considered to be impacted by noise, according to WYDOT procedures, when existing or expected future sound levels approach (within 1 dBA) or exceed the noise-abatement criteria or when expected future sound levels exceed existing sound levels by a substantial amount (15 dBA). These criteria were used to assess impacts at the Jane Dough Unit. Ranch roads (e.g., T-Chair Livestock Company ranch road), which cross the Jane Dough Unit are line sources of noise. Vehicular traffic sound 15 m [50 ft] from a noise-sensitive receptor has been estimated at 54 to 62 dBA for passenger cars and 58 to 70 dBA for heavy trucks (NRC, 2009). Because noise from line sources such as roads is reduced by approximately 3 dBA per doubling of distance (NRC, 2009), the maximum truck sound level of 70 dBA on the shoulder of roads within the Jane Dough Unit would diminish to the level of a Category A Activity approximately 480 m [1,575 ft] from the source, excluding the

Table 3-3. Noise Abatement Criteria: 1-Hour, A-Weighted Sound Levels in Decibels (dBA)

Activity Category	$L_{eq}(h)$*	Description of Activity Category
A	57 (Exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purposes.
B	67 (Exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.
C	72 (Exterior)	Developed lands, properties, or activities not included in Categories A or B above.
D	--	Undeveloped lands.
E	52 (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

*$L_{eq}(h)$ is an energy-averaged, 1-hour, A-weighted sound level in decibels.
Source: 23 CFR Part 772

noise-dampening characteristics of topographic interference and vegetation. Sound levels are assumed to diminish to the point that beyond a distance of 480 m [1,575 ft] from the T-Chair Livestock Company ranch roads, the sound level would be approximately 40 dBA. This conservatively overestimates a baseline that is consistent with the GEIS that states existing ambient noise levels in this region would be 22 to 38 dBA (NRC, 2009).

3.9 Cultural and Historical Resources

The National Historic Preservation Act (NHPA) requires Federal agencies to consider the effects of their undertakings on historic properties. Historic properties are defined as resources that are eligible for listing on the National Register of Historic Places (NRHP). The criteria for eligibility are listed in 36 CFR 60.4 and include (i) association with significant events in history; (ii) association with the lives of persons significant in the past; (iii) embodiment of distinctive characteristics of type, period, or construction; and (iv) sites or places that have yielded or are likely to yield important information (ACHP, 2012). The historic preservation review process (NHPA Section 106) is outlined in regulations the Advisory Council on Historic Preservation (ACHP) issued in 36 CFR Part 800. In addition to these resources, the NRC staff considers impacts on areas of traditional use or importance to Native American tribes that may not be categorized as historic properties of religious significance to Indian tribes under NHPA. These places can include traditional gathering areas, views, landscape characteristics, etc. that are important to the tribes. These areas are identified through tribal consultation.

The issuance of an NRC license or license amendment is a federal action (undertaking) that could possibly affect either known or undiscovered historic properties located on or near the Jane Dough Unit. In accordance with the provisions of the NHPA, the NRC is required to make a reasonable effort to identify historic properties in the area of potential effect (APE). The APE for this review is an area that may be impacted by construction, operations, aquifer restoration, and decommissioning activities associated with the proposed action. If no historic properties are present or affected, the NRC is required to notify the Wyoming State Historic Preservation Office (WY SHPO) before proceeding. If it is determined that historic properties are present, the NRC is required to assess and resolve possible adverse effects of the undertaking.

The Jane Dough Unit encompasses 1,489 ha [3,680 acres] of which 656 ha [1,620 acres] would be directly impacted by project activities. Based on previous studies in the area, such as those for the Nichols Ranch ISR SEIS (NRC, 2011b), there is the potential for indirect impacts within 3.2 km [2 mi] of the project area. The potential for direct impacts is limited to the 656 ha [1,620 acres] area where proposed ground disturbing construction activities could occur. Indirect impacts are considered for the entire area within 3.2 km [2 mi] of the Jane Dough Unit.

There is a Programmatic Agreement (PA) between the BLM and the WY SHPO regarding mitigation of adverse effects to the Pumpkin Buttes TCP. This PA was put in place for anticipated federal minerals development in Campbell County, Wyoming. The Jane Dough Unit is located approximately 9.7 km [6.0 mi] west of South Butte, and about 9.6 km [6 mi] west of the Pumpkin Buttes, which is beyond the 3.2 km [2 mi] radius stipulated in the programmatic agreement between BLM and the WY SHPO. However, the Pumpkin Buttes are visible from the Jane Dough Unit.

3.9.1 Cultural Resources Site Survey

A review of past archaeological surveys was conducted by TRC Environmental Corporation, a licensee contractor, to identify surveys that covered areas overlapping the Jane Dough Unit.

The documents included survey reports with determinations of the potential for effects or adverse effects to properties listed on or eligible for listing in the NRHP. The following section discusses the occurrence of cultural resources as well as consultation with Native American tribes that have a heritage interest on or in the vicinity of the Jane Dough Unit (Uranerz, 2014a).

TRC Environmental Corporation evaluated the current Jane Dough Unit and determined that approximately 1,076 ha [2,660 ac] of the 1,489 ha [3,680 ac] of the Jane Dough Unit had been previously inventoried in association with prior projects, leaving a total of 413 ha [1,020 ac] not inventoried (Uranerz, 2014a).

In 2010, TRC Environmental Corporation inventoried the previously uninventoried portion of the Jane Dough Unit. TRC revisited three previously recorded sites and identified two new isolated finds. This survey resulted in the recommendations of eligibility for three previously identified sites, the Deadwood Road (45CA1568/48JO2292), Bozeman Trail (48JO134) and an unnamed lithic scatter (48JO2292). TRC reviewed and recorded three segments of the Deadwood Road (Segments 14, 15, and 16) that had been previously recorded and identified a new segment of the road (Segment 31). They recommended that three of these segments did not contribute to the eligibility of the overall site (Segments 14, 15, and 31) and one was contributing (Segment 16). TRC revisited two segments of the Bozeman Trail (Segments 65 and 66); one was recommended as contributing (Segment 66) and one was recommended as not contributing (Segment 65) to the eligibility of the overall site. The lithic scatter was recommended as not eligible to the National Register (Uranerz, 2014a). The Class III report was provided to the WY SHPO in August 2016 and the SHPO concurred with the eligibility recommendations for all three of these sites.

Based on this survey and prior inventories, 14 sites have been recorded within the Jane Dough Unit boundary. The 14 sites consist of 9 prehistoric and 5 historic sites. The results of these surveys indicate that of the sites within the Jane Dough Unit, 2 sites are eligible for listing on the NRHP and 12 that are not eligible (see Table 3-4) (Uranerz, 2014a). The two eligible sites are the Deadwood Road and the Bozeman trail, of which only one segment of each is considered contributing to the eligibility of the resource. These segments are outside of the area of direct effect, but the licensee has committed to fence off and avoid the sites.

Tribal Consultation

The NRC staff has made a reasonable and good faith effort to identify Native American tribes for inclusion in the Section 106 consultation process and to provide the identified Native American tribes a reasonable opportunity to participate in the Section 106 consultation process, as is required by 36 CFR 800.2(c)(B)(ii)(A).

The NRC staff initially contacted 22 tribes on December 15, 2014 (NRC, 2014) to initiate consultation and request any information regarding cultural resources potentially affected by the proposed Jane Dough Unit. Follow-up calls were made June 17 and 24, 2015; during these telephone calls, 15 of the 22 tribes expressed interest or potential interest in visiting the site and being kept apprised of the project status. The NRC staff held a tribal webinar on May 25, 2016, in which 5 tribes participated. In August 2016, the NRC staff followed up with all 22 of the tribes to coordinate a visit to the project area. A meeting and site visit was held on September 27 -28, 2016. Two tribes, the Northern Arapaho and Eastern Shoshone, attended the meeting and site visit. The tribes were shown several of the archaeological sites documented in the Class III report and within the area of direct impacts. Additionally, the tribal representatives were provided the opportunity to visit any other areas of interest within the

Table 3-4. Sites Within or Near the Proposed Jane Dough Unit		
Site ID	**Site Type**	**NRHP Eligibility Status**
48CA1568/48JO2292	Deadwood Road	Eligible
48CA5393	Lithic Scatter	Not Eligible
48CA5394	Trash Scatter	Not Eligible
48CA5395	Lithic Scatter	Not Eligible
48CA5396	Lithic Scatter	Not Eligible
48CA5397	Lithic Scatter	Not Eligible
48CA5398	Oil/gas wellfield	Not Eligible
48CA5399	Lithic Scatter	Not Eligible
48CA5400	Lithic Scatter	Not Eligible
48CA5401	Lithic Scatter	Not Eligible
48CA5412	Lithic Scatter	Not Eligible
48CA6583	Trash Scatter	Not Eligible
48JO134	Bozeman Trail	Eligible
48JO3452	Lithic Scatter	Not Eligible
Isolated Resource -1	Lithic Scatter	Not Eligible
Isolated Resource -2	Biface	Not Eligible
Source: Uranerz, 2014a		

Jane Dough Unit. The meeting and site visit were completed on September 27, 2016 because the tribes did not request a second day in the field. Neither tribe identified specific areas of importance nor TCPs during the site visit.

Following the site visit, the Northern Arapaho sent a letter to the NRC staff on October 21, 2016 expressing concern regarding the project and potential impacts to Pumpkin Buttes, but they did not identify any specific resources within the project area. The Cheyenne River Sioux Tribe could not attend the site visit and requested that the NRC attend a Tribal Council meeting. The NRC responded that they would attend a meeting, but the tribe did not respond further. The details of the tribal consultation efforts are documented in the cultural and historic resource sections and in Appendix A of this document.

The cultural resource sections of this document were posted to the NRC's public webpage on January 27, 2017, for public comment consistent with 36 CFR 800.4(d)(1). The tribes (listed in Appendix A) were notified that the document was available for comment. The comment period ended on February 27, 2017. The NRC staff received one comment letter from the Cheyenne and Arapaho Tribes. The tribes agreed with the finding that no properties were affected. However, they requested that if an inadvertent discovery did occur (i.e., archaeological materials, human remains, or other cultural items) that it would be adequately addressed, pursuant to 36 CFR 800.13, which would include notification of the Tribal Historic Preservation Officer (THPO) within 72 hours of the discovery. The Uranerz license for Nichols Ranch ISR Project includes a condition specifically for such inadvertent discoveries (LC 9.8 – Cultural Resources). This license condition requires that any work that results in an inadvertent discovery of cultural resources would cease and the appropriate investigations would be completed per 36 CFR 800, including consultation with the WY SHPO and tribes.

3.9.2 Paleontological Resources Site Survey

TRC Environmental Corporation conducted a paleontological survey for the Jane Dough Unit. The survey did not identify any vertebrate fossils or strata that might contain such. Some invertebrate fossils were discovered. (Uranerz, 2014a)

3.10 Visual and Scenic Resources

This section focuses on updates to the description of the visual and scenic resources presented in the Nichols Ranch ISR SEIS (NRC, 2011b) that are applicable to the Jane Dough Unit. Updates to the visual and scenic resource area information include surface features and proximity to the Pumpkin Buttes. Additional descriptions of visual and scenic resources are available in the Nichols Ranch SEIS Section 3.10.

In general, this region of the PRB where the Jane Dough Unit is located is characterized as basin and range country with prominent buttes and ridges interspersed by rolling grasslands (NRC, 2011b). The Jane Dough Unit is relatively flat with gently rolling hills and low ridges that drain north toward Cottonwood Creek, which borders the northern portion of the unit, and southwest toward Seventeenmile Creek, which traverses the southwest corner of the unit. There are no parks, recreation areas, wilderness areas, or residential areas within the Jane Dough Unit. As previously stated, the Jane Dough Unit is located approximately 9.7 km [6.0 mi] west of South Butte, and about 9.6 km [6 mi] west of the Pumpkin Buttes, which is beyond the 3.2 km [2 mi] radius stipulated in the PA between BLM and the WY SHPO (see Nichols Ranch SEIS for further details) (NRC, 2011b). Segments of the historic Bozeman Trail and historic Deadwood Road are located within the Jane Dough Unit (Uranerz, 2014a). These segments of the Bozeman Trail and Deadwood Road are eligible for listing on the NRHP as contributing to their historical significance (see EA Sections 3.9 and 4.9).

BLM has conducted a Visual Resource Inventory that is described in the Buffalo Field Office Final Resource Management Plan and Environmental Impact Statement (BLM, 2015). As part of this inventory, the BLM completes a scenic quality evaluation, a sensitivity-level analysis, and a delineation of distance zones to group areas into one of four Visual Resource Management (VRM) classes. Class I is the most protected of visual and scenic resources, and Class IV is the least restrictive. VRM Class III provides for moderate landscape change where activities may attract attention but should not dominate the view. Management activities may dominate the view in VRM Class IV areas (BLM, 2015). The majority of the Jane Dough Unit is classified as Class IV, and a portion of the southwest corner of the unit (T45N R67W Sections 30, 31, and 32) is classified as Class III due to the historic Bozeman Trail (BLM, 2015).

3.11 Socioeconomics

This section focuses on updates to the description of the socioeconomic resources presented in the Nichols Ranch ISR SEIS (NRC, 2011b) that are applicable to the Jane Dough Unit. Updates to the socioeconomic resource area information include changes to demographics, income, and housing data. Additional descriptions of socioeconomic resources in the region are available in the Nichols Ranch SEIS Section 3.11.

General socioeconomic factors associated with this region are described in GEIS Section 3.3.10 (NRC, 2009). The socioeconomic region of influence (ROI) is defined by the area where employees and their families would reside, spend their income, and use their benefits, thereby affecting the economic conditions of the region. The NRC staff previously determined for the

then-proposed Nichols Ranch ISR project that because most employees would reside near the ISR facility, the most significant impacts of plant construction and operations are likely to occur in Campbell and Johnson Counties (NRC, 2011b). The NRC staff described demographics using 2000 census data, income, housing, employment structure, local finance, education, and health and social services within the ROI for the Nichols Ranch ISR Project (NRC, 2011b).

Within 98 km [61 mi] of the Jane Dough Unit, the population is centered in the Wyoming communities of Gillette and Casper. The communities of Wright, Edgerton, Midwest, Kaycee, and Buffalo are also located within 98 km [61 mi] of the Jane Dough Unit. These cities provide public services, such as schools, churches, medical care facilities, and commodities. The populations of Campbell and Johnson Counties grew between the years 2000 and 2010 by 37 percent and 21 percent, respectively (USCB, 2016). The largest population changes of cities in the area occurred in Gillette, which grew 48 percent between 2000 and 2010, and Wright, which grew 34 percent. Other cities in the area have grown between 5.6 and 17.6 percent. The town of Midwest declined in population by 1 percent between 2000 and 2010 (USCB, 2016). Persons self-designated as minority individuals in Campbell and Johnson Counties increased about 8.7 and 2.5 percent, respectively, between 2000 and 2010 (USCB, 2016). The 2010 minority population in Campbell and Johnson Counties (14.7 and 6.7 percent, respectively) is composed largely of Hispanic or Latino residents and is lower than the minority population for the state of Wyoming (18.2 percent).

The NRC staff reviewed the most recent estimates (2010 to 2014) for median household income, per capita income, and vacant housing units, which were above the Wyoming average in Campbell County and lower than the Wyoming average in Johnson County (USCB, 2016). Approximately 25 percent of the workforce in Campbell County and 21 percent of the workforce in Johnson County are employed in the agriculture, forestry, fishing and hunting, and mining sectors. Both Johnson and Campbell Counties have less than the Wyoming percentage of families (8 percent) and individuals (11.6 percent) living below the poverty level. Tax structures, school districts, and health care facilities in the ROI are described in the Nichols Ranch ISR SEIS (NRC, 2011b).

3.12 Public and Occupational Health

This section focuses on updates to the description of public and occupational health presented in the Nichols Ranch ISR SEIS (NRC, 2011b) that are applicable to the Jane Dough Unit. This section summarizes the natural background radiation levels in and around the Jane Dough Unit. Descriptions of background radiation levels are known as “preoperational” or “baseline” radiological conditions and support the evaluation of environmental impacts. This section also describes applicable safety criteria and radiation dose limits that have been established for protection of public and occupational health and safety. Additional descriptions of public and occupational health are available in the Nichols Ranch SEIS Section 3.12.

Radiation dose is a measure of the amount of ionizing energy that is deposited in the body. Ionizing radiation is a natural component of the environment and ecosystem, and members of the public are exposed to natural radiation continuously. Radiation doses to the general public occur from radioactive materials found in the Earth’s soils, rocks, and minerals. Naturally occurring low levels of uranium and radium are also found in drinking water and foods. Cosmic radiation from outer space is another natural source of exposure and ionizing radiation dose. In addition to natural sources of radiation, there are artificial or manmade sources, such as medical diagnostic procedures, that contribute to the dose the general public receives. The National Council on Radiation Protection and Measurements (NCRP) (2009) estimates that the

annual average dose to the public from all natural background radiation sources (terrestrial and cosmic) is {3.1 millisieverts (mSv) [310 millirem (mrem)]}. Due to the increase in medical imaging and nuclear medicine procedures, the annual average dose to the public from all sources (natural and human made) is 6.2 mSv [620 mrem] (NCRP, 2009).

In accordance with NRC regulations in 10 CFR Part 40, Appendix A, Criteria 7 and 7A, the licensee developed and implemented a preoperational monitoring program to establish baseline radiological conditions at the Jane Dough Unit (Uranerz, 2014a,b). In 2010 and 2011, the licensee performed radiological surveys and sampling, as applicable, of soils, air, surface water, groundwater, and biota at the Jane Dough Unit (Uranerz, 2014a,b). The licensee then supplemented or revised surveys and sampling, as applicable, in response to NRC requests for additional information (Uranerz, 2016a). In particular, to address a condition related to the Nichols Ranch license, Uranerz collected additional onsite meteorological data that changed the prevailing wind direction they used to determine air monitoring locations for the Jane Dough Unit. In response to an NRC request for additional information about the effect of the change in the prevailing wind direction, the licensee committed to changing the location of three Jane Dough Unit air monitoring stations and recording two additional quarters of particulate, radon, direct gamma, and soil results at these locations prior to operation of the Jane Dough Unit if the amendment is granted (Uranerz, 2016a; 2014c).

The licensee followed guidance in NUREG–1569 (NRC, 2003b), NUREG–1748 (NRC, 2003a), and NRC Regulatory Guide 4.14 (NRC, 1980b), as applicable (Uranerz, 2014a,b). Results of this baseline radiological monitoring are summarized in the following paragraphs. These results provide data on radiological conditions that are used to evaluate impacts in Chapter 4. Additionally, baseline monitoring data allow NRC safety staff to evaluate potential changes in future site conditions from routine facility operations or accidental or unplanned releases, if an NRC license for the proposed amendment is issued.

The ambient gamma radiation survey found mean radiation levels in surface soils and sediments that are generally consistent with the background radiation for Wyoming reported in the Nichols Ranch SEIS of 15 µR/hr (NRC, 2011b). Surface soil gamma measurements ranged from 13 to 16 µR/hr with a mean of 15 µR/hr in surface soils and 14 to 18 µR/hr with a mean of 16 µR/hr in surface water drainage sediments. The ranges and mean gamma radiation levels are slightly higher than comparable measurements evaluated in the Nichols Ranch SEIS (NRC, 2011b). The licensee found no consistent correlations of elevated gamma readings with measured soil concentrations of radium-226, uranium, thorium-230, and lead-210. The NRC staff considers the absence of correlations between the gamma readings and soil concentrations at these low gamma radiation levels near background to be within expectations.

The surface soil sampling to a depth of 15 centimeters(cm) [6 inches (in)] found the average concentrations of uranium were less than 1.37 milligrams per kilogram (mg/kg) while radium-226, thorium-230, and lead-210 values were less than or equal to 0.037 Becquerels per gram (Bq/g) [1.0 pCi/g] and therefore within the range of expected background values and consistent with comparable measured values for Nichols Ranch Unit (NRC, 2011b; Uranerz, 2014a).

The subsurface soil sampling {to a depth of 0.9 m [3 ft]} found the average concentrations of uranium for all depth ranges sampled down to a depth of 36 in [91 cm] were less than or equal to 2.02 mg/kg [2.02 ppm] while radium-226, thorium-230, and lead-210 subsurface averages were less than 0.037 Bq/g [1.0 pCi/g]. The subsurface uranium average concentration was somewhat elevated due to a single measure that was much larger than other measurements.

Overall, the subsurface concentrations were consistent with the NRC staff expectations for background values reported for Nichols Ranch (NRC, 2011b; Uranerz, 2014a).

The drainage basin sediment sampling found that the average concentrations of uranium, radium-226, thorium-230, and lead-210 concentrations were generally consistent with comparable average values reported for Nichols Ranch and Hank Units in the licensee's environment report (ER) (Uranerz, 2014a) and expected background concentrations, with a few exceptions. Two samples had uranium concentrations of 8.93 mg/kg [8.93 ppm] and 9.21 mg/kg [9.21 ppm], which are well above other Jane Dough Unit sediment samples and expected background values. Several lead-210 sediment measurements above normal background of 0.037 Bq/g [pCi/g] for Jane Dough Unit elevated the average concentration to 0.059 Bq/g [1.6 pCi/g], which is higher than the averages for Nichols Ranch Unit at 0.048 Bq/g [1.3 pCi/g] and Hank Unit at 0.037 Bq/g [1.0 pCi/g]. While radium values were within expectations for Jane Dough Unit at 0.03 Bq/g [0.8 pCi/g], the previous Nichols Ranch Unit survey results that were evaluated in the Nichols Ranch SEIS included a number of values above background concentrations of 0.037 Bq/g [1 pCi/g], resulting in a mean value of 0.36 Bq/g [9.6 pCi/g]. The licensee could not explain the reason for increased variability in the sediment sampling relative to the other radiological surveys, but noted that the overall history of the three units was similar (Uranerz, 2014a).

The quarterly radon-222 air sampling found the average airborne radon-222 concentrations to be generally consistent with the expected background previously considered in the Nichols Ranch SEIS of approximately 30 Becquerels per cubic meter (Bq/m^3) [0.8 picocuries per liter (pCi/L)] for this region of Wyoming (based on historic data from the Power Resources, Inc. (PRI) North Butte ISR Project), though higher than the U.S. average of 15 Bq/m^3 [0.4 pCi/L] (EPA, 2012). The Jane Dough Unit survey showed the highest average radon-222 concentrations of 37 Bq/m^3 [1 pCi/L] occurred during warmer and drier months and the lowest mean radon-222 concentration of 11 Bq/m^3 [0.3 pCi/L] occurred during winter months during cold, snowy conditions (Uranerz, 2014a). The licensee noted a similar trend in results for Nichols Ranch and Hank Units (Uranerz, 2014a).

The quarterly ambient gamma exposure rate measurements resulted in an annual Jane Dough Unit average for all sampling sites of 0.383 mSv [38.3 mrem] (Uranerz, 2016a). This average gamma exposure rate is less than the comparable averages for Nichols Ranch Unit of 0.425 mSv [42.5 mrem] and the Hank Unit of 0.454 mSv [45.4 mrem] (Uranerz, 2016a). For context, as previously noted, the annual average dose to the public from all natural background radiation sources (terrestrial and cosmic) is 3.1 mSv [310 mrem] (NCRP, 2009).

The licensee's quarterly air particulate monitoring results showed all airborne concentrations of uranium, radium-226, thorium-230, and lead-210 were well below the NRC 10 CFR Part 20 effluent concentration limits (Uranerz, 2014b).

The NRC staff review of the licensee's surface water sampling results (Uranerz, 2016a) found that all measured concentrations of uranium and radium-226 were below EPA MCLs, except a value of 0.137 mg/L (137 parts per billion, or ppb) natural uranium measured at the Cottonwood U Nichols location, which is above the 30 ppb EPA MCL for uranium.

The quarterly regional baseline groundwater quality sampling of 31 wells in and adjacent to the proposed wellfields found that concentrations of natural uranium, combined radium-226 and radium-228, and gross alpha activity exceeded the EPA MCLs in 45 percent, 12 percent, and

66 percent of the measurements, respectively. Many but not all of the elevated readings were in the ore zone aquifer or near wellfield areas.

Vegetation samples taken from grazing areas, nearest residences, and at air monitoring sites showed uranium, radium-226, thorium-230, and lead-210 concentrations that were consistent with or below previously sampled baseline values for Nichols Ranch or Hank Unit (Uranerz, 2014a). No fish sampling was conducted based on the lack of available habitat (Uranerz, 2014a).

Regarding the protection of public health and safety, the NRC has the statutory responsibility, pursuant to the Atomic Energy Act of 1954, as amended by the Uranium Mill Tailings Radiation Control Act, to protect the public health and safety and the environment. NRC's regulations at 10 CFR Part 20 specify annual dose limits to members of the public of 1 mSv [100 mrem] total effective dose equivalent (TEDE) with no more than 0.02 mSv [2 mrem] in any 1-hour period from any external sources. This public dose limit from NRC-licensed activities is a fraction of the background radiation dose, as discussed in Section 3.12.1.

A review of the surrounding area indicated that there are several ISR facilities within 80 km [50 mi] of the Jane Dough Unit (NRC, 2011b; Uranerz, 2014a):

- Smith Ranch–Highland—this operational ISR facility is located approximately 70 km [44 mi] southeast of the Jane Dough Unit.

- Moore Ranch—this recently licensed but not yet operational ISR facility would be located approximately 18 km [11 mi] southeast of the Jane Dough Unit.

- Nichols Ranch and Hank Units—these NRC licensed ISR facilities are located to the immediate north (Nichols Ranch Unit) and approximately 6.8 km [4.2 mi] northeast (Hank Unit) of the Jane Dough Unit. The Nichols Ranch Unit is operational and contains the CPP for the Jane Dough Unit. The Hank Unit has not yet been constructed.

- Willow Creek facilities—these NRC licensed and operating ISR facilities are located approximately 13 km [8 mi] north (Willow Creek Christensen Ranch) and 26 km [16 mi] northwest (Willow Creek Irigaray) of the Jane Dough Unit.

- North Butte and Ruth—these NRC licensed but not operating satellite ISR facilities are located approximately 13 km [8 mi] northeast and 18 km [11 mi] southwest of the Jane Dough Unit.

- Reynolds Ranch—this NRC licensed but not operating satellite ISR facility is located 67 km [42 mi] south of the Jane Dough Unit.

Several inactive and decommissioned conventional uranium mills are in the 80-km [50-mi] radius. However, because of their relative distances, none of these projects are considered to represent an appreciable source of radiation exposure in or around the Jane Dough Unit. Therefore, the natural background represents the only radiation exposure to individuals in the area surrounding the Jane Dough Unit. Other than CBM activities, there are no major sources of nonradioactive, chemical releases to the atmosphere or water-receiving bodies in the immediate area surrounding the Jane Dough Unit.

The public health in a region is assessed by reviewing health studies conducted in the region over a period of time. Neither the licensee nor the NRC staff identified health studies about radiological and chemical exposures in the vicinity of the Jane Dough Unit.

Regarding the protection of workers, the occupational health and safety concerns and protections that apply to the Jane Dough Unit would be the same as those previously considered in the Nichols Ranch SEIS (NRC, 2011b) because the proposed activities would be similar (i.e., the construction, operation, aquifer restoration, and decommissioning of additional production units once the previously licensed Nichols Ranch production units have completed production). Radiation Protection Standards at 10 CFR Part 20 provide limits on worker exposure to radiation and incorporate the principal of maintaining doses "as low as is reasonably achievable" (ALARA), taking into consideration the purpose of the NRC licensed activity and its benefits, technology for reducing doses, and the associated health and safety benefits. Radiation safety measures that comply with these 10 CFR Part 20 standards must be implemented at ISR facilities to protect workers and to ensure radiation exposures and doses are below occupational limits as well as ALARA.

Industrial hazards and exposure to nonradioactive pollutants are also of concern with respect to occupational health and safety, which for an ISR operation can include common industrial airborne pollutants associated with service equipment (e.g., vehicles), fugitive dust emissions from access roads and wellfield activities, and various chemicals used in the ISR process. Industrial safety aspects associated with the use of hazardous chemicals at the Jane Dough Unit would be regulated by the State of Wyoming. The types of chemicals and impacts are discussed in EA Section 4.12.

3.13 Waste Management

This section focuses on updates to the description of the waste management presented in the Nichols Ranch ISR SEIS (NRC, 2011b) that are applicable to the Jane Dough Unit. This section describes the environment that could potentially be affected by the disposition of liquid and solid waste streams generated by the Jane Dough Unit. Additional descriptions of waste management resources are available in the Nichols Ranch SEIS Section 3.13.

Liquid wastes generated directly or indirectly from the Jane Dough Unit would include well development and well test waters, storm water, sanitary wastewater, and liquid byproduct material. As described in Chapter 2, the NRC staff expects that the licensee would obtain a WDEQ WYPDES permit to discharge well development water into mud pits adjacent to drilling pads on each wellfield that is constructed. Liquid wastes and management activities associated with the processing of Jane Dough Unit solutions were previously described in the license application for the Nichols Ranch ISR Project (Uranerz, 2007) and the NRC SEIS (NRC, 2011b). The licensee manages storm water in accordance with a WDEQ WYPDES permit and storm water pollution prevention plan. The licensee disposes of sanitary wastewater from restrooms and lunchrooms in a WDEQ-permitted septic system.

The licensee disposes of liquid byproduct material from the Nichols Ranch ISR Project using Class I deep disposal wells, as described in EA Chapter 2. The licensee has been authorized by WDEQ to drill, complete, and operate eight Class I deep disposal wells, four at the Nichols Ranch Unit and four at the Hank Unit, and thereby inject radionuclide-bearing liquid waste streams into the Cretaceous Teckla, Teapot, and Parkman Sandstones (WDEQ, 2012a).

The permit states that fluid is injected into these sandstones at depths of approximately 2,338 to 2,645 m [7,670 to 8,675 ft] below ground surface at the Nichols Ranch Unit and depths of approximately 2,366 to 2,634 m [7,760 to 8,640 ft] below ground surface at the Hank Unit. The permit also states that the average daily injection rate would not exceed a total of 568 Lpm [150 gpm] for the Nichols Ranch Unit Class I deep disposal well(s). The same average daily injection total rate of 568 Lpm [150 gpm] applies for the Hank Unit Class I deep disposal well(s) (WDEQ, 2012a). The permit classifies the groundwater within the Teckla, Teapot, and Parkman aquifers as unusable/unsuitable, in accordance with Wyoming regulations, because the depth and location makes the use of water economically and technologically impractical. To date, two Class I deep disposal wells have been constructed and authorized to inject at the Nichols Ranch Unit (WDEQ, 2013b, c).

Solid wastes generated either directly or indirectly from the Jane Dough Unit would include solid byproduct material, nonhazardous solid waste, and hazardous waste.

Solid byproduct material (including radioactively contaminated soils or other media) that does not meet NRC unrestricted release criteria must be disposed of at a licensed facility, as required by 10 CFR Part 40, Appendix A, Criterion 2. As described in Chapter 2, the proposed action would generate solid byproduct material that does not meet NRC criteria for unrestricted release. As required by their NRC license, the Nichols Ranch ISR Project has an agreement in place with a facility licensed to dispose of solid byproduct material.

All proposed phases of the Jane Dough Unit would directly or indirectly generate nonhazardous solid waste. The licensee has proposed to dispose of nonhazardous solid waste offsite in a WDEQ-permitted municipal landfill. The nearest municipal solid waste facility is the Campbell County landfill in Gillette, Wyoming {approximately 74 km [46 mi] north of the Jane Dough Unit}. The NRC staff estimates that the Campbell County landfill has the capacity to dispose of nonhazardous solid waste and construction and demolition waste for approximately 18 years after year 2014. This estimate is based on the available capacity the operator provided in 2010 (CCPW, 2010) and the additional capacity consumed since that time (CCPW, 2014). The current projected average annual rate of nonhazardous solid waste received at the landfill is 50,377 tonnes per year (t/yr) [55,566 tons per year (T/yr)]; with approximately 73 percent municipal solid waste and 27 percent construction and demolition waste (CCPW, 2014). The NRC staff converted the average annual rate of waste received of 50,377 t/yr [55,566 T/yr] to a volume of 106,280 cubic meter (m^3) [138,900 cubic yard (yd^3)] by applying a density factor of 0.36 t/m^3 [0.4 T/yd^3] (Wyoming Office of State Lands and Investments, 2007). The annual amounts of waste received at waste facilities are provided in EA Section 4.13 to show how the Jane Dough generation rate compares with the regional generation from other sources in the impact analysis.

The licensee would develop and implement waste management programs to meet the applicable WDEQ-Solid and Hazardous Waste Division regulatory requirements. All wastes generated from these materials would be handled and disposed in accordance with applicable federal and state regulations. The licensee would not generate mixed waste from any of the proposed waste management options. Mixed waste consists of a mixture of hazardous waste (as defined by the Resource Conservation and Recovery Act) and radioactive waste (as defined by the Atomic Energy Act).

4 ENVIRONMENTAL IMPACTS

4.1 Introduction

The Jane Dough Unit is a proposed expansion of the Nichols Ranch In Situ Recovery (ISR) Project, for which Uranerz Energy Corporation (Uranerz, herein referred to as the licensee) received a license for in 2011. However, the Jane Dough Unit is a separate area that was not analyzed in the Nichols Ranch ISR Supplemental Environmental Impact Statement (SEIS) (NRC, 2011b). In some instances, impact assessments may be the same or similar to those analyzed for the Nichols Ranch ISR Project because of the proximity of the Jane Dough Unit to Nichols Ranch and the similarity of planned activities. Therefore, impact assessments discussed in detail in this chapter have been limited to activities that are either site-specific to the Jane Dough Unit or activities within the resource area that have impact assessments different from those evaluated under the original Nichols Ranch ISR Project license. For more information about the impact assessments for the Nichols Ranch ISR Project, see NUREG–1910, Supplement 2 "Environmental Impact Statement for the Nichols Ranch Project in Campbell and Johnson Counties, Wyoming, Supplement to the Generic Environmental Impact Statement for *In-Situ* Leach Uranium Milling Facilities" (NRC, 2011b).

This chapter analyzes the four lifecycle phases of ISR uranium extraction (i.e., construction, operations, aquifer restoration, and decommissioning) for the proposed Jane Dough Unit for the resource areas described in Chapter 3 of this environmental assessment (EA). The resource areas described in this chapter include land use; transportation; geology and soils; water resources; ecology; meteorology, climatology, and air quality; noise; historic and cultural resources; scenic and visual resources; socioeconomics; public and occupational health; and waste management practices.

The NRC established a standard of significance for assessing environmental impacts in the conduct of environmental reviews based on the Council of Environmental Quality (CEQ) regulations, as described in the NRC guidance in NUREG–1748, Environmental Review Guidance for Licensing Actions Associated with NMSS Programs (NRC, 2003a) and summarized as follows:

SMALL: The environmental effects are not detectable or are so minor that they would neither destabilize nor noticeably alter any important attribute of the resource considered.

MODERATE: The environmental effects are sufficient to alter noticeably but not destabilize important attributes of the resource considered.

LARGE: The environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource considered.

EA Table 2-1 contains a summary of the impact findings for the proposed Jane Dough Unit expansion compared to the No-Action Alternative. In 40 CFR 1508.9, the Council on Environmental Quality defines an EA as a concise public document that briefly provides sufficient evidence and analysis for determining whether to prepare an environmental impact statement (EIS) or a finding of no significant impact (FONSI). As previously stated in EA Chapter 2, although impacts may exist, the impacts will not be significant. An impact that is not significant does not equate to no impact (NRC, 2003a).

4.2 Land Use

Potential environmental impacts to land use at the Jane Dough Unit may occur during all phases of the facility lifecycle. Impacts could include land disturbance from construction and decommissioning, grazing, and access restrictions.

Disturbance from construction-related activities related to the Jane Dough Unit would affect approximately 41 hectares (ha) [101 acres (ac)] of the land. The Jane Dough Unit wellfields would be fenced off during construction to prevent unauthorized entry. Additionally, all land within the Jane Dough Unit is privately owned land with restricted access. In addition, there are no developed recreational sites or facilities within the Jane Dough Unit.

Construction activities include potential development of access roads, development of two wellfields, and pipeline installation. Land disturbance caused by construction of access roads would be minimized by utilizing existing roads within the Jane Dough Unit. To ensure minimal land use impact if new roads are needed, the construction designs for the roads would consider how to best optimize parameters such as drainages, elevation contours, location, and land rights. Wellfield construction would include well development, pipeline construction, header house construction, and lateral pipeline placement. During construction, these activities would have a minimal impact on erosion (NRC, 2011b).

The NRC staff concludes that the land use impacts for the addition of the Jane Dough Unit would be SMALL. This conclusion is based on the following factors: (i) the types of land use activities the licensee proposes are similar to those evaluated in the Nichols Ranch Supplemental Environmental Impact Statement (SEIS) (NRC, 2011b); (ii) the addition of the Jane Dough Unit would disturb 41 ha [101 ac] of land, which is at the small end of the 50 to 750 ha [120 to 1,860 ac] range analyzed in the Generic Environmental Impact Statement (GEIS) (NRC, 2009); and (iii) all the land within the Jane Dough Unit is privately owned land with restricted access, and (iv) impacts from road, wellfield, and pipeline construction would be temporary (i.e., the construction phase timeframe).

Operations at the Jane Dough Unit would take an estimated 5 to 6 years to extract uranium from the two production units. The wellfields in each production unit would be developed in sequence, moving west to east. Livestock grazing would continue to be restricted around each wellfield during the operations phase (Uranerz, 2014a). However, no additional land disturbance would occur from conducting operational activities; therefore, the NRC staff concludes that land use impacts during operations would be SMALL.

Activities during aquifer restoration would use the same infrastructure as during the operations phase. As aquifer restoration proceeds and wellfields are closed, with fewer wells and header houses being used, onsite activities would diminish. Land use impacts from aquifer restoration at the Jane Dough Unit would be similar to operational impacts. No additional land disturbances or withdrawals would occur during the aquifer restoration phase. Therefore, the NRC staff concludes that land use impacts from aquifer restoration would be SMALL.

During the decommissioning phase, the disturbed area from the two Jane Dough Unit wellfields and access roads (those not taken over by the land owner) would progressively decrease. Land would be reseeded and soil replacement would occur primarily where the header houses and roads were removed (Uranerz, 2016a). Because vegetation would be reestablished in reclaimed areas, the NRC staff concludes that the land use impacts from decommissioning activities would be SMALL.

After ISR activities are completed, the wellfields and all disturbed areas would be reclaimed and potentially approved for livestock grazing by the Wyoming Department of Environmental Quality (WDEQ) – Land Quality Division (LQD). If approved by WDEQ–LQD, the project-related fencing would be removed, forage production would return as permanent vegetation is reestablished, and livestock grazing would be allowed, in accordance with the approved reclamation standards (NRC, 2011b).

Under the No-Action Alternative, the Jane Dough Unit would not be licensed, and there would be no associated construction, operation, aquifer restoration, or decommissioning; therefore, the land would remain available for uses such as grazing, coalbed methane (CBM) production, and oil and gas production. No wells would be drilled, no pipeline would be laid, and no new access roads would be constructed. Access restrictions would continue to be in place because the land is all privately held. Uranium ISR activities for the Nichols Ranch ISR Project would continue under the existing license. Potential land use impacts from those activities were previously analyzed in the Nichols Ranch SEIS (NRC, 2011b).

4.3 Transportation

Slight increases in traffic would be generated by ISR construction activities (relative to local traffic counts) but these activities would not significantly increase traffic or accidents on many of the roads in the region (NRC, 2009). Due to the potential commuting distance {ranging from 35 kilometers (km) [22 miles (mi)] to 98 km [61 mi]}, if the maximum estimated number of workers during the construction phase (55 employees) were to commute to the Jane Dough Unit individually on the same road, there is a potential risk to employees of fatigue, injury to wildlife, and encountering adverse weather conditions (Uranerz, 2014a). However, the NRC staff and the licensee anticipate that the number of employees commuting to the Jane Dough Unit independently would be less than 55 due to the licensee carpooling program. Also, the NRC staff expects that commuting workers would come from a variety of locations and would not all commute on the same road, although access to the site is limited to either via Wyoming State Highway 50 to Van Buggenum Road to T-Chair Livestock ranch roads, or from U.S. Highway 387 north on Iberlin Road.

The licensee has stated that the trip frequency to the Jane Dough Unit would be approximately eight passenger vehicles per day (e.g., standard, light-duty, and 3/4-ton trucks; passenger vans; or personal cars) and six tractor-trailers per week (Uranerz, 2014a). This is similar to the transportation parameters analyzed in the Nichols Ranch ISR SEIS (NRC, 2011b). In addition, the licensee anticipates using the same or similar numbers of workers for all phases of the Jane Dough Unit; and, workers would mostly likely commute from the same locations as analyzed in the Nichols Ranch ISR SEIS (Uranerz, 2014a; 2016). The timeframe for the Jane Dough Unit would be approximately 14 years and is expected to start as activities at the Nichols Ranch ISR Project area decline. Therefore, project activities would transition between the Nichols Ranch Unit and the Jane Dough Unit, resulting in consistent traffic volume. Based on the low-traffic volume during the construction phase and the results of the analysis in the Nichols Ranch ISR SEIS (NRC, 2011b) and subsequent NRC license, the NRC staff concludes that the impacts from transportation during construction would be SMALL.

The licensee's trip frequency would be the same during operations and construction; therefore, the amount of traffic from the Jane Dough Unit that would be added to existing traffic counts on local highways during operations would be the same as that described for the construction phase. The Jane Dough Unit would contain only wellfields [i.e., no central processing plant (CPP)]; therefore, radiological traffic accidents would be associated with transportation activities

at the Nichols Ranch Unit, which were analyzed in the Nichols Ranch ISR SEIS (NRC, 2011b). The risk associated with those accidents does not increase with the addition of the Jane Dough Unit; only the time duration over which they could occur changes, due to the increased timespan of the license. Based on the low volume of traffic, the small increase in traffic from commuting workers, and the low radiological risks from transportation accidents, the NRC staff concludes that the overall impacts from transportation during the operations phase would be SMALL.

During the aquifer restoration phase at the Jane Dough Unit, the rate of uranium extraction would gradually decrease, resulting in a reduction in supply shipments. Additionally, the trip frequency to the Jane Dough Unit would be lower during the aquifer restoration phase compared to the operations phase, because the number of process chemicals and resin transfers would be less than when the Jane Dough Unit would be in production (NRC, 2011b). Also, fewer people would be employed during the aquifer restoration phase, relative to the construction and operations phases (Uranerz, 2016a). Therefore, based on the above factors, the NRC staff concludes that the impacts from transportation during aquifer restoration would be less than during the construction and operations phases, and also SMALL.

Transportation activities during decommissioning would include transporting construction equipment and workers to and from the wellfields, and transporting waste material shipments to offsite disposal facilities. The volume of onsite traffic at the Jane Dough Unit would depend on the need for radiological surveys, extraction of buried pipelines, well abandonment, reclamation of disturbed areas, removal of contaminated materials, and monitoring of the restored Jane Dough Unit.

Waste materials generated during decommissioning would be segregated by type and transported offsite to approved disposal facilities. Nonhazardous solid waste would be shipped to the local landfill, and solid byproduct material would be shipped to an authorized facility which accepts byproduct material for disposal. For waste volumes associated with decommissioning, see EA Section 4.13.

Any new roads constructed to access the wellfields may remain in place during and after decommissioning. Landowners would be allowed to determine whether the new roads would be kept in place or reclaimed. Additionally, these roads may remain in use for some period after decommissioning to facilitate monitoring. Due to the limited travel on access roads the NRC staff concludes that impacts during the decommissioning phase would be SMALL.

Under the No-Action Alternative, the Jane Dough Unit would not be licensed, and there would be no associated construction, operation, aquifer restoration, or decommissioning; therefore, there would be no transportation of workers or materials to and from the Jane Dough Unit to support licensed activities. There would be no transportation of either radioactive or solid waste attributable to the addition of the Jane Dough Unit, because the additional unit would neither be licensed nor constructed and operated. Traffic volumes associated with current land use activities such as CBM extraction, oil and gas extraction, and cattle ranching would continue into the future. Therefore, the No-Action Alternative would have no impacts to transportation.

4.4 Geology and Soils

Potential environmental impacts on geology and soils could occur during all phases of the Jane Dough Unit lifecycle; however, impacts would be most likely during the construction phase.

The principal impacts on geology and soils during construction would result from earthmoving activities associated with constructing access roads, wellfields, and pipelines. Earthmoving activities include clearing ground, removing topsoil, and preparing surfaces for well header houses, access roads, and drilling sites. Similarly, excavating and backfilling trenches for pipelines and cables may impact Jane Dough Unit soils. Earthmoving activities would be limited to a small portion of the project area. Consequently, such activities would result in SMALL and temporary (months) disturbance of soils, with impacts mitigated using best management practices (BMPs) (e.g., top soil salvaging). Construction activities would increase the potential for wind and water erosion, due to removal of vegetation and the physical disturbance from vehicle and heavy-equipment traffic. However, these activities would result in SMALL impacts, if equipment operators adopt construction BMPs that prevent or substantially reduce erosion (NRC, 2009).

WDEQ–LQD has established guidelines for topsoil and subsoil management at uranium ISR facilities (WDEQ, 2000). Soil impacts on the Jane Dough Unit would be limited to a total disturbed and reclaimed area of approximately 41 ha [101 ac] for the construction of two wellfields in two production areas and excavation of mud pits (associated with drilling), construction of access roads, and installation of pipelines (Uranerz, 2014a). The licensee's implementation of the following BMPs would mitigate potential impacts to soils temporarily disturbed by construction activities. Topsoil would be salvaged from new access roads and header house locations prior to construction and stored in stockpiles, in accordance with WDEQ requirements (Uranerz, 2014a,b). Topsoil removal from new access roads would be in accordance with the landowner's preferred road construction practices (Uranerz, 2014a). Topsoil stockpiles would be located in areas that are not predisposed to result in material loss from wind and water erosion (Uranerz, 2014a). The licensee would construct berms around topsoil stockpiles and seed them with a mix of western and thickspike wheatgrasses to reduce sediment runoff and wind erosion (Uranerz, 2014a). Disturbed soil areas would be reseeded during the first growing season following disturbance, and other soil protection measures would be used, as appropriate, including grading and contouring, placement of hay bales, culvert installation, or placement of water contour bars (Uranerz, 2014a). During mud pit excavation, the licensee would remove and stockpile topsoil and remove the subsoil, and deposit both next to the mud pit. After mud pit use is complete (usually within 30 days of excavation), the subsoil would be redeposited in the mud pit and the preserved topsoil would be replaced. The licensee would follow a similar topsoil salvage approach for pipeline ditch construction (Uranerz, 2014a). Only the smallest trenching operations would not preserve topsoil, unless specifically required by the landowner (Uranerz, 2014a). Salvaged and stockpiled topsoil would then be reapplied to reclaimed land surfaces and reseeded with a reclamation seed mixture that was developed through discussions with the landowner (Uranerz, 2014b).

In summary, based on the limited extent of the construction area, proposed topsoil stockpiling procedures, erosion control methods and BMPs (e.g., berms, seeding) that would be implemented, and the short duration of mud pit usage and pipeline construction activities, the NRC staff concludes that the potential environmental impact on soils from construction at the Jane Dough Unit would be SMALL. While construction impacts to soils would be SMALL, the NRC staff recognizes that alternative methods for managing drilling fluids are available, which the licensee could choose to implement, to further limit or mitigate potential impacts from mud pits, including lining mud pits with an impermeable membrane, disposal of drilling mud offsite, and use of portable tanks or tubs for containing drilling mud and other drilling fluids.

At the Jane Dough Unit, while removal of uranium from the A Sand during ISR operations would result in a permanent change to the composition of this uranium-bearing rock, the uranium

mobilization and recovery processes during operations and the groundwater sweep and recirculation processes during aquifer restoration would not result in the removal of rock matrix, production of void space, or changes to the rock structure of the A Sand. Therefore, no significant matrix compression or ground subsidence is expected to result in collapse of overlying geologic units (Uranerz, 2014a, 2015). Furthermore, with net fluid withdrawal (production bleed) of only 0.5 to 1.5 percent (average of 1 percent) in the A Sand (Uranerz, 2016a), it is unlikely that ISR operations could reactivate local faults and extremely unlikely for ISR operations to cause earthquakes (NRC, 2009). Therefore, the NRC staff concludes that the potential impact on geology from subsidence during the operations and aquifer restoration phases at the Jane Dough Unit would be SMALL.

During both operations and aquifer restoration phases, if a pipeline ruptures or fails, lixiviant or other solutions could be released to the soil environment and (i) pond on the surface, (ii) runoff into surface water bodies, (iii) infiltrate and adsorb into soil and rock, and (iv) percolate into shallow groundwater. Licensees are expected to establish immediate spill responses through onsite standard operating procedures (NRC, 2003b). As part of the monitoring requirements at ISR facilities, licensees must report spills to NRC within 24 hours. Licensees in the State of Wyoming must also comply with applicable WDEQ requirements for spill response and reporting (NRC, 2009). If soil were contaminated by a lixiviant or other spill, the licensee would remove the contaminated soil and dispose of it at a licensed disposal facility (Uranerz, 2014a). After decontamination, the licensee would conduct radiation surveys to confirm that soils had been remediated, in accordance with applicable NRC standards for unrestricted use (Uranerz, 2014a). The licensee has proposed a program to monitor wellfield and pipeline flow and pressure during the operations phase, as discussed in EA Section 6.1 to ensure timely detection of potential spills and minimize their volume (Uranerz, 2014a, 2015). Because of the requirement to immediately report spills at ISR projects, coupled with spill-recovery actions and the routine monitoring programs that would be implemented by the licensee, impacts to soils from potential spills would be SMALL.

Based on the depth of the ore zone {120 to 180 m [400 to 600 ft]} (Uranerz, 2015) and negligible impacts from the ISR process and groundwater sweep and recirculation processes on the host rock matrix, the NRC staff concludes that the potential environmental impact of operations and aquifer restoration on geology and soils would be SMALL.

Decommissioning activities would include (i) removing buried piping and (ii) plugging and abandoning wells, in accordance with accepted practices. The main impacts on geology and soils during decommissioning would be from land-reclamation activities and the cleanup of contaminated soils. Additional reclamation goals are to return the Jane Dough Unit to preproduction conditions and reestablish native vegetative communities. Disturbance and/or displacement of soils would be minimal due to the small total disturbed area {approximately 41 ha [101 ac]}. Removal of impervious surfaces on the Jane Dough Unit (e.g., well header houses) (Uranerz, 2015), would assist in returning the Jane Dough Unit to previous natural conditions.

Impacts on geology and soils would occur as decommissioning and reclamation progress; however, the outcome of these activities would be to return the Jane Dough Unit to its prior use of livestock grazing and wildlife habitat, natural resource extraction, and recreation. Soil impacts during decommissioning would be limited to a disturbed area of approximately 41 ha [101 ac] (Uranerz, 2014a), which is less than the low end of the range evaluated in the GEIS {50 to 750 ha [120 to 1,860 ac]} (NRC, 2009). Based on the temporary nature of the decommissioning impacts, the licensee's goal to decommission and reclaim the site to

preproduction conditions, and the magnitude of soil disturbance being less than the range evaluated in GEIS, the NRC staff concludes that the potential environmental impact on geology and soils from the decommissioning phase of the Jane Dough Unit would be SMALL.

Under the No-Action Alternative, the Jane Dough Unit would not be licensed, and there would be no associated construction, operation, aquifer restoration, or decommissioning; therefore, no soils would be disturbed by earthmoving activities associated with construction of access roads, wellfields, and pipelines, and no spills would occur. Geologic resources would be unaffected by the proposed action because no fluids would be injected into the subsurface. The current land uses affecting geology and soils on and near the Jane Dough Unit, which include grazing, natural resource extraction, and recreation, would continue with no environmental impact from the proposed action.

4.5 Water Resources

Potential environmental impacts on water resources may occur during all phases of the Jane Dough Unit lifecycle. This assessment is divided into two sections: (i) surface waters and wetlands (EA Section 4.5.1) and (ii) groundwater resources (EA Section 4.5.2). Impacts to surface waters and wetlands can result from road and wellfield construction, channel filling, road travel, soil erosion, surface water runoff, spills or leaks, and wellfield operations (NRC, 2009). Impacts to groundwater resources can result from spills or leaks (fuels, lubricants, and discharges of wellfield fluids from pipeline or wellhead leaks), consumptive water use (e.g., production bleed), horizontal and vertical excursions of lixiviant from the production aquifer (A or AB Sands), and water quality degradation and water chemistry impacts on the A and AB Sands and surrounding aquifers.

4.5.1 Surface Waters and Wetlands Impacts

Under the proposed action, soil disturbances from road construction, vehicular traffic, and wellfield construction, operations, and decommissioning could result in soil erosion and sediment transport during periods of ephemeral surface water flow. In addition, spills or leaks of fuels and lubricants, and discharges of wellfield fluids from pipeline or wellhead leaks could affect surface water quality. The potential environmental impacts on surface water, including Waters of the United States (WOTUS) pursuant to the Clean Water Act, including wetlands, from the construction, operations, aquifer restoration, and decommissioning phases are detailed in this section for the proposed action and No-Action Alternative.

Ephemeral Drainage Impacts

As described in EA Section 3.5.1, stream drainages within the Jane Dough Unit are ephemeral in nature and flow only in response to precipitation events and snowmelt. To minimize impacts to ephemeral drainages, Uranerz would implement BMP measures in accordance with WDEQ mining and construction permits and its WDEQ Wyoming Pollutant Discharge Elimination System (WYPDES) Permit No. WYR104331 (Uranerz, 2014a), which it plans to revise to include the Jane Dough Unit. The WYPDES permit would limit the amount of pollutants that could be discharged to surface water bodies, such as streams and wetlands. As part of the WYPDES permit, Uranerz would be required to develop a Storm Water Pollution Prevention Plan (SWPPP) that accounts for drainage topography, weather conditions, and stated landowner road construction preferences (Uranerz, 2014a,b) to control storm water runoff and to ensure that surface water runoff from disturbed areas meet WYPDES permit limits.

To minimize impacts to ephemeral drainages from sedimentation and soil erosion, the licensee would use the existing 20.3 km [12.6 mi] of roads (Uranerz, 2014b) within and surrounding the Jane Dough Unit (e.g., Iberlin Road, and CBM and oil and gas well access roads) to the extent possible (Uranerz, 2014a). However, Uranerz has indicated that it would construct new wellfield access roads for equipment delivery and to construct, operate, and decommission the two wellfields in the two production areas as needed (Uranerz, 2014a). When designing and constructing new roads, Uranerz would attempt to cross ephemeral drainages at right angles or along elevation contours to minimize soil erosion while using appropriately sized engineered culverts {46 cm [18 in] minimum} or diversion ditches to control runoff and pass a 25-yr peak runoff event (Uranerz, 2014a,b). Where a drainage has to be crossed but cannot at a right angle or along elevation contours, appropriate measures for erosion control would be implemented (Uranerz, 2014a). For example, the licensee stated that bare soil on steep slopes would be temporarily reseeded during the first spring or fall growing season following land disturbance using landowner- and WDEQ–LQD-approved seed mixtures to reduce surface water runoff (Uranerz, 2014a).

In addition to new access road construction, wellfield construction activities (i.e., drilling, well development, pipeline construction, header house construction, lateral pipeline placement) would also result in soil erosion. The licensee stated that when undertaking these activities, it would incorporate BMPs appropriate for the location and conditions under which construction activities are taking place, such as grading and contouring, reseeding steep topography, placement of hay bales or water contour bars, culvert installation, and sedimentation breaks (Uranerz, 2014a,b). Pipelines connecting the injection and production wells with the Nichols Ranch Unit CPP may cross ephemeral channels, including Cottonwood Creek. Pipelines would be installed below grade, backfilled after installation, and would not block surface water flow (Uranerz, 2014a).

The licensee would avoid constructing injection, production, and monitoring wells in channels and washes wherever possible to minimize damage from soil erosion and to avoid floodwater damage to wellfield infrastructure (Uranerz, 2016a); however, four minor drainages (potentially inundated during a 25-year flood), one crossing each wellfield, and the 25-year Cottonwood Creek floodplain may not be completely avoidable based on their spatial relationship to subsurface ore bodies. For example, several wells may be placed within an ephemeral channel crossing over the southeastern ore body in Production Unit #2 (Uranerz, 2015). In addition, an indeterminate but potentially greater number of wells may be placed in a flowing WOTUS channel crossing over the southwestern ore body in Production Unit #1 (Uranerz, 2014a). Likewise, ephemeral channels also cross above both northern wellfields. The licensee stated that anywhere surface runoff is impeded by wellfield infrastructure (including well header houses), engineered culverts and diversion ditches would be installed to maintain surface water flow through ephemeral drainages, control runoff, and prevent excessive soil erosion (Uranerz, 2014a). If surface runoff is concentrated in an area, BMPs such as energy dissipaters would be used to slow the flow so that erosion and sediment transport are minimized (Uranerz, 2014a). Wells constructed in an ephemeral drainage would be accompanied by appropriate erosion protection controls to minimize impacts to the drainage. Protection controls include but are not limited to grading and contouring, placement of hay bales or water contour bars, culvert installation, rocked low water crossings, and specifying designated traffic routes (Uranerz, 2014a,b). For example, traffic and activities within the drainage bottoms would be limited to those necessary for constructing and servicing the well(s) (Uranerz, 2014b). Wells constructed in drainages where runoff is likely to impact the wellhead would have added wellhead protection measures. Wellhead protection measures include placing barriers to surround the wellhead, such as protective steel casing or cement blocks (Uranerz, 2014a).

The use of heavy duty vehicles and machinery during construction and decommissioning may lead to spillage of fuels and lubricants. In addition, pipeline and wellhead leaks may lead to spills of process-related fluids during wellfield operations. When transported with surface runoff generated by local rainstorms and snowmelt events, such spills may cause water quality degradation to nearby receiving streams. Southwestern wellfield wells within the Seventeenmile Creek drainage basin would be located south of a drainage divide with very limited upland contributing areas (Uranerz, 2016a). Any spilled fluids in the Seventeenmile Creek basin might flow offsite after entering Seventeenmile Creek if the flow exceeds the infiltration rate along the wetted pathway (Uranerz, 2016a). Likewise, any spilled fluids in this wellfield on the northern side of the drainage divide might flow offsite to the Dry Fork tributary of the Powder River after entering a small unnamed ephemeral channel (Uranerz, 2014a). Wellfields within the Cottonwood Creek drainage basin also would have limited upland contributing areas. Any spilled fluids in the four minor drainage areas associated with the northwestern, northeastern, and southeastern wellfields would first flow down the channels in each drainage area prior to entering Cottonwood Creek, either onsite or offsite (Uranerz, 2014a). However, because surface water on the Jane Dough Unit is limited and surface water flow in drainages is ephemeral, there would be minimal potential for water quality degradation from spills of fuels, lubricants, and process-related fluids. Furthermore, the licensee's SWPPP would include an emergency response plan to identify and clean up accidental spills and leaks and monitoring requirements to identify and control any surface water contamination. The licensee's program for operational surface water monitoring is discussed in EA Section 6.4. Combined with BMP implementation, compliance with requirements of the licensee's WDEQ construction permit and WYPDES permits would protect surface water from excessive storm water discharges and minimize potential water quality impacts. Therefore the NRC staff concludes the impact on surface water resources would be SMALL.

Wetland Impacts

As described in EA Section 3.5.1, a single jurisdictional (i.e., WOTUS) wetland was identified within the Jane Dough Unit. This jurisdictional wetland crosses the western permit boundary of the Jane Dough Unit within the Seventeenmile Creek drainage area south of the southern ore bodies (Uranerz, 2014a), and therefore would not be disturbed by the proposed ISR activities. Approximately 91 meters [300 feet] of a delineated WOTUS is located inside the boundary of Production Unit #1, near the center of the southwestern ore body, in association with a groundwater-well-supplied wetland (see EA Section 3.5.1). This WOTUS may be disturbed by wellfield development and operations. Within Production Unit #1, its drainage channel is approximately 1.2 m [4 ft] wide, and disturbance may result in a maximum of 0.01 ha [0.027 ac] of impacts from activities such as pipeline installation and road construction (Uranerz, 2014a). The licensee stated that the potential impact to this WOTUS would be mitigated through implementation of BMPs specified in the Uranerz WYPDES storm water permit. Pipelines crossing this WOTUS would be installed below grade, backfilled after installation, and would not block surface water flow in this area (Uranerz, 2014a). In addition, appropriately sized culverts would be installed and BMPs would be implemented to mitigate the impacts of any new access roads crossing this WOTUS. Therefore, Uranerz's activities would comply with the specifications for U.S. Army Corps of Engineers (USACE) permits, and the licensee would prepare and submit an appropriate application to the USACE for such a permit, if required by USACE (Uranerz, 2014a). The NRC staff concludes that impacts to wetlands would be SMALL.

In summary, because of the limited areal extent of surface disturbances, the limited extent of surface water and wetlands and the licensee's commitment to implement BMPs, a SWPPP, and spill prevention and clean-up procedures, the NRC staff concludes that the potential impact on

surface water and wetlands in the Jane Dough Unit from construction, operations, aquifer restoration, and decommissioning activities would be SMALL.

Under the No-Action Alternative, there would be no impact on either surface water or wetlands from the Jane Dough Unit. The Jane Dough Unit would not be licensed, no associated infrastructure (i.e., access roads and pipelines) would be constructed, and no wellfields would be developed and operated. The current land uses affecting surface water would continue.

4.5.2 Groundwater Impacts

Under the proposed action, potential environmental impacts on groundwater at the Jane Dough Unit may occur throughout the project lifecycle, but impacts would primarily occur during operations and aquifer-restoration activities. ISR activities can impact aquifers immediately above and below the ore-bearing aquifer (A Sand) as well as surficial and deep aquifers. The potential environmental impacts on groundwater from construction, operations, aquifer restoration, and decommissioning are detailed in this section for the proposed action and the No-Action Alternative.

During wellfield construction and decommissioning, groundwater use would be limited to dust suppression, cement mixing, drilling support, well development, hydrologic testing, well abandonment, revegetation, and reclamation of disturbed areas. Uranerz has no plans to install water-supply wells at the Jane Dough Unit to support the project during construction and decommissioning (Uranerz, 2016a). Instead, Uranerz would use a water-supply well located near the Nichols Ranch CPP to provide water for consumptive use (Uranerz, 2016a). This water-supply well draws from a Fort Union aquifer located beneath the A Sand; the associated water right is permitted through the Wyoming State Engineer's Office (Uranerz, 2016a). Hydrologic testing at the Jane Dough Unit would require producing water from near-surface Wasatch Formation aquifers that could be affected by the project. Groundwater removed during well development and hydrologic testing would meet WDEQ–WDQ Class IV (Livestock) standards and be discharged to the surface in accordance with the licensee's approved WYPDES permit (Uranerz, 2014b). The WYPDES permit would protect surficial aquifers by limiting the discharge volume and by prescribing concentration limits to discharged waters. The NRC staff concludes that consumptive water use during construction and decommissioning would be SMALL.

During wellfield construction, the licensee would use mud pits to store drilling fluids and muds to manage the spread of fluids, minimize the area of contaminated soil, and enhance evaporation to reduce their volume (Uranerz, 2014a). The volume of drilling fluids and muds used during well installation would be limited. Introduction of drilling fluids to the surficial and underlying aquifers would occur during well drilling, but the NRC staff concludes that the potential environmental impact of these fluids to groundwater resources would be SMALL because mud pit footprints are small, volumes are limited, and drilling muds introduced downhole are designed to seal boreholes to set casing, thereby preventing vertical contamination across subsurface units.

During construction, the groundwater quality of surficial aquifers (e.g., the F and G Sands) would be protected by WDEQ–LQD and Water Quality Division (WQD) permit requirements and BMPs, including implementation of a WDEQ-approved spill prevention and cleanup program to prevent soil and near-surface groundwater contamination from construction equipment fuel and lubricant leaks (NRC, 2011b). The potential volume of stored fuels and lubricants within the Jane Dough Unit would be small, and leaks or spills would result in an immediate cleanup

response to prevent soil contamination and infiltration to the surficial aquifer. The NRC requirement for well mechanical integrity testing (NRC, 2003b; Uranerz, 2015) and similar requirements in the WDEQ underground injection control (UIC) permit No. 778 would also reduce the potential for well integrity failure induced surficial groundwater impacts during wellfield operations and aquifer restoration.

In addition, the surficial aquifers are not important domestic or agricultural water sources on the Jane Dough Unit. For example, the licensee's well survey indicates that of the 17 livestock wells located within a 0.8 km [0.5 mi] radius of the Jane Dough Unit permit boundary, none are screened in surficial aquifers. Furthermore, surficial aquifers in the Jane Dough Unit area are not hydraulically connected to local and regional water supply aquifers; rather, the alluvial, F, and G Sands are hydraulically separated from other important aquifers (Uranerz, 2015, 2016a).

Based on the depth to surficial groundwater in the Jane Dough Unit production units, lack of importance of the surficial aquifers for domestic and agricultural uses, and lack of hydraulic connection between the surficial groundwater and other important local and regional aquifers, the NRC staff concludes that wellfield operation impacts on the surficial aquifers at the Jane Dough Unit could be SMALL to MODERATE. However, required well mechanical integrity testing and implementation of the leak detection and spill correction program would mitigate potential impacts (i.e., early detection and cleanup) and result in SMALL impacts on alluvial, F, and G Sand surficial aquifers at the Jane Dough Unit.

Consumptive Water Use and Impacts to Local Wells

During wellfield operations and aquifer restoration, the licensee's consumptive use of groundwater would impact the Jane Dough production aquifer (i.e., A and AB Sands). During operations, consumptive use of ground water would average 1 percent, or 133 Lpm [35 gpm], of the 13,300 Lpm [3,500 gpm] licensed production flow rate at the Nichols Ranch Central Processing Plant. During restoration, the licensee estimated consumptive use would be higher and average about 387 Lpm [100 gpm] (Uranerz, 2016a). As described in the GEIS and Nichols Ranch SEIS, the impacts from groundwater consumptive use during restoration is generally greater than during ISR operations (NRC, 2009; NRC, 2011). The licensee's assessment of the total consumptive use volume, including operations and restoration of both the Nichols Ranch and Jane Dough Units, is about 3 billion liters [700 million gallons] or 2,200 acre-feet of water over the course of a 16-year period, or an annual average of about 170 million liters [45 million gallons] or 140 acre-feet (Uranerz, 2016a). By comparison, as explained in Section 4.2.4.2.3 of the GEIS, 230 acre-feet of water is needed to irrigate 21 ha [53 acres] in Wyoming for 1 year (Hutson et al, 2004).

Consumptive water use could also potentially impact local water users' groundwater outside the exempted aquifer zone by lowering hydraulic heads in wells completed in the A Sand or AB Sand. Significant drawdowns would potentially reduce flowing well yields both in the A Sand and in other hydraulically connected aquifers (e.g., B Sand). The licensee's drawdown predictions show that at a net pumping rate of 133 Lpm [35 gpm] for a period of 51 months, the potential drawdown from wellfield operations could reach 1.5 meters [5 feet] out to a distance of up to 8-km [5 miles] from the center of the Jane Dough Unit (Uranerz, 2016a). The licensee showed in Figure 3-12 of its technical report that production in the Jane Dough Unit will last eight years and not 51 months, as assumed by Uranerz in its drawdown predictions. In addition, restoration activities, which were not included in the licensee's drawdown predictions, will continue for an additional 3.5 years (Uranerz, 2016a). As a result, the drawdown 8 km

[5 miles] from the center of the Jane Dough Unit will likely exceed 1.5 meters [5 feet] at the end of restoration activities.

The licensee stated there are 10 flowing wells within a 4.8-km [3 mile] radius of the Jane Dough Unit, but most are not thought to be completed in the A Sand (Uranerz, 2016a). If any of these wells are located in the A or AB Sands, they may be impacted by the drawdown described above. However, the licensee has agreements in place with private well owners to either provide pumping capability or to replace wells if water level drawdowns affect well yield. The licensee is also required to provide NRC an annual report, in accordance with Nichols Ranch ISR Project license condition 11.7, in which it: (1) identifies the location, screen depth, and estimated pumping rate of any new groundwater wells or new use of an existing well within the license area and within 2 kilometers [1.3 miles] of any production area, and (2) evaluates the impact of ISR operations on potential ground water users and recommends any additional monitoring or other measures to protect ground water users (NRC, 2015). In addition, as described in WDEQ's Guideline No. 4, "In Situ Mining Noncoal," the licensee is required to provide an annual report that includes updated potentiometric surface maps for all aquifers that are or may be affected by the mining operation (WDEQ, 2013). These updated potentiometric surface maps would alert the licensee and State regulators of drawdowns affecting nearby wells. Also, after production and aquifer restoration are completed and groundwater withdrawal cease at the Nichols Ranch Unit, the groundwater levels would recover completely with time. Therefore, the NRC staff concludes that potential environmental impacts from consumptive groundwater use at the Jane Dough Unit would be SMALL.

Groundwater Quality and Excursions

During operations, groundwater in the production units would be impacted by elevated groundwater concentrations of certain constituents in the A and AB Sands. These impacts would be localized and temporary because upon completion of aquifer restoration, per NRC license condition, the groundwater quality would be returned to pre-mining baseline conditions or if approved, to its pre-mining class-of-use defined by WDEQ–LQD regulations and Wyoming State Statutes (Uranerz, 2016a). Uranerz would submit the results of its restoration activities to the NRC staff and the WDEQ for final approval, prior to the completion of aquifer restoration.

Excursion of lixiviant-fortified groundwater beyond the expected confines (horizontal or vertical) of a wellfield could occur due to (i) an improper balance between injection and recovery rates, (ii) undetected high-permeability strata or geologic faults, (iii) improperly abandoned wells, (iv) discontinuity and unsuitability of the confining units that allow migration of the lixiviant out of the ore zone, (v) poor well integrity, (vi) fracking of the ore zone or surrounding confining units, or (vii) a temporary wellfield shut-in. Appropriate characterization of the geologic and hydrogeologic setting and adequate construction, testing, and abandonment of wells would address the majority of these circumstances. Uranerz would control the potential for horizontal excursions (i.e., within the A and AB Sands) through the wellfield bleed rate. If the bleed rate is not maintained, lixiviant-fortified groundwater would migrate to and be intercepted by a monitoring well (Uranerz, 2016a). When a potential excursion is verified, the WDEQ–LQD and NRC staff would be verbally notified within 24 hours (Uranerz, 2014b). Any excursions would be reversed by temporarily increasing the bleed rate, thereby drawing the lixiviant back into the production zone. The natural groundwater velocity within the A Sand at the Jane Dough Unit is approximately 3.7 m/yr [12 ft/yr], so during a 45-day shut-off period, plume travel distance within the A Sand would be less than 0.6 m [2 ft] (Uranerz, 2016a), demonstrating adequate containment of lixiviant during a temporary wellfield shut-in. The natural mean groundwater velocity within the B Sand is less than within the A Sand; using the licensee-supplied maximum

value for the hydraulic conductivity of the B Sand {i.e., 0.11 m/day [0.37 t/day]}, plume travel distance during a 45-day shut-off period in the AB Sand would be less than 0.9 m [3 ft] (Uranerz, 2016a), again demonstrating adequate containment.

Previously existing improperly abandoned wells could impact aquifers above or below the ore zone by providing hydrologic connections between it to overlying or underlying aquifers.

During the decommissioning phase, all monitoring, injection, and production wells would be plugged and abandoned, in accordance with WDEQ Rules and Regulations (Uranerz, 2014a; WDEQ, 2015c). The licensee's well-abandonment procedure is described in Section 5.2.5 of the ER (Uranerz, 2014a). Wells would be filled with cement and clay and then cut off at least 0.6 m [2 ft] below ground surface to ensure that groundwater does not flow through the abandoned wells. Any deviation from the licensee's declared abandonment procedure would be approved in advance by the NRC staff and WDEQ. If wells are properly plugged, abandoned, and isolated from the flow domain, the NRC staff concludes that the potential environmental impact would be SMALL.

Wellfield Operation Impacts to Deep Aquifers

Bleedwater generated in the two production units would be disposed of using UIC Class I deep disposal wells on the Nichols Ranch Unit, resulting in no local impacts to deep aquifers beneath the Jane Dough Unit.

Under the No-Action Alternative, the Jane Dough Unit would not be licensed, and there would be no associated construction, operation, aquifer restoration, or decommissioning; therefore, there would be no impact to groundwater. No lixiviant would be injected into the production aquifer, and there would be no threat to groundwater quality nor would consumptive groundwater use occur. No additional impacts to groundwater would take place beyond those that already exist.

4.6 Ecology

The NRC staff previously evaluated effects to local wildlife from ISR mining operations for the then proposed Nichols Ranch Unit and determined that potential impacts to ecological resources, including protected species, during all phases of the project would be SMALL (NRC, 2011b).

Most of the potential effects to wildlife from the Jane Dough Unit would be due to habitat-related disturbances, such as habitat alteration, fragmentation, or loss. Potential impacts to individual animals and wildlife habitat would occur during well drilling, topsoil stripping, trenching, excavating, backfilling, compacting, and grading. These potential impacts to wildlife from clearing and grading, increased noise, traffic, or other disturbances associated with the development of the Jane Dough Unit wellfields include: direct and indirect mortalities; displacement of individual animals; loss of forage; erosion; and, changes in predator/prey populations. Indirect effects due to vegetation alteration affecting wildlife habitat typically persist longer than direct effects to individual animals due to the length of time (months to decades depending on the type of plant community) required for vegetation to reestablish and become habitable.

Vegetation

The potential impacts on vegetation (including protected species) from ISR activities at the Jane Dough Unit would result primarily from well-drilling activities and from the construction and decommissioning of wellfields and associated infrastructure such as pipelines, access roads, and overhead power lines. These potential impacts to vegetation include: an increased potential for nonnative species invasion establishment, shifts in species composition; changes in vegetative density; soil erosion; changes in visual aesthetics; reduction of wildlife habitat; reduction in livestock forage; and, expansion from invasive and noxious species found within the Jane Dough Unit. The licensee estimates that for the Jane Dough Unit the total amount of soil and vegetation disturbed during all phases of ISR activities would be approximately 40.8 ha [101 ac], or 2.7 percent of the entire Jane Dough Unit. Uranerz would access the Jane Dough Unit from the adjacent Nichols Ranch Unit using an existing road; therefore, no additional disturbances are expected within the Nichols Ranch Unit as a result of the Jane Dough Unit. The sagebrush grassland and mixed grassland vegetation communities would be the most affected vegetation communities. Based on the licensee's baseline vegetation surveys, less than 4.4 ha [11 ac] of sagebrush would be disturbed. As stated in EA Section 3.6, invasive plant species are present at the Jane Dough Unit. Cheatgrass, in particular, is a growing threat for Wyoming sagebrush habitats because of its ability to change fire and vegetation patterns (WGFD, 2010). The licensee has committed to revegetation measures that would reduce the overall impacts. Because the licensee has committed to revegetation measures, the NRC staff concludes that impacts on vegetation from the proposed action would be SMALL.

Mammals

Pronghorn and mule deer were the only big game species observed during baseline wildlife surveys that use the Jane Dough Unit as yearlong range. Although the number of pronghorn and mule deer were not counted during baseline wildlife surveys, the estimated 2011 population density of pronghorn and mule deer in the herds that occur at the Jane Dough Unit are approximately 18 pronghorn per 2.6 km^2 [1 mi^2] and 3.5 mule deer per 2.6 km^2 [1 mi^2] (Uranerz, 2014a). Temporary disturbance of big game species during the Jane Dough Unit project lifecycle may have isolated effects on portions of these herds, as animals could potentially be disturbed away from active project areas. Hunting and hunting access would not likely be affected as the entire Jane Dough Unit is privately owned land. Direct mortalities could be higher for smaller mammal species (e.g., voles, ground squirrels, mice) than for other wildlife because of the likelihood they would retreat into burrows if disturbed and thus potentially be killed by vehicles, topsoil scraping, or staging activities. A smaller percentage of small- and medium-sized mammals compared to big game species are likely to move to suitable habitat near the Jane Dough Unit area during construction. However, small- and medium-sized mammal species do have higher reproductive potential than large wildlife species that require large home ranges and occur in lower densities (i.e., large mammals) thereby making smaller species less vulnerable to habitat loss (BLM, 2007). However, the NRC staff anticipates that the Jane Dough Unit would not be uninhabitable when construction ends, and some animals may return to their previously occupied habitats (NRC, 2009). Therefore, the NRC staff concludes that the potential impact to big game, and small and medium-sized mammals from the proposed action would be SMALL.

Birds

The licensee's wellfield layout of Production Units #1 and #2 indicate that one active golden eagle nest, one active red-tailed hawk nest, one active long-eared owl nest, and one active

great horned owl nest are located less than 0.8 km [0.5 mi] from Jane Dough Unit activities. These active nests are closer to planned Jane Dough Unit activities than U.S. Fish and Wildlife Service (FWS) recommended spatial and seasonal buffers for the respective species (FWS, 2016; Uranerz, 2014a, 2015). FWS states that activities should not occur within the spatial/seasonal buffer of any nest (occupied or unoccupied) when raptors are in the process of courtship and nest site selection (FWS, 2016). The WDEQ describes the necessary measures a licensee must take to obtain a permit to mine, including consulting with FWS if mine activities could potentially affect the nest of any raptor species (WDEQ, 1994). Some raptors may continue to use nests as they acclimate to the Jane Dough Unit construction activities and could return to inactive nests within the Jane Dough Unit. Direct effects could include destruction of nests and deaths from collisions with traffic and equipment. Presence and construction of power lines may also result in direct and indirect effects. Avian collision and electrocution with overhead power lines, a direct effect, could occur year-round throughout the life of the Jane Dough Unit. In addition to other project activities, indirect effects from overhead power lines on raptors could include nesting disruption and displacement of prey species, which may reduce food availability within the area. The NRC staff anticipates that these indirect effects to raptors from overhead power lines would affect a broader group of avian and mammal species than collisions or electrocutions of avian species alone.

Removal of any active migratory bird nest or removal of any structure that contains an active nest (e.g., a tree, fence post, or power line pole) is prohibited by law (FWS, 2016). In addition, nest manipulation is not allowed without a permit (FWS, 2016). Also, all native migratory birds, their feathers and body parts, nests, eggs, and nestling birds are protected by the federal Migratory Bird Treaty Act (MBTA), making it unlawful to, hunt, shoot, wound, kill, trap, capture, or sell birds listed under this convention. All the bird species observed during baseline wildlife surveys for the Jane Dough Unit are protected under the MBTA (Uranerz, 2014a,b; 70 FR 12710). Eagles are additionally protected by the Bald and Golden Eagle Protection Act (BGEPA) (FWS, 2016). The licensee would be responsible for complying with these acts during all phases of the Jane Dough Unit, limiting potential effects on birds from the addition of the Jane Dough Unit to the Nichols Ranch ISR Project license.

The licensee's wellfield layout of Production Units # 1 and # 2 indicate that four occupied Greater sage-grouse leks are located less than 3.2 km [2 mi] away from wellfield activities. The State of Wyoming has set forth protective stipulations for Greater sage-grouse both inside and outside core population areas, or PHMAs (Mead, 2015). Projects located within 3.2 km [2 mi] of an occupied lek outside core population areas, or PHMAs, are expected to follow the Wyoming recommendations for avoiding and minimizing impacts. This means that surface-disturbing or disruptive activities, or a combination of both, should not occur from March 15 through June 30 within 3.2 km [2 mi] of an active lek to protect breeding activities.

The NRC staff concludes that given the mitigations required by WDEQ and FWS the potential impacts to raptors and upland game birds from the proposed action would be SMALL.

Reptiles, Amphibians, and Aquatic Species

Although baseline wildlife surveys targeting reptiles and amphibians were not required by WDEQ or conducted, there is suitable habitat within the Jane Dough Unit to support a variety of reptiles and amphibians, including CBM discharge reservoirs, scattered stock ponds, riparian areas, wetlands, and rocky outcrops (USGS, 2016). No reptiles or amphibians were observed at the Jane Dough Unit during baseline wildlife surveys, and only two snakes were observed at the Nichols Ranch Unit (AUC, 2014a; NRC, 2011b). Potential impacts to reptiles and

amphibians from construction activities at the Jane Dough Unit would primarily result in the mortality of individual reptiles and amphibians, destruction of habitat, degradation of water quality from surface-disturbing activities that cause erosion, and exposure to accidental spills. Construction of wellfields could result in direct mortalities to basking reptiles and amphibians, and to reptiles that spend the winter underground in rocky outcrops and crevices. The construction of proposed secondary and tertiary roads, header houses, monitoring wells, and trunklines that cross wetlands and potential riparian areas would occur primarily in the western half of the Jane Dough Unit. Potential erosion and siltation impacts to reptiles and amphibians would be localized and temporary (e.g., during storm events or when snow melts). Consistent with the determination in the Nichols Ranch ISR SEIS (NRC, 2011b), the NRC staff concludes impacts to reptiles and amphibians for all phases of the proposed action would be SMALL.

Because of the limited and ephemeral nature of surface water within the Jane Dough Unit, the occurrence of aquatic species is also limited. Additional information on surface water at the Jane Dough Unit is provided in EA Section 3.5. CBM discharge reservoirs, scattered stock ponds, and wetlands and ponds found in the Jane Dough Unit that are seasonal in nature do not provide sufficiently deep water habitat for fish. In addition, there is no year-round source of surface water sufficient to maintain aquatic plant species. However, potential impacts to the limited aquatic and semiaquatic species (e.g. tadpoles, algae, or insect larvae) at the Jane Dough Unit would occur primarily along drainages and scattered stock ponds. Direct impacts to potential aquatic habitat would be limited to periods of stream channel disturbances and wetland encroachment during construction activities. Construction activities have the potential to result in minor spills of drilling fluids, muds from drilling, and fuels and lubricants from heavy equipment operation and refueling. The NRC staff concludes that due to inadequate habitat to support aquatic species the impact for all phases of the proposed action would be SMALL.

As previously stated, most potential impacts to wildlife would be from habitat-related disturbances as a result of construction related activities, traffic, and human encounters. To minimize effects on wildlife and vegetation, areas affected by well-drilling activities, pipeline laying, and access road construction would be reseeded as soon as possible following these activities (Uranerz, 2014a; NRC, 2011b). WDEQ (2006) requires that mine operations include temporary seeding for reclamation during the first spring or fall with WDEQ-approved seed mixes. The licensee commits to final reclamation and permanent reseeding with a landowner- and WDEQ-approved seed mix during the first growing season upon completion of construction and decommissioning operations (Uranerz, 2014a; NRC, 2011b). Once permanent revegetation efforts are complete, it would likely require 2 to 4 years for grasses to be reestablished, but it could take 10 or more years for mature shrub communities to be reestablished (BLM, 2013a, 2015). As required for decommissioning, the licensee would submit an updated reclamation plan for review and approval by NRC and the appropriate state agencies. This plan would address ecological impacts such as vegetation restoration.

The licensee commits to install fencing constructed in accordance with Wyoming Game and Fish Department (WGFD) recommendations to limit wildlife access to wellfields. WGFD (2004) and WDEQ (1994) specify fencing construction techniques to minimize impediments to big game movement. The licensee has committed to implementing mitigation measures such as reduced speed limits to reduce the risk of vehicular collision and resulting potential collisions with animals. Reducing speed limits would also reduce fugitive dust on unpaved roads. Fugitive dust could increase localized air and visual disturbances to wildlife and settle on plants, making them unpalatable to wildlife. The licensee has committed to apply dust suppressant to control fugitive dust emissions from unpaved roads (Uranerz, 2016a). The licensee also has

committed to reclaiming and restoring mud pits by backfilling and grading in accordance with WDEQ requirements (Uranerz, 2014a,b). Mud pits would be reseeded after construction of the wells is complete (Uranerz, 2014a,b). FWS recommends that immediate removal of the drilling fluids after well completion and restoring the area as soon as possible is the key to preventing wildlife mortality in temporary mud pits (FWS, 2009).

To reduce unnecessary or undue disturbance to raptors and greater sage-grouse, Uranerz has committed to (i) no surface occupancy within 0.4 km [0.25 mi] of a lek; (ii) coordination of monitoring activities at Cottonwood Creek with WGFD personnel; (iii) no surface-disturbing activities within 3.2 km [2 mi] of any occupied lek from March 15 through June 30; (iv) limiting non-surface disturbing activities to daylight from March 15 through June 30; (v) not constructing overhead power lines, permanent high-profiled structures such as storage tanks, or other perch sites within 0.4 km [0.25 mi] of any active lek; and (vi) enforcing speed limits for specific access roads (Uranerz, 2014a). The licensee commits to conducting annual raptor and sage-grouse surveys during the life of the project as required by the WDEQ (Uranerz, 2014a). In the unlikely event that it becomes necessary to disturb a raptor nest, a mitigation plan would be developed, including consultation with the WDEQ, WGFD, and the FWS. Any required permits would be obtained from the appropriate agencies.

As discussed in EA Section 3.6, no federally listed threatened or endangered plant or animal species or critical species habitat are known to occur within the Jane Dough Unit. Therefore, the NRC staff concludes there will be no effect on federally listed species. The overall impact to protected species during the life of the Jane Dough Unit would be SMALL.

As previously stated, the licensee has committed to limiting potential impacts on ecological by applying mitigation measures including, but not limited to, the following: limiting stream disturbances, spills, and erosion (EA Section 4.5.1), avoiding jurisdictional wetlands (Uranerz, 2014a), seeding disturbed areas and topsoil stockpiles (EA Section 4.4), suppressing fugitive dust on unpaved roads, enforcing speed limits, fencing wellfield areas, and conducting annual raptor and sage-grouse surveys. Based on NRC's previous conclusion for the Nichol's Ranch Unit, the foregoing analysis that approximately 40.8 ha [101 ac] of mostly grassland vegetation would be disturbed, and the licensee's mitigation commitments, the NRC staff expects no significant impacts would result from the Jane Dough Unit; therefore, NRC staff determines that impacts to ecological resources from all phases of the proposed action would be SMALL.

Reestablishment of native shrub species could be hindered by yearlong grazing pressure. Large ungulates (i.e., wild and domestic animals with hooves) are attracted to more succulent, younger plants and they often concentrate in newly seeded locations during the critical early-growth stage. As a mitigation strategy, the licensee could fence off areas with young vegetation, which would reduce these types of disturbances where possible. Based on recommendations that WGFD made for similar uranium recovery projects (McMahan, 2013), WGFD recommendation to control invasive weeds by ensuring that earth moving equipment is cleaned prior to entering the site. To further minimize impacts to riparian areas, WGFD staff recommend that equipment should be serviced and fueled away from streams and riparian areas, and that equipment staging areas should be at least 91 m [300 ft] from riparian areas. The Bureau of Land Management (BLM)'s interim guidance for migratory birds (BLM, 2012) recommends that pre-disturbance clearances are conducted within 7 days prior to the disturbance in order to detect any newly arriving nesting birds. BLM further advises that if active nests with eggs or young are located within the Jane Dough Unit, the licensee should establish buffers around those nests, construction activities should be delayed until all young have fledged, and the licensee should consult with the FWS. Buffer distances for bird species should

be developed in coordination with FWS to determine appropriate mitigations. In addition, the licensee should follow guidelines suggested by the Avian Power Line Interaction Committee (APLIC, 2006), which would reduce overall impacts to all birds, including raptors. For example, constructing new overhead power lines and retrofitting old power lines with a 150-cm (60-in) distance between energized conductors or hardware and grounded conductors or hardware limits the risk for birds to be electrocuted (APLIC, 2006). In addition, the licensee could enforce seasonal closure of roads if reptile and amphibian mortalities are observed on the roads during the breeding season when young are emerging from breeding areas. These additional mitigation measures could further reduce impacts to ensure the potential impacts to ecology remain SMALL.

Under the No-Action Alternative, there would be no construction, operation, aquifer restoration, or decommissioning activities associated with the Jane Dough Unit; therefore, there would be no land disturbance from the proposed action that could impact either vegetation or wildlife populations. The area would continue to sustain vegetation communities and wildlife habitat typical of the region. Land would continue to be used for livestock grazing and CBM extraction. Under the No-Action Alternative, if current grazing and CBM practices continue, only a few individual species could be affected as a result of land management decisions (e.g., overgrazing or conflicts between cattle and other species, wildlife exposure to CBM discharges, wildlife disturbances from CMB operations and employees); however, affected species would be likely to relocate to suitable nearby habitats.

4.7 Air Quality

This analysis considers the impacts on air quality (nonradiological air emissions) from the peak year as well as the various ISR phases. The peak year accounts for the times when ISR phases occur simultaneously and represents the highest amount of emissions the project would generate in 1 year.

As described in GEIS Section 2.7.1 (NRC, 2009), nonradiological air emission impacts primarily involve fugitive dust emissions from vehicles traveling on unpaved roads and combustion engine emissions from mobile sources. The GEIS analysis concluded that air-quality impacts from these emission sources were SMALL (see GEIS Section 4.3.6). In the Nichols Ranch SEIS (NRC, 2011b), the NRC staff determined that the site-specific impact from fugitive dust at Nichols Ranch Unit was greater than that assessed in the GEIS. In the Nichols Ranch SEIS analysis, the pollutant with the highest emission level was particulate matter PM_{10}, and the estimated emission level for that pollutant was greater than that cited in the GEIS (see EA Appendix B, Table B–5). In the Nichols Ranch SEIS, fugitive dust emissions are the primary consideration for potential impacts because this source comprises about 98 percent of the overall particulate matter PM_{10} emissions (NRC, 2011b). The NRC staff concluded in the Nichols Ranch SEIS that fugitive road dust generated from travel on unpaved roads results in short-term and intermittent MODERATE impacts. However, the NRC staff concluded that average air quality is expected to remain in compliance with ambient standards and overall impacts would be SMALL.

For the other pollutants, which are generated from combustion engine emissions, the discrepancy between the emission levels for the Nichols Ranch SEIS and GEIS analyses is much smaller, with the GEIS possessing the higher estimates (see EA Appendix B, Table B–5). Since the Nichols Ranch SEIS emissions were less than the GEIS emissions, the NRC staff concluded in the Nichols Ranch SEIS that the site-specific impacts for these other pollutants would be SMALL, as determined in the GEIS.

The NRC staff's fugitive dust emissions inventory (PM_{10}) is provided in EA Appendix B, Table B-1. The annual emissions are provided for each of the three production units (Nichols Ranch, Hank, and Jane Dough), along with a total for the entire Nichols Ranch ISR Project, which is comprised of all three production units. The NRC staff compared this inventory to the emissions inventories previously evaluated by the NRC staff in the GEIS and Nichols Ranch SEIS. The Table B-1 inventory incorporates dust suppression for the unpaved access and haul roads (see EA Appendix B, Section B.1.1). The licensee identified other mitigation measures; however, these other measures are not credited in the calculation of the inventory (i.e., the estimated pollutant levels were not reduced because of the implementation of this mitigation). Particulate matter PM_{10} is the pollutant with the highest emission level, and the estimated amounts of this pollutant for Jane Dough Unit is much greater than the amount estimated in the GEIS (see EA Appendix B, Table B–5). Based on the estimated particulate matter PM_{10} inventory for the Jane Dough Unit, the NRC staff concludes that the site-specific conditions for the Jane Dough amendment are not bounded by those described in the GEIS for air quality. The estimated particulate matter PM_{10} emissions for the Nichols Ranch and Hank Units in the Nichols Ranch SEIS analyses and for the Jane Dough Unit in this analysis were both 123.3 metric tons [135.9 short tons] (see EA Appendix B, Table B-5). The updated peak year Nichols Ranch ISR Project inventory is 130.6 metric tons [144.0 short tons]. Because the level and nature (i.e., primarily fugitive dust from travel on unpaved roads) of the inventories considered in the Nichols Ranch SEIS and Table B-1 are very similar, the impact magnitudes for particulate matter PM_{10} for the Jane Dough amendment would be the same as that in the Nichols Ranch SEIS. The NRC staff concludes that for the Jane Dough Unit the overall impacts from fugitive road dust generated from travel on unpaved roads would be SMALL; however short-term and intermittent MODERATE impacts for the peak year and construction phase are possible. The impact for the other three ISR phases would be SMALL.

For the other pollutants, the Jane Dough amendment emission levels are lower than the emission levels estimated in the Nichols Ranch SEIS (see EA Appendix B, Table B–5). The difference between the Jane Dough amendment and Nichols Ranch SEIS emission estimates can primarily be attributed to a difference in the number of Class I deep disposal wells drilled during the peak year. The Jane Dough amendment combustion emission estimates assume the drilling of two of these wells (see EA Appendix B, Section B.1.2), whereas the Nichols Ranch SEIS estimates assume the drilling of eight of these wells (NRC, 2011b). Since the Jane Dough amendment emission levels are lower than those in the GEIS analysis, the NRC staff concludes that for the Jane Dough amendment analysis the site-specific impacts for these other pollutants would be SMALL, as determined in the GEIS.

Under the No-Action Alternative, there would be no construction, operation, aquifer restoration, or decommissioning activities associated with the Jane Dough Unit. Specifically, there would be no additional fugitive dust emissions associated with well construction, transportation of workers, or radiological material. Uranium ISR activities for the Nichols Ranch ISR Project would continue under the existing license and potential air quality impacts from those activities were previously analyzed in the Nichols Ranch SEIS and summarized above.

4.8 Noise

The Jane Dough Unit is located in a rural area, and the closest residences are the Dry Fork and Rolling Pin Ranches located about 1.6 km [1 mi] west and east, respectively, of the Jane Dough Unit area. Primary noise sources would be associated with drilling and operation of the wells, specifically the use of heavy equipment to scrape and level the ground surface for drilling and traffic noise. Noise levels would be highest during construction, with a decrease during

subsequent phases. Noise levels are expected to be higher during daylight hours when construction is more likely to occur and more noticeable in proximity to the operating equipment. For individuals living in the vicinity of the Jane Dough Unit, the ambient noise levels would return to background at distances more than 300 m [1,000 ft] from the construction activities; therefore, the NRC staff concludes that the noise impacts during construction would be SMALL.

During the operations phase, wellfield equipment (e.g., pumps, compressors) would be contained within structures (e.g., header houses), thus limiting the propagation of noise to offsite individuals. Traffic noise from commuting workers and truck shipments to and from the CPP would be localized and limited to highways in the vicinity of the Jane Dough Unit, and access roads on the Jane Dough Unit. The potential impact from noise onsite during the operations phase would be less than during the construction phase because fewer pieces of heavy machinery would be in use and, therefore, the NRC staff concludes that the impact would be SMALL.

Noise generated during the aquifer restoration phase would either be similar to or less than noise generated during the operations phase. Traffic noise would be limited to supply deliveries and staff traveling to the site, resulting in overall fewer vehicular trips than during previous phases. Because the amount of equipment used and the volume of traffic would be less than during the construction phase (i.e., highest potential for a noise impact), the NRC staff concludes that the noise impacts during aquifer restoration would be SMALL.

The noise generated during the decommissioning phase would be similar to or less than that generated during the construction phase. The sources of noise would include earthmoving, excavation, and building demolition. Fewer demolition shipments to and from the Jane Dough Unit would occur as decommissioning progressed, resulting in less noise from traffic. Therefore, the NRC staff concludes that the estimated impact on the nearest resident during decommissioning would be SMALL.

Under the No-Action Alternative, the Jane Dough Unit would not be licensed, and there would be no associated construction, operation, aquifer restoration, or decommissioning; therefore, there would be no change in the current sound levels within the Jane Dough Unit or to surrounding receptors. The rural setting of the Jane Dough Unit and the continuation of ongoing natural resources exploration activities would result in sound levels remaining at ambient levels.

4.9 Cultural and Historical Resources

Potential environmental impacts to historic, cultural, and paleontological resources at the proposed Nichols Ranch ISR Project site may occur during all phases of the facility lifecycle. Predominantly, these impacts could result from the loss of or damage to historic, cultural, and archaeological resources, as well as temporary restrictions on access to these resources.

As part of prelicensing activities, the licensee conducted the appropriate historic and cultural resource surveys. The eligibility evaluation of historic properties for listing in the National Register of Historic Places (NRHP) or as a traditional cultural property (TCP) under criteria in Title 36 of the *Code of Federal Regulations* (CFR) Part 60.4(a)–(d) was conducted as part of a site-specific environmental review because most TCPs are identified through consultation. The licensee has completed the necessary archaeological surveys of the area and the report has been provided to the WY SHPO for concurrence on eligibility recommendations. The WY SHPO concurred with these determinations in August 2016 (WY SHPO, 2016). Therefore, the

entire Jane Dough Unit has been surveyed and archaeological sites that were identified were evaluated for eligibility to the NRHP.

Areas of importance to Native American tribes or TCPs are identified during consultation between the NRC staff and the tribes. To date, consultations regarding the Jane Dough Unit have not resulted in the identification of specific areas or resources within and around the Jane Dough Unit for direct or indirect impacts. Although the Pumpkin Buttes are visible from the Jane Dough Unit, the Jane Dough Unit is located approximately 9.7 km [6.0 mi] west of South Butte, and about 9.6 km [6 mi] west of the Pumpkin Buttes, which is beyond the 3.2 km [2 mi] radius stipulated in the Programmatic Agreement (PA) between the BLM and the WY SHPO (BLM, 2009a).

Construction activities, including wellfields and access roads, could directly impact archaeological sites and isolated finds identified within the Jane Dough Unit. The results of the Class III inventories indicate that 14 sites and 2 isolated resources (IRs) are located within the direct area of impact (see EA Section 3.9.1). Of the 14 sites, 2 sites (segments of the Bozeman Trail and Deadwood Road) are eligible for listing on the NRHP. Both of the contributing segments of the Deadwood Road and Bozeman Trail are located within the Jane Dough Unit but outside of the area of direct impacts; therefore, they will not be impacted by this project. The remaining 12 sites have been determined not eligible for listing on the NRHP; therefore, there would be no impacts on these resources. For the two eligible sites listed in EA Table 3-4, the licensee has committed to avoiding direct ground-disturbing activities on the segments (Uranerz, 2014a, 2015). Additionally, the licensee would not conduct any ground-disturbing activities in areas that have not been previously inventoried and cleared for cultural resources (Uranerz, 2014a).

If the licensee determines that they need to expand construction activities outside of the current area of direct impacts, they would be required to do additional NHPA, Section 106 review, including consultation. If the licensee determined that it must conduct ground-disturbing activities within the boundaries of an eligible site, the licensee would notify NRC, WY SHPO, and WDEQ–LQD, and the licensee would prepare an appropriate cultural resource mitigation plan and submit the plan to NRC and WY SHPO for review and approval. Once approved, the mitigation plan would be implemented before any ground-disturbing activities are undertaken. Any approved mitigation plan(s) would be subsequently incorporated into the WDEQ Mine Permit and the NRC license (if issued). Also, if cultural resources are discovered during operations, the licensee would immediately stop ground-disturbing activities in the area of the discovery and would immediately notify WDEQ–LQD, NRC, and WY SHPO. Within 2 working days of the notification, WDEQ–LQD, NRC, and WY SHPO would evaluate or have evaluated any discovered cultural resources and would determine whether any action may be required to protect or preserve such discoveries. Therefore, the NRC staff concludes that the impact from construction on historic and cultural resources would be SMALL.

There would be minimal impacts from operations on NRHP-eligible sites and TCPs at the Jane Dough Unit. The two eligible sites would not be directly affected by operations, because these sites are located outside of the wellfield area and would be avoided. Additionally, there have been no TCPs or other areas of cultural importance identified within the Jane Dough Unit or the larger area for indirect impacts. Therefore, there are no historic and cultural resources or TCPs in the Jane Dough Unit that would be affected by facility operation or maintenance. Should resources be encountered during construction or routine maintenance activities, per site procedures, the licensee would stop work and notify NRC, WY SHPO, and other appropriate

agencies (NRC, 2015e). Therefore, the NRC staff concludes that impacts to historic and cultural resources during operations would be SMALL.

There would be minimal aquifer restoration and decommissioning impacts on NRHP-eligible sites and TCPs at the Jane Dough Unit. No sites would be directly impacted by either aquifer restoration or decommissioning activities, because there are no eligible sites within the wellfield area. However, should resources be encountered during restoration activities, per site procedures, the licensee would stop work and notify NRC, WY SHPO, and other appropriate agencies (NRC, 2015e). Therefore, the NRC staff concludes that impacts to cultural resources would be SMALL.

For further information about licensee commitments for mitigation of cultural resources, see the Nichols Ranch ISR SEIS (NRC, 2011b).

Although no paleontological resources were identified, should there be an inadvertent discovery of a paleontological resource, NRC-approved procedures would be followed to address any disturbance in excess of a few feet. Therefore, the NRC staff concludes that the impact from all phases on paleontological resources would be SMALL.

Under the No-Action Alternative, the Jane Dough Unit would not be licensed, and there would be no associated construction, operation, aquifer restoration, or decommissioning; therefore, there would be no archaeological sites, isolated cultural resources, TCPs, or paleontological resources affected by the proposed action. Cultural impacts from current land activities, such as CBM extraction, oil and gas extraction, and cattle ranching, would continue.

4.10 Visual and Scenic Resources

The Jane Dough Unit occurs in an area where livestock grazing, oil and gas extraction, extensive CBM development, and uranium recovery activities have occurred and where additional CBM development is planned. The visual resources would be impacted from the use of equipment such as drill rigs; dust and other emissions from such equipment; installation of header houses and other structures and site and wellfield access roads; land clearing and grading activities; and lighting for nighttime operations. Disturbance associated with access roads, pipelines, and power lines would create linear contrasts with the natural lines and the wells would contrast with the natural forms.

The Jane Dough Unit is located approximately 9.7 km [6.0 mi] west of South Butte and separated by hills and pronounced drainages. Visual impacts would be similar to, but less than, those experienced from the extensive CBM and oil and gas development in the area and from ISR activities at the Nichols Ranch Unit because no CPP would be constructed at the Jane Dough Unit. CBM installations include networks of wells, underground piping, pump structures, and overhead power lines, which are much larger and more extensive than those used for ISR facilities.

Uranerz commits to mitigation measures that would limit the visual impacts of the Jane Dough Unit. Header houses associated with the Jane Dough Unit would be painted to blend in to the natural landscape, and power lines and pipelines would be buried where appropriate (NRC, 2011b; Uranerz, 2014b). The licensee commits to recontouring surface disturbances that do occur to blend in with the natural terrain and would use dust suppressant, as warranted, to minimize fugitive dust (NRC, 2011b; Uranerz, 2014b). BLM's proposed Resource Management Plan (RMP) recommends limiting surface disturbance and infrastructure within 4.8 km [3 mi] of

the Bozeman Trail, where development is either not visible or would result in a weak contrast to the setting (BLM, 2015). For more information on the Bozeman trail and the licensee's mitigation measures and WY SHPO and WDEQ requirements to protect this resource, see EA Section 3.9. In addition, the Pumpkin Buttes TCP is located approximately 9.6 km [6 mi] of the Jane Dough Unit (NRC, 2011b; Uranerz, 2014a). The NRC staff has evaluated the potential impacts on the Pumpkin Buttes TCP in the Nichols Ranch SEIS (NRC, 2011b) and determined that both the Nichols Ranch and Jane Dough Units are beyond the 3.2 km [2 mi] radius specified in the PA between BLM and the WY SHPO and, therefore, are not required to comply with mitigative measures stipulated in the PA. The potential effects from the addition of the Jane Dough Unit would be less than those effects experienced from the Nichols Ranch ISR Project because no CPP is being constructed at the Jane Dough Unit and because of the greater distance from the Pumpkin Buttes; therefore, the viewshed would not be affected. Limiting visual contrasts should minimize visual resource impacts from the Jane Dough Unit activities and keep the visual impacts consistent with the predominant Visual Resource Management Classes III and IV of the region. Therefore, the NRC staff concludes the impacts on visual and scenic resources from the Jane Dough Unit would be SMALL.

Under the No-Action Alternative, the Jane Dough Unit would not be licensed, and there would be no associated construction, operation, aquifer restoration, or decommissioning; therefore, there would be no change to the existing visual and scenic resources. The existing pipelines, wellfields, and utility lines within the Jane Dough Unit from CBM and gas extraction activities would remain. No additional structures (header houses) associated with the Jane Dough Unit would be introduced from the proposed action to affect the existing viewscapes, and the existing scenic quality would remain unchanged. Therefore, under the No-Action Alternative, there would be no impact to visual and scenic resources.

4.11 Socioeconomics and Environmental Justice

Socioeconomic impacts are defined in terms of changes to the demographic and economic characteristics and social conditions of a region. The NRC staff analyzed the potential impacts on the socioeconomic conditions (e.g. demographics, employment rate, housing, income, education) for the Nichols Ranch ISR Project and determined that the impact would be SMALL across all aspects of socioeconomics (NRC, 2011b).

For all phases (construction, operations, aquifer restoration, and decommissioning) of the Jane Dough Unit, the number of workers is anticipated to be approximately the same (45-55 employees) as those proposed and analyzed in the Nichols Ranch SEIS (NRC, 2011b; Uranerz, 2014a). In addition, the licensee anticipates the workers would most likely commute from the same locations as analyzed in the Nichols Ranch SEIS. Therefore, there would be no increase in traffic levels from those already accounted for as part of the Nichols Ranch ISR Project, or demand for law-enforcement, emergency-response services, or health services. The timeframe for the Jane Dough Unit would extend approximately 5 years longer than the activities analyzed in the Nichols Ranch SEIS. Since the Jane Dough Unit is expected to start as activities at the Nichols Ranch ISR Project area decline, the Jane Dough Unit is anticipated to have consistent employment numbers as in the Nichols Ranch SEIS analysis. County jurisdictions would benefit from the increased tax revenues from the Jane Dough Unit, both directly from increased property taxes and indirectly from worker spending and local purchases of goods and services. However, this benefit would be offset by maintaining public services (e.g. roads, schools, health care facilities, etc.). The licensee states the Jane Dough Unit would use the same number of workers for an additional 5 years; therefore, the NRC staff concludes that continued impacts on socioeconomics from the Jane Dough Unit would also be SMALL.

Under the No-Action Alternative, the Jane Dough Unit would not be licensed, and there would be no associated construction, operation, aquifer restoration, or decommissioning; therefore, socioeconomic conditions in Campbell and Johnson Counties would not change under the No-Action Alternative.

Environmental Justice

Under Executive Order 12898 (59 FR 7629, 1994), federal agencies are responsible for identifying and addressing potential disproportionately high and adverse human health and environmental impacts on minority and low-income populations. Environmental justice refers to a federal policy implemented to ensure that minority, low-income, and tribal communities historically excluded from environmental decision-making are given equal opportunities to participate in decision-making processes. In 2004, the Commission issued a Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions (69 FR 52040, 2004), which states, "The Commission is committed to the general goals set forth in Executive Order 12898, and strives to meet those goals as part of its National Environmental Policy Act review process."

The Council on Environmental Quality (CEQ) provides the following definitions to consider when conducting environmental justice reviews within the framework of National Environmental Policy Act (NEPA), in *Environmental Justice: Guidance under the National Environmental Policy Act* (CEQ, 1997):

- Disproportionately High and Adverse Human Health Effects—Adverse health effects may include bodily impairment, infirmity, illness, or death. Disproportionately high and adverse human health effects occur when the risk or rate of exposure to an environmental hazard for a minority or low-income population is significant (as employed by NEPA) and appreciably exceeds the risk or exposure rate for the general population or for another appropriate comparison group.

- Disproportionately High and Adverse Environmental Effects—A disproportionately high environmental impact that is significant (as employed by NEPA) refers to an impact or risk of an impact on the natural or physical environment in a low-income, minority, or Indian tribe community that appreciably exceeds the environmental impact on the larger community. Such effects may include ecological, cultural, human health, economic, or social impacts. An adverse environmental impact is an impact that is determined to be both harmful and significant (as employed by NEPA). In assessing whether potential environmental effects could occur in minority or low-income populations or American Indian tribe, cumulative and multiple exposures are considered.

- Minority individuals—Individuals who identify themselves as members of the following population groups: Hispanic or Latino, American Indian or Alaskan Native, Asian, Black or African American, Native Hawaiian or Other Pacific Islander, or two or more races meaning individuals who identified themselves on a Census form as being a member of two or more races, for example, Hispanic and Asian.

- Minority populations—Minority populations are identified when (i) the minority population of an affected area exceeds 50 percent or (ii) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis. In identifying minority communities, groups of individuals living in geographic proximity to one another,

or a geographically dispersed/transient set of individuals (such as migrant workers or Native American), are considered.

- Low-income populations—Low-income population is defined as individuals that fall below the poverty level identified by the U.S. Census Bureau, including variations by family size and composition. If the total income for a family or unrelated individual falls below the relevant poverty threshold, then the family or unrelated individual is classified as being "below the poverty level." Low-income populations may be communities of individuals living in close geographic proximity to one another, or they may be a set of individuals, such as migrant workers, who, as a group, experience common conditions.

Consistent with NRC's Policy Statement (69 FR 52040) and guidance within NUREG–1748 (NRC, 2003a), the NRC staff conducted an environmental justice analysis in the Nichols Ranch ISR SEIS (NRC, 2011b) and determined that there would not be disproportionately high and adverse human health and environmental effects on minority and low-income populations for the areas covered in the Nichols Ranch and Hank Units and for a radius of 1.6 km [2 mi] around the Nichols Ranch Unit.

The NRC requires that an environmental justice analysis be included in its licensed federal actions; however, if a particular action would have no clear potential for offsite impacts to minority and low-income communities, NRC guidance states there is no need to consider whether the action will have disproportionately high and adverse impacts on certain populations (69 FR 52040; NRC, 2003a). The NRC staff assessed minority and low-income populations within a 6.4-km [4-mi] radius of the Jane Dough Unit and determined that no minority or low-income populations are present. This is not expected to change within the timeframe of the Nichols Ranch ISR Project because the Jane Dough Unit is located over six miles from the nearest State-maintained road on privately-owned land. Following NRC (2003a) guidance, no further environmental justice analysis is necessary. Nonetheless, because the Jane Dough Unit area is adjacent to the Nichols Ranch ISR Project area (directly south with a shared project boundary line) and would have fewer activities for construction, operations, aquifer restoration and decommissioning due to no CPP at the Jane Dough Unit, the NRC staff considers the analysis in the Nichols Ranch ISR Project SEIS as a bounding analysis for the addition of the Jane Dough Unit. Additionally, the Jane Dough Unit activities would start as activities at the Nichols Ranch site decline. Therefore, the NRC staff concludes that the Jane Dough Unit would have no disproportionately high and adverse effects on minority and low-income individuals in the area and all populations would be exposed to the same health and environmental effects generated from construction, operations, aquifer restoration, and decommissioning activities.

Under the No-Action Alternative, the Jane Dough Unit would not be licensed, and there would be no associated construction, operation, aquifer restoration, or decommissioning; therefore, the relative conditions affecting minority and low-income populations in Campbell and Johnson Counties would remain unchanged. Additionally, there would be no disproportionately high and adverse effects to minority and low-income populations from this alternative.

4.12 Public and Occupational Health

As described in GEIS Section 4.3.11,[1] potential radiological and nonradiological effects from ISR activities may occur during all phases of the ISR facility's lifecycle (NRC, 2009). These effects may occur during normal operations where proposed activities are executed as planned, or during potential accident conditions when unplanned events can generate additional hazards. Additionally, the potential hazards and associated effects can be either radiological or nonradiological. The impact analysis in this section evaluates the radiological and nonradiological public and occupational health and safety impacts for normal and accident conditions in each phase of the ISR facility life cycle. The applicable direct effects include those associated with the addition of the Jane Dough Unit production units to the Nichols Ranch ISR Project license, and the impacts associated with the processing of Jane Dough Unit solutions at the Nichols Ranch CPP.

Workers could be exposed to low levels of background radiation during the construction phase by direct exposure, inhalation, or ingestion of radionuclides during well construction, soil-disturbing activities, and fugitive dust from vehicular traffic. Because the proposed activities (e.g., wellfield construction) and the environmental conditions (including measured background radiation and radionuclide concentrations in soils and water at the Jane Dough Unit wellfields, as described in Section 3.12) are comparable to those considered previously in the Nichols Ranch ISR Project licensing review, the NRC staff concludes that the construction phase of the Jane Dough Unit would have a SMALL impact on workers and the general public.

Potential worker impacts during operations would be similar to the impacts analyzed in the previous licensing review for the Nichols Ranch ISR Project (NRC, 2011b) and in the GEIS (NRC, 2009). The Jane Dough Unit wellfields and the existing Nichols Ranch ISR facility design and operations are consistent with the evaluations in these prior impact analyses. To limit radiological exposure to workers, the licensee would apply its existing radiological protection program that (i) assigns radiation dosimetry badges to all employees with significant potential for exposure; (ii) utilizes ventilation designed to limit worker exposure to radon; (iii) conducts regular monitoring of gamma radiation exposure, air particulates, and radon daughter products to verify that radiation levels are as low as reasonably achievable and in compliance with NRC regulations; and (iv) conducts work area radiation and contamination surveys to help prevent and limit the spread of contamination (Uranerz, 2014b).

To evaluate the radiological impacts to the public from normal operations, the licensee estimated the radiological emissions from all concurrent activities associated with the Jane Dough, Nichols Ranch, and Hank Units (Uranerz, 2014a). Sources of radon that the licensee identified and modeled included wellfield development during the construction phase, and CPP and wellfield operations during the operational and aquifer restoration phases (Uranerz, 2014b). The licensee ran the computer code MILDOS to model the radiological impacts on human and environmental receptors (e.g., air and soil) using site-specific data that included radon release estimates, meteorological and population data, and other parameters. The estimated radiological impacts from routine project activities were compared to applicable

[1] The GEIS concluded that potential public and occupational health and safety impacts from ISR activities would not significantly vary by region and therefore referred to the in-depth analysis in GEIS section 4.2.11 rather than repeating the same discussion for each region. Similarly, in this EA, the analysis refers to both the region-specific discussion and the more in-depth discussion in GEIS Section 4.2.11, as appropriate.

public dose limits in 10 CFR Part 20 {1 millisievert (mSv)/yr [100 millirem (mrem)/yr]}, as well as to baseline radiological conditions (Section 3.12).

The NRC staff's review of the licensee's radiological impact modeling independently verified that appropriate receptor locations and exposure pathways were modeled and reasonable input parameters were used. The licensee calculated annual total effective dose equivalents (TEDEs) at 4 project boundary locations (west, east, north, south) surrounding each unit of the Nichols Ranch ISR Project (Nichols Ranch, Hank, Jane Dough Units) and at 7 nearby residences for a total of 19 locations). The licensee described the source terms, and the NRC staff's review concluded that the source terms reflected planned operations. The source terms included emissions from wellfield development, CPP and wellfield operations, and aquifer restoration (Uranerz, 2014b). The NRC staff also verified that the licensee used updated wind direction information from site-specific meteorological measurements taken since the Nichols Ranch ISR Project was licensed. The NRC staff review found that the schedule of proposed activities in the licensee's MILDOS modeling was different than both the original schedule and the latest revised schedule of activities provided by the licensee (Uranerz, 2014b; 2016a). After further review, the NRC staff determined an update of the licensee's MILDOS modeling was not necessary because the radon releases considered in the licensee's MILDOS modeling bounded the expected peak annual radon release from the latest revised schedule and therefore bounded the calculated doses from the Jane Dough Unit activities.

Results of the licensee's MILDOS modeling (Uranerz, 2014b) indicated that the maximum offsite TEDE of 0.15 mSv/yr [15 mrem/yr] is located at the existing Nichols Ranch Unit project boundary west of the CPP. This calculated dose is 15 percent of the 10 CFR Part 20 public dose limit of 1 mSv/yr [100 mrem/yr]. The maximum calculated boundary TEDE for the Hank Unit was 0.05 mSv/yr [5 mrem/yr] and for Jane Dough it was 0.04 mSv/yr [4 mrem/yr]. Additionally, all calculated TEDE at residences were less than or equal to 0.004 mSv/yr [0.4 mrem/yr]. This is 0.4 percent or less of the 10 CFR Part 20 public dose limit of 1 mSv/yr [100 mrem/yr]. Thus, the modeling results show that all the calculated doses are below the 10 CFR Part 20 public dose limit. These calculated doses are also within the range of dose modeling results reported for ISR facilities in the GEIS {0.317 mSv [31.7 mrem] per year for the Crow Butte facility to 0.004 mSv [0.4 mrem] per year for the Irigaray facility} (NRC, 2009).

Based on the preceding analyses, the NRC staff concludes the potential radiation doses to occupationally exposed workers and members of the public during normal operations would be SMALL. The licensee's existing radiation protection program (Uranerz, 2014b) would maintain worker exposures below the NRC limits in 10 CFR Part 20 for protecting workers from radiation hazards. Additionally, calculated radiation doses from the releases of radioactive materials to the environment are small fractions of the limits in 10 CFR Part 20 that have been established for the protection of public health and safety.

Direct operational radiological accident risks at the Jane Dough Unit would be limited to the proposed wellfield operations (e.g., loss of control of solutions). The NRC staff expects wellfield equipment leaks would be detected by the licensee's proposed pressure monitoring or by visual inspection and be promptly addressed to limit the potential spread of contamination and maintain radiological exposures within safe levels. Radiological accident risks associated with processing solutions from the Jane Dough Unit at the Nichols Ranch Unit include the potential for equipment failures leading to yellowcake slurry spills, or release of radon gas or uranium particulate. These accident risks would be the same as previously evaluated for the Nichols Ranch ISR Project (NRC, 2011b). In the unlikely event of an unmitigated accident, and depending on the type of accident, potential doses to workers may result in a MODERATE

impact to occupational health and safety. However, there would be only a SMALL impact to public health and safety. Typical protection measures, such as radiation and occupational monitoring, respiratory protection, standard operating procedures for spill response and cleanup, and worker training in radiological health and emergency response, are required as a part of the licensee's NRC-approved radiation protection program (Uranerz, 2014b). These procedures and plans would reduce the radiological consequences to workers from accidents. Therefore, the NRC staff concludes that the overall radiological impacts from accidents for the proposed action would be SMALL.

In their license application for the Nichols Ranch ISR Project, Uranerz committed to implementing an overall chemical safety program that was consistent with regulatory requirements that include risk management planning (accidental release modeling, safety information, hazards reviews, operating procedures, safety training, and emergency preparedness), process safety management of highly hazardous chemicals, threshold planning quantities, and reportable quantities for spills. Therefore, the nonradiological impacts during normal operations and accidents at the Nichols Ranch ISR Project CPP from processing solutions generated by the Jane Dough Unit would be SMALL.

The proposed aquifer restoration activities would be similar to activities that would take place during operations (e.g., operation of wellfields, wastewater treatment and disposal from solution processing at the existing Nichols Ranch CPP). Therefore, the potential impact on public and occupational health and safety would be expected to be similar to the operational impacts. The radiation doses associated with restoration are included in the previous operations assessment and associated MILDOS dose calculations. Similarly, the nonradiological hazards during aquifer restoration (e.g., chemical hazards) would be similar to the operational hazards previously evaluated. Therefore, for the proposed action, aquifer restoration would be expected to have a localized SMALL occupational impact on workers and to the general public (primarily from the release of radon gas).

The potential public and occupational impacts from decommissioning the Jane Dough Unit would involve similar activities and impacts as previously evaluated for decommissioning wellfields in the Nichols Ranch ISR Project (NRC, 2011b). Assuming the NRC staff's review and approval of the licensee's decommissioning plan, the licensee's compliance with any applicable license conditions and regular NRC inspection and enforcement activities, the anticipated impact from decommissioning for the proposed action would be SMALL.

Under the No-Action Alternative, the Jane Dough Unit would not be licensed, and there would be no associated construction, operation, aquifer restoration, or decommissioning; therefore, there would be no wellfields associated with the Jane Dough Unit. Existing licensed activities in the area and associated impacts would likely continue.

4.13 Waste Management

As described in GEIS Section 4.3.12 (NRC, 2009), environmental impacts on waste management could occur during all phases of the ISR lifecycle. The Jane Dough Unit would generate radiological and nonradiological liquid and solid waste materials that must be handled and disposed of properly. Direct impacts would be those associated with the proposed construction, operation, aquifer restoration, and decommissioning of the Jane Dough Unit production units, and the impacts to waste management involving the additional generation of processing and decommissioning wastes that would require management and disposal. The

environmental impacts of each ISR lifecycle phase of the Jane Dough Unit are evaluated in the following paragraphs.

During the construction phase of the Jane Dough Unit, the primary waste produced would be nonhazardous solid waste. Examples of nonhazardous construction waste include building materials and piping. As discussed in EA Chapter 2 and Section 3.13, the licensee has proposed to dispose of nonhazardous solid waste at the Campbell County landfill located at Gillette, Wyoming, approximately 74 km [46 mi] northeast of the Jane Dough Unit. An alternate regional landfill is the Casper, Wyoming, landfill, approximately 98 km [61 mi] southwest of the Jane Dough Unit, if additional capacity is needed. As described in EA Chapter 2 and Section 3.13, the NRC staff expects that the licensee would obtain a WDEQ WYPDES permit to discharge well-development water into mud pits adjacent to drilling pads. The permit would require reporting of flow, pH, radium (Ra-226), uranium, TDS, and total suspended solids (TSS) to the WDEQ-WQD. Because well-development water would be managed onsite using permitted practices, there is available capacity for nonhazardous solid waste, and the ISR wellfield construction phase is expected to annually generate a small volume. Therefore, the NRC staff concludes that the impact on waste management from constructing the Jane Dough Unit would be SMALL.

During operations of the Jane Dough Unit, the liquid byproduct material generated from processing the wellfield solutions would include production bleed, waste brine streams from elution and precipitation, resin transfer wash, filter backwash water, and plant washdown water. The licensee would treat the liquid byproduct material stream onsite to remove uranium by ion exchange. The licensee would have to meet applicable U.S. Environmental Protection Agency (EPA), State of Wyoming, and NRC requirements before injection in a Class I deep disposal well. Disposal of liquid byproduct material at the Nichols Ranch ISR Project using up to four deep disposal wells (two have already been drilled) was previously evaluated (NRC, 2011b). The licensee is limited by NRC license condition to a CPP flow rate of 3,500 gpm and by WDEQ permit conditions for its deep disposal wells to an injection flow rate of 150 gpm (Uranerz, 2014b). The licensee has proposed a schedule of operations in the Nichols Ranch and Jane Dough Units which provides assurance that sufficient Class I deep disposal well capacity will remain available for the duration of the project (Uranerz, 2016a). The licensee's analysis supports the NRC staff's conclusion that waste management impacts from the disposal of liquid byproduct material via Class I deep disposal wells during ISR operations phase would be SMALL.

Solid byproduct material generated during operations could include spent resin, empty chemical containers and packaging, pipes and fittings, tank or storage pond sediments, contaminated soil from leaks and spills, and contaminated construction and demolition debris. The licensee has already obtained a disposal agreement for solid byproduct material that ensures disposal capacity would be available for solid byproduct material generated by the Jane Dough Unit and, therefore, the NRC staff concludes that the impacts on waste management from the disposal of solid byproduct material during the ISR operations phase would be SMALL.

Nonhazardous solid waste generated during operations could include facility trash, septic solids, and other uncontaminated solid materials (e.g., piping, valves, instrumentation, and equipment). Because the proposed generation rate of nonhazardous solid waste of 540 to 770 m^3 [700 to 1,000 yd^3] per year (Uranerz, 2014a) would be a small percentage of the landfill capacity (EA Section 3.13), the NRC staff concludes that the impact on waste management would be SMALL. Additionally, as described in EA Section 3.13, the small quantity of hazardous waste

that would be generated and managed in accordance with State and Federal laws would mitigate potential impacts and, therefore, the impacts would be SMALL.

In summary, based on the type and quantity of byproduct material and waste expected to be generated and the available capacity for disposal, the NRC staff concludes that the waste management activities during the ISR operations phase of the Jane Dough Unit would have a SMALL impact on waste management resources.

For the Jane Dough Unit, the licensee would use the same waste management systems during aquifer restoration as for ISR operations, with the exception of additional reverse osmosis units. Aquifer restoration waste management impacts considering reverse osmosis waste treatment were previously evaluated (NRC, 2011b) for the Nichols Ranch ISR Project, and the impacts were found to be SMALL. For the Jane Dough Unit, the potential combined demand during concurrent production and aquifer restoration activities was addressed in the preceding operations impact analysis, which concluded that sufficient Class I deep disposal well capacity is available. As such, other proposed waste streams, including solid byproduct material, nonhazardous solid waste, and hazardous waste would involve volumes and disposition similar to operations and impacts would therefore be SMALL.

In summary, based on the type and quantity of waste expected to be generated and the available capacity for disposal, the NRC staff concludes that the waste management actions during the ISR aquifer restoration phase of the Jane Dough Unit would have a SMALL impact on waste management resources.

The proposed decommissioning activities at the Jane Dough Unit would be comparable to those described in GEIS Section 2.6 for decommissioning wellfields (NRC, 2009). To disposition these wastes, the licensee proposed to conduct radiological surveys of decommissioned facilities and equipment and classify materials in accordance with the applicable disposition of the materials, including decontamination, recycling and reuse, disposal as byproduct material at a licensed facility, or disposal as nonhazardous solid waste at a municipal solid waste landfill (Uranerz, 2014b).

Decommissioning of the additional wellfields proposed in the Jane Dough Unit would generate additional waste relative to the waste volumes that were previously reviewed for the Nichols Ranch ISR Project. To evaluate the potential impacts, the NRC staff estimated the additional volume of decommissioning wastes associated with the Jane Dough Unit based on the wellfield decommissioning waste volume information evaluated previously for the Nichols Ranch ISR Project (NRC, 2011b) and other information as follows.

The volume of solid byproduct material that would be generated from decommissioning the two Jane Dough production units (over a planned 1-year decommissioning period) was estimated by the NRC staff considering available information. The amendment request did not include an estimate of the volume of this material. The estimated volume of decommissioning solid byproduct material previously considered in licensing the Nichols Ranch Project was based on information in the licensee's financial assurance bond estimate (hereafter, surety) as described in the SEIS for that licensing action (NRC, 2011b).

The Nichols Ranch ISR Project surety showed the majority of solid byproduct material from wellfield decommissioning would come from the removal of buried trunkline. The amount of trunkline material was determined by the size of the pipe and its length. In the absence of detailed information in the amendment request, the NRC staff assumed the Jane Dough

trunklines would be the same diameter as documented in the Nichols Ranch surety {20 cm [8 in] high density polyethylene (HDPE)}. Additionally, the NRC staff estimated the trunkline length using a map of the expected extent and location of Jane Dough Unit ore bodies (Uranerz, 2016a) and the existing location of the Nichols Ranch CPP (Uranerz, 2014b). The map-traced distance of an assumed trunkline trench following the contour of the ore body footprints and terminating at the Nichols Ranch CPP was approximately 9,800 m [32,000 ft]. The total trunkline length was assumed to be double the trench length or 20,000 m [64,000 ft] to accommodate two-way solution flow. Based on the pipe diameters in the licensee's surety, the NRC staff determined there would be 0.169 ft^3 of plastic in each foot of this pipe. Applying this factor to the estimated trunkline length and assuming chipped pipe has 30 percent of void space, the NRC staff estimates approximately 400 m^3 [520 yd^3] of chipped pipe (solid byproduct material) would be generated when the pipe is removed and processed for disposal during decommissioning. This trunkline volume is considerably lower than what was previously estimated for the Nichols Ranch ISR Project (NRC, 2011b). The length of trunkline in the prior Nichols Ranch ISR Project surety calculations was overestimated. In the most recent Nichols Ranch ISR Project surety revision, the licensee reduced the trunkline length to a value that more closely matches the size of the wellfield (Uranerz, 2016b). Additionally, the NRC staff's byproduct material estimates involved a lower plastic volume-per-pipe-length conversion factor (described previously) that was derived directly from the licensee's pipe diameter information and more closely approximated typical values for this size of pipe. The result of these updates is that the overall quantity of solid byproduct material from decommissioning wellfields at both Nichols Ranch and Jane Dough Units is minimal.

The licensee has a disposal agreement in place with a licensed facility to accept solid byproduct material to ensure adequate capacity is available for byproduct material disposal (EA Chapter 2 and Section 3.13). Based on the disposal agreement and availability of disposal capacity, the NRC staff concludes that the impact on waste management from the generation of byproduct material during decommissioning would be SMALL.

The volume of nonhazardous solid waste from decommissioning the Jane Dough Unit wellfields (e.g., pumps and header houses) was estimated by the NRC staff by scaling the estimates of the largest contributing waste streams described in the Nichols Ranch surety (Uranerz, 2013) to Jane Dough Unit considering the relative number of wells to determine the number of pumps and header houses that would be expected to support Jane Dough Unit operations. The resulting estimated volume of nonhazardous solid waste from decommissioning both Jane Dough Unit wellfields in 1 year is 370 m^3 [490 yd^3]. Because of the small quantity of waste, the available landfill disposal capacities of the Campbell County landfill in Gillette, Wyoming (EA Section 3.13), and the Jane Dough Unit duration (EA Chapter 2), the NRC staff concludes that there would be sufficient landfill capacity at the time of decommissioning. Based on this capacity analysis, the NRC staff concludes that the potential impacts of the Jane Dough Unit on nonhazardous solid waste management resources would be SMALL.

The hazardous waste streams from decommissioning would be similar to the waste streams generated during the ISR construction phase and could include used oil, batteries, and cleaning solvents. The licensee has a hazardous material program in place to comply with applicable EPA and WDEQ requirements for its handling, storage, and disposal at approved facilities. Because the volume of hazardous waste generated by the proposed action would be minimal and the waste would be handled, stored, and disposed of in accordance with applicable regulations, the NRC staff concludes that the impacts on waste management would be SMALL.

In summary, NRC staff concludes that the impacts to waste management resources during the decommissioning phase of the Jane Dough Unit would be SMALL for all materials, based on the type and quantity of waste expected to be generated and the available capacity for disposal.

Under the No-Action Alternative, the Jane Dough Unit would not be licensed, and there would be no associated construction, operation, aquifer restoration, or decommissioning; therefore, there would be no radioactive or nonradioactive liquid or solid waste would be generated because the facility would not be licensed. No earthmoving activities that could result in the generation of nonhazardous solid waste would occur, no buildings would be constructed, no wellfields would be developed, and no wastewater would be disposed of into the subsurface. No arrangements would need to be made for waste management.

5 CUMULATIVE IMPACTS

5.1 Introduction

The Council on Environmental Quality's (CEQ's) National Environmental Policy Act (NEPA) defines cumulative effects as "the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" [Title 40 of the *Code of Federal Regulations* (40 CFR) 1508.7]. Cumulative effects or impacts[2] can result from individually minor but collectively significant actions taking place over a period of time. A proposed project could contribute to cumulative effects when its environmental impacts overlap with those of other past, present, or reasonably foreseeable future actions.

The analysis of the cumulative impacts of the addition of the Jane Dough Unit to the Nichols Ranch ISR Project was based on publicly available information, information in the Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities (GEIS) (NRC, 2009), information in the Nichols Ranch Supplemental Environmental Impact Statement (SEIS) (NRC, 2011b), information provided in the application (Uranerz, 2014a,b, 2015, 2016), and general knowledge of the conditions in Wyoming and in the nearby communities, and reasonably foreseeable future actions that could occur.

5.1.1 Methodology

In assessing potential cumulative impacts, the individual resources, ecosystems, and human communities identified in the affected environment sections of Chapter 3 and information in the Nichols Ranch SEIS (NRC, 2011b) are the resource parameters evaluated in this analysis. Similarly, direct and indirect impacts identified in Chapter 4 and in the Nichols Ranch SEIS (NRC, 2011b) form the basis for the analysis in this chapter. The U.S. Nuclear Regulatory Commission (NRC) staff developed a methodology that follows CEQ guidance (NRC, 2009; CEQ, 1997).

1. Identify the initial potential cumulative impact issues of the proposed action based on the affected environment, the direct and indirect impacts of the proposed action, the cumulative impacts identified in past ISR licensing reviews, and the cumulative impact issues identified in the GEIS. For this environmental assessment (EA), these cumulative impact issues are discussed in EA Sections 5.1.2.1 through 5.1.2.7.

2. Identify the geographic scope for the analysis for each resource area. This scope will vary from resource area to resource area, depending on the geographic extent over which the potential impacts may occur; therefore, where appropriate, each individual resource area discussed in Sections 5.2-5.13 will note the geographic area covered in the analysis. For the cumulative impact issues in the region of the Jane Dough Unit, the general study area is an 80 kilometer (km) [50 mi (mile)] radius from the center of the Jane Dough Unit.

[2]For the purpose of this analysis, "cumulative impacts" is deemed to be synonymous with "cumulative effects."

3. With regard to the timeframe for assessing cumulative impacts, the analysis of cumulative impacts in this EA are based in significant measure on the results of the NRC's 2011 cumulative impacts analysis presented in the Nichols Ranch SEIS (NRC 2011b). In the Nichols Ranch SEIS, the NRC staff considered impacts through the expected life of the Nichols Ranch ISR Project, which at that time was expected to continue through the year 2020. The proposed action considered in this EA to add the Jane Dough wellfields would extend NRC-licensed activities through the year 2031. Therefore, for the resource-specific analyses in Sections 5.2 through 5.13 of this EA, the NRC staff either relies on new information to extend the cumulative effects analysis to 2031 or explains how the Nichols Ranch SEIS analysis extends to 2031.

   At the time the Nichols Ranch SEIS was prepared, the primary activity in the project region was a resurgence of mining industries (e.g., other ISR sites, coal mining, oil and gas extraction, coal bed methane development, and other mining). NRC staff assumed, for purposes of the cumulative impact analysis in the Nichols Ranch SEIS, that the resurgence in mining industries would continue through 2020, along with government and industry support to develop related infrastructure.

   However, since the Nichols Ranch SEIS was published in 2011, the mining industry in Wyoming has experienced a significant downturn. For example, Bullard (2016) predicts Wyoming will experience a 23 percent decrease in employment in the mining industry between 2014 and 2024. Therefore, the analysis in the Nichols Ranch SEIS is based on higher mining industry employment than currently predicted, and thus is conservative when applied to the Jane Dough Unit. The NRC staff compared the projected growth in mining and other mineral recovery activity in the Nichols Ranch SEIS to the projected downturn in the recent Bullard study. Based on that comparison, the staff concludes that if the projected downturn does not continue through 2031, or if growth resumes at the rates projected in the SEIS, the total mining and mineral recovery activity in the region by 2031 will not exceed the amounts projected in the SEIS. This is because the currently projected downturn will result in significantly lower total activity by the end of 2024, such that, even if very high growth rates resume after that period, it will take a significant amount of time for activity to recover to the rates occurring at the time the SEIS was issued and then to grow beyond the levels considered in the SEIS. Therefore, where the NRC staff relies in this EA on the previous Nichols Ranch SEIS analysis to extend the cumulative effects analysis to the year 2031, the NRC staff believes that Nichols Ranch SEIS analysis is bounding.

4. Identify other ongoing and prospective projects and activities in the area surrounding the project site that could affect the same resource areas as the proposed action. These projects and activities, called other past, present, and reasonably foreseeable future actions, are described in EA Section 5.1.2.

5. Assess the cumulative impacts on each resource area from the proposed action. The cumulative impacts are the incremental effects from the proposed action when added to the effects from other past, present, and reasonably foreseeable future actions. This analysis is informed by the cumulative impact issues identified in Step 1 and considers the potential environmental impacts identified in Chapter 4 and the impacts of other past, present, and reasonably foreseeable future actions identified in Step 4 that would occur within the resource-specific geographic scope and timeframe described in Steps 2 and 3.

6. The cumulative impacts are described using the same significance levels (SMALL, MODERATE, and LARGE) (NRC, 2003a) that were used in assessing the direct and indirect impacts of the proposed action in Chapter 4.

The NRC staff recognizes that many aspects of the activities associated with the Jane Dough Unit would have SMALL potential impacts on the affected resources. It is possible, however, that a potential impact that may be SMALL by itself, but could result in a MODERATE or LARGE cumulative impact when considered in combination with the impacts of other actions on the affected resource. Likewise, if a resource is regionally declining or imperiled, even a potential SMALL individual impact could be important if it contributes to or accelerates the overall resource decline. The NRC staff determined the appropriate level of analysis that was merited for each resource area potentially affected by the proposed action. The level of analysis was determined by considering the impact significance level to the specific resource, as well as the likelihood that the quality, quantity, and stability of the given resource could be affected.

5.1.2 Other Past, Present, and Reasonably Foreseeable Future Actions

The Jane Dough Unit would be located in the Wyoming East Uranium Milling Region as defined by the GEIS (NRC, 2009). This region encompasses large portions of northeastern Wyoming including the Powder River Basin (PRB). The PRB covers approximately 26,000 km^2 [10,000 mi^2] of land and holds the largest deposits of coal in the United States, as well as significant reserves of uranium and other natural resources (i.e., oil and gas). As such, there has been, and continues to be, extraction activities throughout the PRB. While coalbed methane (CBM) extraction was a dominant activity in the region for many years, the region has recently experienced a decline in CBM activity and an increase in oil and gas production as the result of evolving oil and gas drilling extraction techniques.

Federal agencies have completed several environmental impact statements (EISs) and EAs related to activities within the PRB Region. Most of these EISs and EAs are related to resource management actions on federal lands administered by the U.S. Bureau of Land Management (BLM) or U.S. Forest Service (USFS) and are focused on improving natural resource conditions and reducing adverse impacts from various human-related activities. In addition, the Jane Dough Unit would be a license amendment to an already existing license for the Nichols Ranch ISR Project. As part of the review for the Nichols Ranch ISR application, a cumulative impact analysis was conducted, which can also be applied to the Jane Dough Unit for some resource areas. As explain in Section 5.1.1 of this EA, where appropriate, information from the Nichols Ranch SEIS (NRC, 2011b) has been incorporated by reference for this cumulative impact analysis. The various past, present, and reasonably foreseeable future actions in the vicinity of the Jane Dough Unit are discussed in the next sections.

5.1.2.1 Uranium Recovery Sites

Within the cumulative impact study area of approximately 80 km [50 mi] surrounding the Jane Dough Unit, there are 14 uranium recovery or disposal sites that are either proposed, existing, or currently undergoing decommissioning (EPA, 2016; NRC, 2015b,c; 2016) (see EA Figure 5-1). The two conventional uranium mining sites that are undergoing decommissioning are the Bear Creek Uranium Recovery Project (Bear Creek) and Highlands Uranium Recovery Facility (Highlands). Bear Creek is owned by Bear Creek Uranium Company and is located approximately 48 km [30 mi] southeast of the Jane Dough Unit. Highlands is owned by Exxon Mobil Corporation and is located in Converse County, Wyoming, approximately 74 km [46 mi] southeast of the Jane Dough Unit.

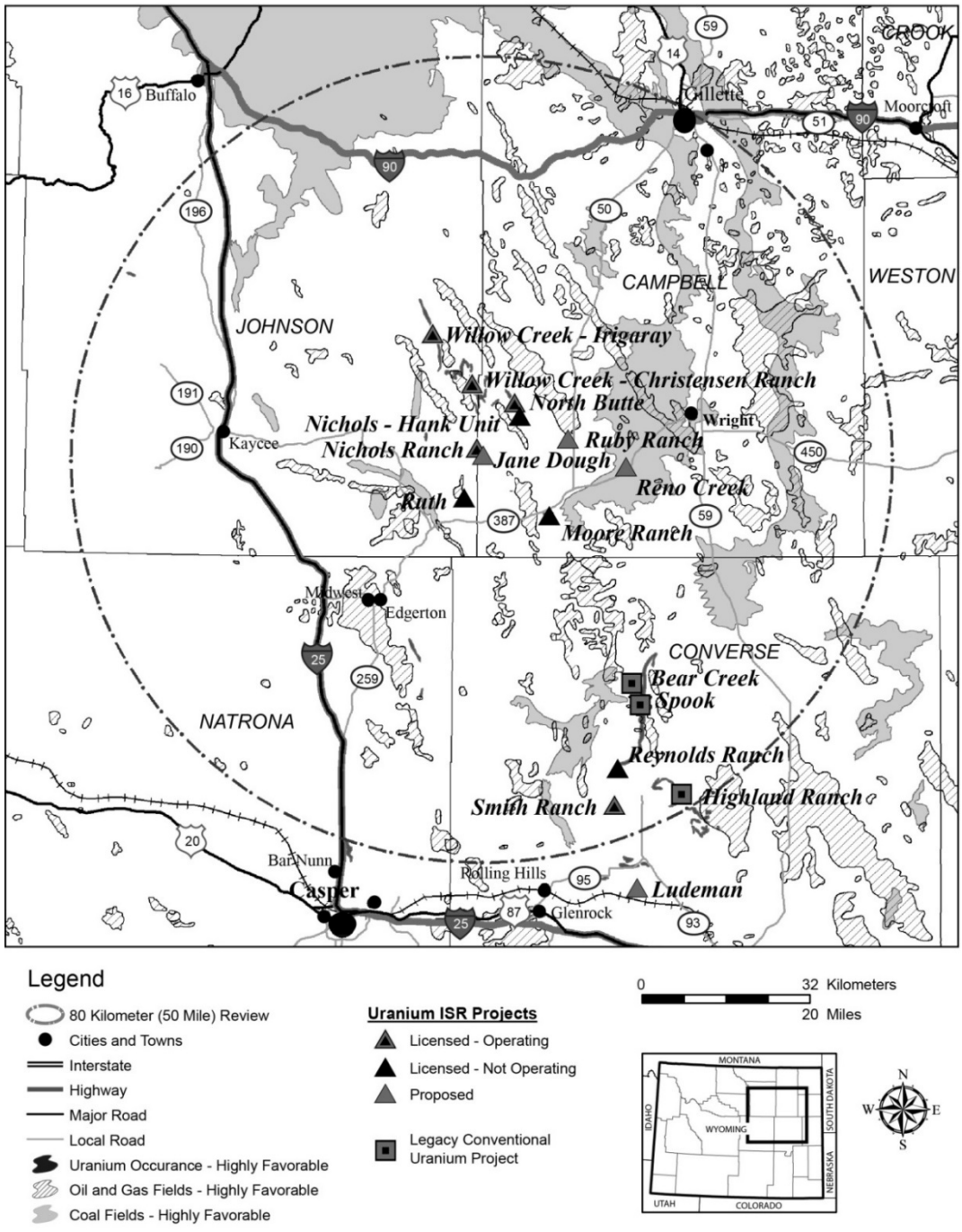


Figure 5-1. Potential and Existing Uranium Milling and Mining Sites Within 80 km [50 mi] of the Jane Dough Unit (NRC, 2016)

As noted in the GEIS Section 5.1 (NRC, 2009) uncertainties exist related to the cumulative effects of mineral production (which includes uranium recovery) due to varying extraction technologies, design of long-term monitoring programs, and the effectiveness of predictive models. However, the likelihood of mining projects, milling projects, or both being collocated has the potential to impact the surrounding environment. The various activities associated with uranium production would likely impact multiple resources areas (for example, land use, ecology, and groundwater).

5.1.2.2 Coal Mining

As of 2008, there were 13 operating surface coal mines in the Wyoming PRB area. Coal produced from these mines is over 96 percent of the coal produced in Wyoming each year (BLM, 2005a; 2011; 2013). Eight of these surface coal mines are operating within 80 km [50 mi] of the Jane Dough Unit (WMA, 2015). The remaining five surface coal mines are located in the Gillette area between 80 km [50 mi] and 97 km [60 mi] northeast from the Jane Dough Unit. One proposed mine (School Creek) is located approximately 72 km [45 mi] from the Jane Dough Unit (WMA, 2015). One reclaimed mine site (Dave Johnston) is located approximately 72 km [45 mi] south-southeast from the Jane Dough Unit in Converse County (WMA, 2015). No underground coal mines are operating within the cumulative impact study area. Surface mining of coal can 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 waste management (BLM, 2010; 2012b; 2013). The long-term historical trend in coal production is characterized by overall annual increases despite several annual production declines due to periodic unfavorable market conditions. Although difficult to accurately predict, existing coal mining operations are expected to continue.

5.1.2.3 Oil and Gas Production

Oil and gas exploration and extraction continue to occur throughout the Wyoming PRB, and within 80 km [50 mi] of the Jane Dough Unit. The application of improved technology and the emergence of unconventional plays (i.e., oil fields) led to an oil production increase of 19 percent from 2013 through the first three quarters of 2014 in the Wyoming PRB (WSGS, 2015). Directional and horizontal drilling, as well as hydraulic fracturing in unconventional plays, resulted in a nationwide surge in production between 2012 and 2014; however, U.S. oil production outpaced demand and is being adversely affected by low oil prices (EIA, 2015). U.S. natural gas production increased 35 percent between 2005 and 2013 and is expected to continue to increase through 2040 (EIA, 2015). Wyoming is projected to have produced 75 million barrels of oil in 2014, compared to the 63 million barrels of oil produced in 2013 (WSGS, 2015). The licensee reported that three active oil and gas wells are located on the Jane Dough Unit (Uranerz, 2014b).

Regional oil and gas exploration, production, disposal, and pipeline construction could potentially generate cumulative impacts. Construction of wells (production and disposal) necessitates the building of temporary access roads to reach and construct 1.2-ha [3-ac] drill pads for each drill site (BLM, 2009b). At that time, there would be a temporary increase in fugitive dust emissions due to the use of heavy machinery. During oil well production, the region would have an increase in traffic on county-maintained paved roads from oil trucks moving product to a refinery. Cumulative impacts to surface and groundwater from leaks and spills from oil and gas exploration activities can be found in EA Section 5.5.

5.1.2.4 Coalbed Methane Development

Since 2008, within the Wyoming PRB, and within 80 km [50 mi] of the Jane Dough Unit, CBM has been common, but has been in decline (WMA, 2015). Currently, CBM activities account for 18 percent of Wyoming's natural gas production. CBM has been declining due to (i) the drop in natural gas prices worldwide, (ii) the depletion of reservoirs, and (iii) competition from unconventional gas resources. Most of the remaining reserves in the PRB are currently not economically viable for development. The Wyoming Oil and Gas Conservation Commission (WOGCC) is in the process of reviewing options for the "orphaned" CBM wells that were abandoned but still remain in the PRB region (WGOCC, 2015). The overall life of each well is approximately 7 to 10 years, after which pipes are abandoned in place and well sites are reclaimed (NRC, 2009). There are 47 permitted or completed CBM wells located within the Jane Dough Unit (Uranerz, 2014b).

5.1.2.5 Energy Projects

Coal-Generating Plants

The Dave Johnston coal-fired power plant is the only coal-fired power plant within the cumulative impact study area. The plant is located approximately 72 km [45 mi] southeast of the Jane Dough Unit near the town of Glenrock. Owned and operated by PacifiCorp Energy, the plant was commissioned in 1958 and currently operates 3 units on a 1,011 ha [2,500 ac] site. The combined output of the 3 coal-fired units is 762 megawatts of electricity (PacifiCorp, 2011a).

There are two coal-fired power plants (Basin Electric's Dry Fork project and Black Hills Corporation's WYGEN 3 project) in operation near Gillette, Wyoming, between 80 km [50 mi] and 88 km [55 mi] northeast of the Jane Dough Unit. No additional coal-fired power plants are currently being planned for the Wyoming PRB, and given the uncertainty of current and potential air quality regulations, no additional plants are projected for operation by 2020 (BLM, 2011).

Wind Power

The southern portion of Wyoming has the greatest potential for wind energy in the state. However, Campbell and Johnson Counties also support commercial-scale wind generation projects. There are five projects within 80 km [50 mi] of the Jane Dough Unit:

- PacifiCorp's Glenrock, Glenrock III, and Rolling Hills Wind Projects provide power in the Wyoming PRB. Construction was completed on Glenrock's 66 1.5-MW turbines in 2008, on another 26 1.5-MW turbines for Glenrock III in 2009, and for 66 1.5-MW turbines for Rolling Hills in 2009. The wind farm cluster is located on 121 ha [300 ac] of the reclaimed Dave Johnston Coal Mine, approximately 72 km [45 mi] southeast of the Jane Dough Unit, generating up to 237 MW of energy (PacifiCorp, 2011b,c).

- Duke Energy (doing business as 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 68 km [42 mi] south of the Jane Dough Unit in Converse County and consists of 66 wind turbines generating 99 MW (PacifiCorp, 2015).

- Duke Energy built the Top of the World Wind Energy Project, a 200-MW wind farm consisting of 110 turbines located approximately 60 km [37 mi] south-southeast of the Jane Dough Unit. The project began commercial operation in 2010 (Duke Energy, 2015).

In addition to these operating projects, Third Planet Windpower has proposed a 150-MW wind project with 100 1.5-MW turbines. This proposed project, the Reno Junction Wind Project, would straddle a north-south stretch of Wyoming State Highway (SH) 50 approximately 13 km [8 mi] east of the Jane Dough Unit. The company received a construction and operations permit from the Wyoming Industrial Siting Council in July 2010, but did not begin construction within 3 years of the date of the permit. Therefore, the permit was revoked in August 2013 (WDEQ, 2016a). No other proposed wind energy projects have been identified in the cumulative impact study area.

Land disturbance for wind energy projects results from development of access roads, a turbine assembly pad, and a foundation pad for each wind turbine tower. Additional land disturbances result from installation of transformers and substations, underground electric and fiber optic communications cables, one or more operations and maintenance facilities, meteorological towers, and transmission lines 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). Wind-generating projects have an expected life of approximately 25 years, which could be extended based on market conditions and the overall condition of the infrastructure. Some redisturbance would occur at the time of decommissioning, followed by final reclamation (BLM, 2011).

5.1.2.6 Transportation Projects

The Dakota Minnesota and Eastern (DM&E) Railroad filed an application to construct the Powder River Basin Expansion Project with the federal Surface Transportation Board (STB) in February 1998. The project seeks approval to construct and operate a new rail line and associated facilities in east-central Wyoming and southwest South Dakota (STB, 2001). The project would require the construction of temporary roads to access the rail line right-of-way, thus potentially increasing project-related construction traffic and accidents along the new rail line corridor. Potential effects from construction of this project would be similar to effects from construction of roads evaluated for ISR facilities described in EA Chapter 4, including fugitive dust emissions, noise, incidental wildlife or livestock kills, increased sedimentation and degradation of surface water quality, and land surface and habitat disturbances. If approved and completed, the project will add coal-hauling rail capacity and establish a dedicated, direct route to transport coal from the PRB to Midwest markets. The extension will add 418 km [260 mi] of rail line and connect the northern DM&E line to operating coal mines located south of Gillette, Wyoming. At this time, Canadian Pacific—DM&E's parent company—has not yet decided whether to build the extension. The decision to build is contingent on several factors: (i) acquiring the necessary right-of-way to build the line, (ii) executing agreements with PRB mining companies for the right of DM&E to operate loading tracks and facilities, (iii) securing contractual commitments from prospective coal shippers to ensure that revenues from the proposed line are economical, and (iv) arranging financing for the project. No other major transportation projects were identified within the study area by the NRC staff.

5.1.2.7 Other Mining

Sand and gravel, bentonite, and clinker (scoria) have been and are being mined in the PRB. Sand and gravel (aggregate), borrow material, stone, clay (shale and bentonite), and clinker (scoria) have been and are being mined in the study area (USGS, 2011b). Aggregate resources are widespread in the study area and are quarried near the location of use to limit transportation costs. Aggregate mines can vary in size and location depending on the need of the industries relying on the products (BLM, 2011). In the PRB, the largest identified aggregate operation is located in northern Converse County. It has a total disturbance area of approximately 27 ha [67 ac], of which 1.6 ha [4 ac] have been reclaimed. Examples of potential adverse impacts from mining construction and operations would include increased noise, fugitive dust, haul traffic and road infrastructure damage, visual and scenic effects, land surface disturbance, diesel emissions, the potential for impacts to water quality, threatened and endangered species, and cultural resources. The NRC staff assumes that other mining operations would use existing transportation corridors, but may construct new access roads at some locations. Based on the common use of sand and gravel and clinker for road maintenance and coal mining, mining is expected to continue for the next 15 to 20 years (WMA, 2015b).

5.2 Land Use

The geographic study area considered for the analysis of cumulative impacts to land use is incorporated by reference from the Nichols Ranch ISR Project (NRC, 2011b). The Nichols Ranch ISR Project cumulative impacts study area incorporates the four counties (Campbell, Johnson, Converse and Natrona) surrounding the Nichols Ranch Unit. Therefore, because the Jane Dough Unit is directly south and adjacent to the Nichols Ranch Unit, the NRC staff finds that this study area and analysis are bounding and appropriate for the Jane Dough Unit land use cumulative impact analysis. The timeframe selected for the Jane Dough Unit analysis begins in 2015 and ends in 2031. Though the timeframe for the Nichols Ranch SEIS analysis of cumulative impacts ended in the year 2020, the NRC staff considers the results of the analysis for land use to extend to 2031 because: (1) activities such as livestock grazing and hunting are long-term activities that have persisted for generations and are likely to continue; and (2) as explained below, energy projects (e.g., uranium recovery, CBM production, wind energy, etc.) are expected to continue at levels previously projected or lower.

The NRC staff evaluated cumulative impacts within the study area between 2007 and 2020 for the Nichols Ranch ISR Project (NRC, 2011b). Past, present, and reasonably foreseeable actions considered as part of the Nichols Ranch ISR Project cumulative impacts analysis included evaluation of: (i) livestock grazing, (ii) disturbed vegetation due to ongoing resource development, (iii) oil and gas development, (iv) CBM development, (v) coal mining, and (vi) uranium resource extraction. The NRC staff determined that all past, present, and reasonably foreseeable actions would result in a MODERATE cumulative impact on land use. Because the land use study area is the same, the NRC staff concludes that the cumulative impact is the same for the Jane Dough Unit.

The NRC staff further determined that the Nichols Ranch ISR Project would have a SMALL incremental effect on land use when added to the MODERATE cumulative impacts from all other past, present, and reasonably foreseeable actions. The determination was based on the small amount of total disturbed land from the Nichols Ranch ISR Project—120 ha [300 ac] and an additional 24 ha to 32 ha [60 to 80 ac] fenced off from grazing activities. By comparison, the Jane Dough Unit would disturb a total of 40.8 ha [101 ac] (Uranerz, 2014a); therefore, a similar

impact assessment can be applied to the Jane Dough Unit for all other past, present, and reasonably foreseeable actions.

Given that the Jane Dough Unit cumulative impact analysis extends to 2031, additional consideration was given to activities not previously covered under the Nichols Ranch ISR Project timeframe. Of the activities in the study area (e.g., livestock grazing, hunting, uranium recovery, and CBM development), the NRC staff assumes that both livestock grazing and hunting would continue at the current rate. However, since all land within the Jane Dough Unit boundary is privately owned land, hunting would only be allowed with the permission of the land owner, and the land owner has committed to restricting hunting within the Jane Dough Unit boundary (Uranerz, 2014a, 2016). Although there are 47 permitted or completed CBM wells located within the Jane Dough Unit (Uranerz, 2014b), CBM development has been in decline since 2008 and there are no new CBM projects planned within or near the Jane Dough Unit. Additionally, there are three active oil and gas wells located on the Jane Dough Unit (Uranerz, 2014b), but the licensee has stated that no further oil and gas development would take place in any unit of the Nichols Ranch ISR Project area (Uranerz. 2014a).

The NRC staff determined that for all phases of the Jane Dough Unit, land use impacts would be SMALL (EA Section 4.2). This was based on the following factors: (i) the types of land use activities the licensee proposes are similar to those evaluated in the Nichols Ranch (SEIS (NRC, 2011b); (ii) the addition of the Jane Dough Unit would disturb 40.8 ha [101 ac] of land, which is at the small end of the 50 to 750 ha [120 to 1,860 ac] range analyzed in the GEIS (NRC, 2009); (iii) all the land within the Jane Dough Unit is privately owned land with restricted access, (iv) impacts from road, wellfield, and pipeline construction would be temporary (i.e., would only occur during the construction phase timeframe), and v) all disturbed land, except roads remaining at the request of the land owner, would be reseeded and reclaimed during decommissioning.

Based on this information, the NRC staff concludes that the addition of the Jane Dough Unit to the existing Nichols Ranch ISR Project would have a SMALL incremental effect on land use when added to the MODERATE cumulative impacts from past, present and reasonably foreseeable future projects.

5.3 Transportation

The geographic study area considered for the analysis of cumulative impacts to transportation is incorporated by reference from the Nichols Ranch ISR Project (NRC, 2011b). The Nichols Ranch ISR Project cumulative impacts study area incorporates the Campbell, Johnson, and Natrona counties. This study area was selected because major transportation routes within the region (both Interstate and U.S. Highways) occur within these three counties, and the Jane Dough Unit is in both Campbell and Johnson counties (see EA Figure 2-1). Therefore, because the Jane Dough Unit transportation resources are appropriately covered in the Nichols Ranch ISR Project analysis, the NRC staff concludes that this study area and analysis are bounding and appropriate for the Jane Dough Unit transportation cumulative impact analysis. The timeframe selected for the Jane Dough Unit analysis begins in 2015 and ends in 2031. Though the timeframe for the Nichols Ranch SEIS analysis of cumulative impacts ended in the year 2020, the NRC staff considers the results of the analysis for transportation to extend to 2031 because most of the cumulative impacts on transportation resources in the study area were considered to be from future ISR projects, CBM projects, and oil and gas operations, which are expected to continue at the same intensity or lower for the foreseeable future.

Past, present, and reasonably foreseeable impacts on transportation resources were discussed in the Nichols Ranch ISR Project SEIS (NRC, 2011b). That analysis noted that impacts could occur from the following: (i) increased traffic on transportation corridors would have a potential increase in traffic impacts, (ii) any new ISR facilities would require construction of new road surfaces or improvement of existing roads, (iii) CBM and oil and gas extraction activities could increase vehicular traffic (and potential for accidents), and (iv) all increases in transportation activities would increase the wear and tear on existing roads. Therefore, the NRC staff concluded that impacts to transportation resources resulting from past, present and reasonably foreseeable future ISR projects, CBM projects, and oil and gas operations with transportation requirements would be MODERATE (NRC, 2011b). This conclusion also applies to the Jane Dough Unit analysis.

As discussed in EA Section 4.3, for the Jane Dough Unit, transportation resources would be utilized predominately during the construction phase when earthmoving equipment, supplies, and the highest number of workers commuting would be utilizing the roads. During both operations and aquifer restoration phases, use of transportation resources would be minimal and would be limited to travel on access roads due to maintenance work on wellfields and associated infrastructure. For the decommissioning phase, activities include transporting construction equipment and workers to and from the wellfields and transporting waste material shipments to offsite disposal facilities. During decommissioning, the travel on roads would be less than during construction. For all phases of the Jane Dough Unit, the impact to transportation resources would be SMALL.

Based on this information, the NRC staff concludes that the cumulative impacts to transportation resources as the result of the addition of the Jane Dough Unit to the existing Nichols Ranch ISR license would have a SMALL incremental effect on the MODERATE cumulative impacts resulting from past, present and reasonably foreseeable future projects.

5.4 Geology and Soils

The geographic study area considered for the analysis of cumulative impacts to geology and soils is incorporated by reference from the Nichols Ranch ISR Project (NRC, 2011b). The Nichols Ranch ISR Project cumulative impacts study area incorporates Campbell and Johnson counties as well as another bordering county, Sheridan. This study area was selected because the Nichols Ranch Unit is centrally located with this area, and because the Jane Dough Unit is directly south and adjacent to the Nichols Ranch Unit, the study area is appropriate for this EA. Because the Jane Dough Unit geology and soils resources are appropriately covered under the Nichols Ranch ISR Project analysis, the NRC staff concludes that this study area and analysis is bounding and appropriate for the Jane Dough Unit geology and soils cumulative impact analysis. The timeframe selected for the Jane Dough Unit analysis begins in 2015 and ends in 2031. Though the timeframe for the Nichols Ranch SEIS analysis of cumulative impacts ended in the year 2020, the NRC staff considers the results of the analysis for geology and soils to extend to 2031 because most of the cumulative impacts on geology and soil resources in the study area were considered to be from future ISR projects, CBM projects, and oil and gas operations, which are expected to continue at the same intensity or lower for the foreseeable future.

In the Nichols Ranch ISR Project cumulative impact analysis, the NRC staff evaluated the soil disturbance for all past, present, and reasonably foreseeable future actions. These activities included oil and gas exploration and development, CBM development, coal mining, and other ISR activities. Collectively these mineral extraction projects would contribute to soil disturbance

of approximately 76,393 ha [168,000 ac] (NRC, 2011b). Direct effects on geology from these activities would be limited to excavation and relocation of disturbed bedrock and unconsolidated surficial materials associated with surface disturbances. In the Nichols Ranch ISR Project cumulative impact analysis, the NRC staff determined that the cumulative impact on geology and soils within the study area resulting from past, present, and reasonably foreseeable future actions would be MODERATE (NRC, 2011b). Additional surface and subsurface disturbing activities occurring after the Nichols Ranch ISR cumulative impact assessment timeframe would be expected to be similar to those described and analyzed in the Nichols Ranch ISR Project SEIS. Therefore, the NRC staff concludes that the cumulative impacts to geology and soils would remain MODERATE. These conclusions also apply to the Jane Dough Unit analysis.

As discussed in EA Section 4.4, because of the limited extent of the construction area {for a total disturbed area of 40.8 ha [101 ac]}, topsoil stockpiling procedures {topsoil salvaged 54.6 ha [135 ac]}, erosion control methods, and BMPs (e.g., berms, seeding), the impacts to soils at the Jane Dough Unit would be SMALL. As also noted in EA Section 4.4, impacts to geologic resources would be limited to use of aggregate (e.g., sand and gravel), and activation of geologic hazards (e.g. landslides and rockfalls); therefore, the NRC staff concludes that the impact to geologic resources would be SMALL.

Based on this information, the NRC staff concludes that the cumulative impacts to geology and soils resources as the result of the addition of the Jane Dough Unit to the existing Nichols Ranch ISR license would have a SMALL incremental effect on the MODERATE cumulative impacts resulting from past, present and reasonably foreseeable future projects.

5.5 Water Resources

The geographic study area considered for the analysis of cumulative impacts to water resources is incorporated by reference from the Nichols Ranch ISR Project (NRC, 2011b). The Nichols Ranch ISR Project cumulative impacts study area for surface water and wetlands is confined to the Dry Fork Basin of the Upper Powder River because the Nichols Ranch Unit is located within this drainage basin and could potentially be affected by other activities that discharge surface water to drainages within this basin. The Jane Dough Unit stream drainages, Cottonwood and Seventeen mile Creeks, are ephemeral in nature and both drain into the Dry Fork River; therefore, the Jane Dough Unit is within the Dry Fork Basin of Upper Powder River. The Nichols Ranch ISR Project cumulative impacts study area for groundwater includes an 80 km [50 mi] radius around the Nichols Ranch Unit. The NRC staff finds that the study area and analysis are bounding and appropriate for the Jane Dough Unit water resources cumulative impact analysis. The timeframe selected for the Jane Dough Unit analysis begins in 2015 and ends in 2031. Though the timeframe for the Nichols Ranch SEIS analysis of cumulative impacts ended in the year 2020, the NRC staff considers the results of the analysis for water resources to extend to 2031 because most of the cumulative impacts on water resources in the study area were considered to be from future ISR projects, CBM projects, and oil and gas operations, which are expected to continue at the same intensity or lower for the foreseeable future.

Surface Waters and Wetlands

Past, present, and reasonably foreseeable actions considered as part of the Nichols Ranch ISR Project cumulative impacts analysis for surface water and wetlands included evaluation of: (i) CBM-produced water, (ii) uranium resource development, and (iii) oil and gas development. The NRC staff determined that all past, present, and reasonably foreseeable actions would result in a MODERATE cumulative impact on surface water and wetlands. The Nichols Ranch

ISR Project cumulative analysis concluded that no surface water would be discharged as part of the Nichols Ranch ISR Project operations, and the potential impact to onsite ephemeral channels would be from increased surface water runoff. In addition, potential impacts to surface water features (ephemeral streams) would be mitigated through the industrial and construction Wyoming Pollutant Discharge Elimination System (WYPDES) permits the licensee would be required to obtain. The NRC staff determined that the Nichols Ranch ISR Project would have a SMALL incremental effect on surface water and wetlands when added to the MODERATE cumulative impacts from all other past, present, and reasonably foreseeable actions (NRC, 2011b).

As discussed in EA Section 4.5.1, for the Jane Dough Unit, the licensee would avoid constructing injection, production, and monitoring wells in channels and washes wherever possible to minimize damage from soil erosion (Uranerz, 2016). The use of heavy duty vehicles and machinery during the construction and decommissioning phases may lead to spillage of fuels and lubricants. In addition, pipeline and wellhead leaks could potentially spill process-related fluids during wellfield operations. When spill fluid is transported with surface water runoff generated by local rainstorms and snowmelt events, such spills may cause water quality degradation to nearby receiving streams. If a well were to be installed in an ephemeral drainage, appropriate erosion protection controls would be implemented to minimize damage. Such controls would include grading and contouring, culvert installation, low-water crossings constructed of stone, and designated traffic routes to minimize off-road travel (Uranerz, 2014a). The licensee's program for operational surface water monitoring combined with best management practices (BMP) implementation (e.g., energy dissipaters and wellhead barriers) and compliance with requirements of the licensee's WDEQ construction and WYPDES permits would protect surface water from excessive storm water discharges and minimize potential water quality impacts. Therefore, the NRC staff concludes that the impact on surface water resources would be SMALL.

A single jurisdictional wetland was identified within the Jane Dough Unit (EA Sections 3.5.1 and 4.5.1) (Uranerz, 2014a). This wetland is located outside of the disturbed area associated with the Jane Dough Unit production areas, but within the Jane Dough Unit boundary. In addition, approximately 91 m [300 ft] of a delineated Waters of the U.S. (WOTUS) is located inside the boundary of Production Unit #1. The WOTUS could potentially be disturbed by Jane Dough wellfield development and operations. The licensee stated that the potential impact to this WOTUS would be mitigated through implementation of BMPs specified in the WYPDES permit. Pipelines crossing this WOTUS would be installed below grade, backfilled after installation, and would not block surface water flow in this area (Uranerz, 2014a). Through implementing mitigations specified in the WYPDES permit, as well as any mitigation from the U.S. Army Corps of Engineers (for the wetland area), the NRC staff concludes that the impacts to wetlands and WOTUS would be SMALL.

Based on the information from the Nichols Ranch ISR Project analysis of past, present and reasonably foreseeable future actions, and the Jane Dough Unit surface water and wetlands analysis, the NRC staff concludes that the cumulative impacts to surface water and wetlands as the result of the addition of the Jane Dough Unit to the existing Nichols Ranch ISR license would have a SMALL incremental effect on the MODERATE cumulative impacts resulting from past, present and reasonably foreseeable future projects.

Groundwater

Cumulative impacts on groundwater resulting from the interaction between ISR activities and CBM activities and oil and gas production in the subsurface could occur but are not likely because CBM and oil and gas production and ISR activities are conducted in stratigraphically separate aquifers separated from the ore production zone by hundreds to thousands of feet of rock. Other ISR projects located within the 80 km [50 mi] study area used for the Nichols Ranch ISR analysis are located at sufficient horizontal distances such that the potential cumulative impact on groundwater levels at or near the Nichols Ranch ISR Project would be SMALL. In addition, under NRC regulations, ISR sites are required to implement excursion detection, control, mitigation, and remediation plans which would further reduce the overall impact. Class I deep disposal wells are a method of disposing of process wastewater. Deep disposal wells are used by CBM, ISR, and oil production facilities in the Powder River Basin. For deep well disposal, UIC Class I permits from the WDEQ are required for the targeted deep aquifer. The WDEQ would grant the permit if the deep disposal well location and flow rate is safe for public health and safety and would not impact any potential underground sources of drinking water. Because of these permitting requirements and use of remediation and best practices, the NRC staff determined that the cumulative impact on groundwater resources within an 80 km [50 mi] radius of the Nichols Ranch ISR Project resulting from past, present, and reasonably foreseeable future actions would be MODERATE. This conclusion also applies to the Jane Dough Unit.

As discussed in EA Section 4.5.2, based on the depth to surficial groundwater in the Jane Dough Unit production units, limited use of the surficial aquifers for domestic and agricultural uses, and lack of hydraulic connection between the surficial groundwater and other important local and regional aquifers, the NRC staff concludes that overall impacts on the surficial aquifers at the Jane Dough Unit could be SMALL to MODERATE. However, required well mechanical integrity testing and implementation of the leak detection and spill correction program would mitigate potential impacts (i.e., early detection and cleanup) and result in SMALL impacts for all project phases. Consumptive water use would result in a small increase in drawdown. The licensee would implement mitigation measures (e.g., well replacement) if a flowing well is impacted. Results from multi-well pump tests (Uranerz, 2014b, 2016) indicate minimal leakage across aquitards from either overlying or underlying aquifers, and net loss of groundwater from the production aquifer would be replaced by aquifer recharge. Therefore, the NRC staff concludes that the impact from consumptive water use at the Jane Dough Unit would be SMALL. Due to monitoring of injection and production wells, and properly plugged abandoned wells, the NRC staff concludes that the impact to groundwater quality would be SMALL.

The NRC staff concludes that the cumulative impacts to groundwater, as the result of the addition of the Jane Dough Unit to the existing Nichols Ranch ISR license would have a SMALL incremental effect on the MODERATE cumulative impacts to groundwater resources resulting from past, present and reasonably foreseeable future projects.

5.6 Ecological Resources

The geographic study area considered for the analysis of cumulative impacts to ecology is an 80 km [50 mi] radius from the center of the Jane Dough Unit. This study area is different than that analyzed in the Nichols Ranch ISR Project. However, the Jane Dough Unit is within the Wyoming PRB; therefore, impacts that are occurring in the Wyoming PRB summarized in EA Section 5.1.2 are applicable to the Jane Dough Unit. Activities occurring in the PRB include

livestock grazing (cattle and horses), wildlife herd management, hunting, uranium recovery, CBM production, wind energy, and oil and gas exploration. In addition, a regional transportation project is planned for transporting coal. The timeframe selected for the analysis begins in 2015 and ends in 2031. Though the timeframe for the Nichols Ranch SEIS analysis of cumulative impacts ended in the year 2020, the NRC staff considers the results of the analysis for ecological resources to extend to 2031 for two reasons: (1) the cumulative impacts on ecological resources in the study area were considered to be from future ISR projects, CBM projects, and oil and gas operations, which are expected to continue at the same intensity or lower for the foreseeable future; (2) an underlying BLM analysis considered by the NRC staff (BLM, 2013b) extended through 2030, as explained below.

The NRC staff evaluated cumulative impacts within the Wyoming PRB between 2012 and 2020 for the Nichols Ranch ISR Project (NRC, 2011b), and determined that the proposed Nichols Ranch ISR Project would have a SMALL incremental effect on terrestrial ecology and protected species in a 80-km [50-mi] radius study area around the Nichols Ranch Project when considered with all other past, present, and reasonably foreseeable actions. The NRC staff concluded that that the overall cumulative impact on terrestrial ecology and protected species within the Nichols Ranch study area resulting from all past, present, and reasonably foreseeable future actions would be MODERATE. The NRC staff concluded that the Nichols Ranch ISR Project would have a SMALL incremental effect on aquatic ecology when added to the SMALL cumulative effects from all other past, present, and reasonably foreseeable future actions in the cumulative impacts study area.

The known mineral- and energy-development activities (including wind energy projects, transportation projects, and coal, oil, and gas extraction developments) that occur within the Wyoming PRB are summarized in EA Section 5.1.2. BLM conducted a cumulative effects analysis for vegetation and wildlife for the Wyoming PRB through 2030 (BLM, 2013b). Although the BLM's analysis stops in 2030 and the Jane Dough Unit analysis extends to 2031, NRC staff determines that the BLM analysis remains adequate for comparing potential impacts to the Jane Dough Unit. Potential effects to ecological resources with the region of influence, both flora and fauna, are similar to those described in EA Section 4.6 and include loss, alteration, or incremental fragmentation of habitat; displacement of and stresses on wildlife; modification of prey and predator communities; direct or indirect mortalities; reduction in forage productivity; degradation of water quality; and potential spread of invasive species and noxious-weed populations. Development activities in the Wyoming PRB could potentially reduce wildlife populations if habitats adjacent to land in the 80 km [50 mi] radius around the Jane Dough Unit are at, or near, their carrying capacity (e.g., the maximum population an area will support) for a species, considering that there may be an unavoidable reduction or alteration of existing habitats (BLM, 2013b). For some species that require specific conditions for their habitats (e.g., small mammals), future populations would be strongly influenced by the quality and composition of the remaining habitats.

Terrestrial Ecology

BLM estimated that by 2030 approximately 171,471 ha [423,716 ac] (approximately 5.2 percent) of the vegetation in the Wyoming PRB Coal Review study area, including wetland and riparian vegetation, will have been disturbed by all mineral, energy (excluding wind), and transportation projects (BLM, 2013b). BLM estimated that 60 percent of these disturbances would occur in sagebrush shrubland communities. BLM also estimated that by 2030, approximately 58 percent of these disturbances would be reclaimed, and that the remaining disturbed area would be reclaimed incrementally or following a project's completion, depending on the type of

development activity and permit requirements. BLM estimates that approximately 171,272 ha [423,716 ac] of the PRB Coal Review study area, or approximately 5.2 percent, is habitat for terrestrial species (e.g., big game, upland game birds, raptors, waterfowl and shorebirds, nongame and migratory birds, small- and medium-sized mammals, reptiles, and amphibians) that could be disturbed by 2030 (BLM, 2013b). To assess the extent of cumulative vegetation and wildlife effects within the 80-km [50-mi] study area around the Jane Dough Unit, the NRC staff assumes the same percentage of vegetation and habitat disturbance (including wetland and riparian vegetation) as the BLM Wyoming PRB estimate for mineral, energy (excluding wind), and transportation projects. Wind energy projects have the potential to increase mortalities to birds and bats from collisions with wind turbine blades, particularly in migration routes (BLM, 2005b). Using a conservative estimate of 1 ha [2.47 ac] of disturbance per megawatt (MW) of wind energy produced, an additional 0.2 percent {536 ha [1,325 ac]} of land could be disturbed from development of wind energy projects within 80-km [50-mi] of the Jane Dough Unit (Denholm et al., 2009). These disturbances would total approximately 106,313 ha [262,706 ac] of vegetation within the 80-km [50-mi] radius around the Jane Dough Unit. Assuming 58 percent of these disturbances would be reclaimed by 2030 per BLM's estimates; the remaining 44,652 ha [110,337 ac], or about 2.2 percent of the study area, of vegetation would still be disturbed at the end of 2030.

Reclamation of disturbed areas would proceed concurrently with operations during mining and drilling projects, which would mitigate these impacts. The NRC staff anticipates that the requirements of WDEQ-approved permits (i.e., weed management, timely revegetation, groundwater monitoring, and discharge water quality control) would ensure that vegetation and habitats support a stable ecosystem (WDEQ, 2006a,b). Federal laws and regulations protect the majority of birds found in the Wyoming PRB (see EA Section 4.6), as do U.S. Fish and Wildlife Service (FWS) requirements under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA). WDEQ may also enforce other mitigation measures for projects such as speed limits, fencing and overhead power line construction techniques that limit effects on wildlife, and timing and buffer stipulations. Therefore, with the exception of the Greater sage-grouse, the overall cumulative impact to terrestrial vegetation and wildlife from the addition of the Jane Dough to the Nichols Ranch ISR Project would be SMALL. Greater sage-grouse is a species that the FWS previously considered for listing on the Endangered Species Act (ESA), and which continues to be at risk because of population declines related to habitat loss and degradation, particularly in sagebrush shrubland vegetation. Oil and gas development is regarded as playing a major role in the decline of the Greater sage-grouse species (BLM, 2015; Taylor et al., 2012). Therefore, because oil and gas development activities are occurring in the 80 km [50 mi] radius surrounding the Jane Dough Unit, the cumulative impacts from all past, present and reasonably foreseeable actions would be MODERATE to the Greater sage-grouse.

As discussed in EA Section 4.6, the potential impact on vegetation and terrestrial wildlife, taking into account the licensee's proposed mitigation measures for the Jane Dough Unit, would be SMALL. Vegetation within the Jane Dough Unit is primarily the sagebrush grassland plant community. As described in EA Section 4.6, approximately 40.8 ha [101 ac], or 0.4 percent of the 80 km [50 mi] radius around the Jane Dough Unit would be disturbed. Of the 40.8 ha [101 ac], less than 4.4 ha [11 ac] of sagebrush vegetation would be disturbed. Thus, the Jane Dough Unit's incremental impacts to cumulative impacts would be SMALL when added to the SMALL cumulative impacts on terrestrial vegetation and wildlife from all past, present, and reasonably foreseeable future actions in the cumulative impact study area. However, for the reasons previously detailed in this section, cumulative impacts to the Greater sage-grouse

would continue to be MODERATE, even with the addition of the Jane Dough Unit to the Nichols Ranch ISR Project.

Aquatic Ecology

In the PRB, CBM and coal mining projects use or manage the majority of water resources as part of their operations (BLM, 2013b). BLM estimated that the small remaining amounts of surface water flow from these projects would discharge into intermittent and ephemeral streams within the Upper Powder River subwatershed, but would have little or no effect on stream flows due to high evaporation and infiltration rates before the discharges reach the streams. Further, BLM determined that the contribution of coal-related development under a high-production scenario in year 2030 would have low effects on fish in the Upper Powder River subwatershed, and are not expected to significantly impact surface water quality (BLM, 2013b). BLM also anticipates that construction and operation of reasonably foreseeable future activities within the PRB would be temporary, localized, and would not occur within stream channels and would not result in removal of ponds or reservoirs; thus, no direct loss or alteration of aquatic habitat would occur (BLM, 2013b). To assess the extent of impacted aquatic resources as a result of the projects discussed in EA Section 5.1.2, the NRC staff assumes that the effects from all projects including wind energy projects would also not result in direct loss or alteration of aquatic habitat. Because the majority of the water uses in the PRB are for coal-related projects, which are not expected to significantly impact surface water quality, the NRC staff concludes that the cumulative impact on aquatic ecology resulting from all past, present, and reasonably foreseeable future actions in the 80-km [50-mi] radius surrounding the Jane Dough Unit would be SMALL. In addition, all proposed activities in this study area would be regulated by a WYPDES permit and would comply with federal and state water quality regulations, which would reduce impacts on aquatic ecology.

As described in EA Section 4.6, because of the limited and ephemeral nature of surface water at the Jane Dough Unit, the occurrence of aquatic species is also limited. No loss of aquatic habitat would result from planned ISR activities during any phase of the Jane Dough Unit. In addition, no surface water would be diverted, no process water would be discharged into an aquatic habitat, and stormwater runoff would be managed through the SWPPP and the WYPDES permit (as discussed in EA Section 4.6). The NRC staff concludes that the Jane Dough Unit would have a SMALL incremental effect on aquatic ecology when added to the SMALL cumulative effects from all other past, present, and reasonably foreseeable future actions in the cumulative impacts study area. This conclusion is based on the limited and ephemeral nature of surface water features within the Jane Dough Unit and because of the mitigation requirements associated with the required regulatory permits and licenses.

Protected Species and Species of Concern

A number of protected species and species of concern are or could be potentially present within the Wyoming PRB and 80 km [50 mi] radius surrounding the Jane Dough Unit, including the Ute ladies'-tresses orchid, Northern long-eared bat, Canada lynx, bald eagle, mountain plover, black-tailed prairie dog, and white-tailed prairie dog (BLM, 2009c; WGFD, 2010; see EA Section 3.6). For the purposes of this cumulative assessment, protected species and species of concern are those species for which state or federal agencies afford an additional level of protection by law, regulation, or policy. Potential impacts to terrestrial protected species and species of concern from regional projects in the 80 km [50 mi] radius around the Jane Dough Unit would be similar to those discussed previously in this section. Increased activity and noise from projects that occur within potential habitat for these species, especially during respective

breeding seasons, could decrease a species' use of a habitat or the overall suitability of a habitat (BLM, 2009c). However, given the location of development activities compared with the geographical occurrence of many of these species, and with mitigating permit requirements and state policies and federal regulations in place (e.g., the ESA and MBTA), the cumulative impacts from all past, present and reasonably foreseeable actions would be to protected species would be SMALL.

As discussed in EA Sections 3.6 and 4.6, no federally listed threatened or endangered plant species or critical habitat are known to occur within the Jane Dough Unit. FWS species of concern could potentially occur within the Jane Dough Unit (see EA Section 3.6). However, for reasons explained in EA Section 4.6, due to licensee commitments and mitigation measures, federal regulations and state policies and permit requirements, the NRC staff concludes that the Jane Dough Unit would have a SMALL impact on protected species and species of concern. Therefore, incremental impacts would also be SMALL when added to the SMALL cumulative impacts to protected species and species of concern from all past, present, and reasonably foreseeable future actions in the 80 km [50 mi] radius surrounding the Jane Dough Unit.

5.7 Air Quality

The NRC staff assessed the cumulative impacts to air quality primarily within an 80 km [50 mi] radius of the Jane Dough Unit, hereafter called the region of influence (or study area). There are minor differences in the study area analyzed in the Nichols Ranch ISR Project SEIS and the Jane Dough Unit. The main difference is how the study area was subdivided in the analysis, but both analyses cover the same geographic region. The assessment of the impacts within the region of influence will be called the near-field analysis, and the assessment of the impacts beyond the region of influence will be called the far-field analysis. The timeframe for the air quality cumulative impacts analysis runs from 2015 to 2031. This assessment first considers impacts from non-greenhouse gases followed by impacts from greenhouse gases.

Non-Greenhouse Gas Emissions

As described in EA Section 5.1.2, past, present, and reasonably foreseeable future activities that may contribute to pollutant emissions include uranium exploration and extraction, coal mining, oil and gas production, CBM development, energy projects, transportation projects, and ISR other projects. Air pollutants emitted by these sources potentially have cumulative impacts including, but not limited to, particulate matter from travel on unpaved roads and carbon monoxide, nitrogen oxides, sulfur dioxide, particulates, and volatile organic compounds from various types of combustion emissions.

Near-Field Analysis

The effects of past and present activities on the air quality in the near-field are represented in the National Ambient Air Quality Standards (NAAQS) compliance status and air monitoring results. WDEQ operates and maintains seven monitoring stations inside the region of influence whose primary purpose is to evaluate NAAQS compliance on an ongoing basis. EA Table B–9 contains monitoring results for these seven stations. The *Wyoming Ambient Air Monitoring Annual Network Plan 2016* reports that the results for these seven monitoring stations are in compliance with the NAAQS (WDEQ, 2016b).

The next part of the near-field analysis considers the various reasonably foreseeable future actions within the region of influence (EA Section 5.1.2). The potential for air emissions from

the Jane Dough Unit to overlap with other reasonably foreseeable future actions is reduced by the following factors:

- Mobile and fugitive sources generate all of the Jane Dough Unit's emissions (see EA Appendix B, Section B.1) and these types of sources do not generate emissions continuously.

- Particulate matter PM_{10}, the Jane Dough Unit's primary air pollutant, is almost entirely generated by travel on unpaved roads (see EA Appendix B, section B.1). Heavier particles (i.e., particulate matter PM_{10}) generated from travel on unpaved roads are the type of emission most likely to be removed from the air close to the generating source (Countess, 2001).

- Emissions vary over the lifetime of the Jane Dough Unit. As depicted in EA Appendix B, Table B–1, many of the project years generate much lower emission levels than the peak year.

- Wind direction at the Jane Dough Unit is predominately from the east (Uranerz, 2014a,b) which would transport pollutants away from the majority of the other air emission sources in the region of influence. In contrast, the wind direction for other ISR facilities located to the east of the Jane Dough Unit is predominately from the west or southwest (e.g., the. proposed Reno Creek ISR Project) which would transport pollutants from these sources away from the Jane Dough Unit.

According to information in EA Figure 5-1, there are six ISR projects within the region of influence that are either in the prelicensing stage or are licensed and not operating. The air emissions from other ISR project are similar in nature to the air emissions that would be produced by the Jane Dough Unit. The ISR projects staggered schedules and variable emission rates over a project's lifetime limit potential overlap. For example, the peak year particulate matter PM_{10} emission estimate for the combined Nichols Ranch, Hank, and Jane Dough units is only about 6 percent greater than the estimate for the individual Jane Dough Unit (see EA Appendix B, Table B–1). The predominant wind direction and relative location of the Jane Dough Unit to the other ISR projects reduces the potential for overlapping impacts.

Potential overlap of impacts between the Jane Dough Unit and other reasonably foreseeable future actions identified in EA Section 5.1.2 can be characterized in a similar manner to interactions between the Jane Dough Unit and other ISR projects. A proposed coal mine is located approximately 72 km [45 mi] from the Jane Dough Unit. The large distance between these two projects is the major factor that limits potential overlap of impacts. As depicted in EA Figure 5-1, highly favorable areas for oil and gas development occur about 8.0 km [5 mi] from the Jane Dough Unit. The potential for overlapping impacts with oil and gas development is limited by the same considerations identified for the potential cumulative effects between the Jane Dough Unit and the other ISR projects. In addition, there are no plans for new coal-fired power plants, wind generation projects, or increases in CBM development in the region of influence. The one potential new transportation project identified in EA Section 5.1.2.6 is the DM&E Powder River Basin Rail Expansion Project. Potential for overlapping impacts would be limited because the proposed rail project's emissions are not continuous and would be spread out over a large area rather than localized at one location. The predominant wind direction further reduces the potential for overlapping impacts. Other mining (e.g., sand, gravel, and

bentonite) in the vicinity disturbs small land areas, and the emissions are primarily generated from mobile and fugitive sources that do not operate continuously.

The NRC staff concludes that the cumulative impact on air quality within the region of influence resulting from other past, present, and reasonably foreseeable future actions is MODERATE because the ambient pollutant concentrations are noticeable but not destabilizing. EPA currently designates the region of influence as attainment areas for all pollutants, and recent monitoring results continue to support this classification. Based on the description of the reasonably foreseeable future actions in this section, the NRC staff expects this trend to continue within the region of influence for the Jane Dough Unit.

Cumulative impacts on air quality for the near-field include incremental effects from the Jane Dough Unit added to the aggregate effects of other past, present, and reasonably foreseeable future actions. The NRC staff concludes in EA Section 4.7 that the Jane Dough Unit fugitive dust emissions would overall have a SMALL impact and other pollutants would have a SMALL impact. When combining the incremental impacts from the Jane Dough Unit with all other MODERATE impacts from other past, present, and reasonably foreseeable future actions in the region of influence, the NRC staff concludes that the cumulative impact for the near-field would be MODERATE.

Far-Field Analysis

The collective emissions generated from all of the sources within the region of influence have the potential to affect receptors outside of the region of influence (i.e., the far-field). Analyses of the effects from regional emissions often focus on Class I areas since these areas have the greatest level of protection (i.e., the most stringent standards) under the Prevention of Significant Deterioration (PSD) program. Wind Cave National Park, the closest Class I area, is located about 185 km [115 mi] to the east of the Jane Dough Unit.

The effects of past and present activities on the air quality in the far-field are represented in the NAAQS compliance status and air monitoring results. Wind Cave National Park is in attainment (40 CFR 81.342). According to the South Dakota Ambient Air Monitoring Annual Network Plan (SDDENR, 2016), recent pollutant concentrations at the Wind Cave site are below the applicable NAAQS. In addition to attainment status, air quality at Class I areas also considers visibility impairment. Wind Cave National Park has experienced visibility impacts according to the South Dakota Department of Environment and Natural Resources Regional Haze State Implementation Plan (SDDENR, 2011).

Future impacts on the air quality in the far-field are less well-defined. In 2014, BLM published the most recent version of the Powder River Basin (PRB) Coal Review (BLM, 2014). The PRB Coal Review developed regional emission inventories for 2008 (the base year), 2020, and 2030 and conducted modeling based on these three inventories for several locations, including Wind Cave National Park. The information derived from the regional PRB modeling primarily relates to changes in pollution concentrations caused by variations in emissions levels over time from all of the emission sources within the region. The trend at the regional level is that both the 2020 and 2030 modeled concentrations for all pollutants remain unchanged or tend to decrease relative to the 2008 base year (BLM, 2014). In the recently published final EIS for the Buffalo Regional Management Plan (BLM, 2015), BLM noted concerns about the quality of the emission inventory and modeling in the PRB Coal Review (BLM, 2014). BLM stated in the final EIS that they would not be using the PRB Coal Review air quality analysis to inform planning decisions for the Buffalo Regional Management Plan or for future projects in the planning area (BLM,

2015). At this time, the NRC staff has not identified an appropriate information source to replace the PRB Coal Review air quality analysis.

The NRC staff concludes that current far-field impacts from all past and present actions are MODERATE because of the visibility impacts experienced at Wind Cave National Park. Based on the currently available information, the NRC staff expects future impacts to continue at a similar level. However, based on known flaws in the currently available information (BLM, 2014), the NRC staff acknowledges the possibility that future impacts to air quality could be LARGE. Therefore, the NRC staff determines that the far-field cumulative impacts on air quality resulting from other past, present, and reasonably foreseeable future actions could range from MODERATE to LARGE.

Although there is uncertainty concerning future impacts to the far-field, the contribution of the Jane Dough Unit to the far-field impacts is better understood. Uranium extraction only contributes a small portion of the overall emissions in the southern portion of the PRB (i.e., the location of the Jane Dough Unit). The only pollutant generated from uranium extraction activities that contributes more than one percent to the overall emission levels is nitrogen dioxide at two percent (BLM, 2014). These percentages are based on all of the uranium extraction projects in the southern portion of the PRB, not just a single project. Based on the relative contribution of the proposed activities at the Jane Dough Unit, the NRC staff concludes that the Jane Dough Unit would have a SMALL incremental effect on the far-field air quality. When combining the incremental impacts from the Jane Dough Unit with all the impacts from other past, present, and reasonably foreseeable future actions in the region of influence, the NRC staff concludes that the cumulative impact for the far-field would be MODERATE to LARGE.

Greenhouse Gas Emissions and Global Climate Change

The impact magnitude resulting from a single source or a combination of greenhouse gas emission sources over a larger region must be placed in geographic context for the following reasons:

- The environmental impact is global rather than local or regional.
- The effect is not particularly sensitive to the location of the release point.
- The magnitude of individual greenhouse gas sources related to human activity, no matter how large compared to other sources, are small when compared to the total mass of greenhouse gases resident in the atmosphere.
- The total number and variety of greenhouse gas emission sources is extremely large, and the sources are ubiquitous.

Consequently, the NRC staff determines that an appropriate approach to address the cumulative impacts of greenhouse gas emissions (including carbon dioxide) is to recognize that

- Greenhouse gas emissions contribute to climate change.
- Climate change is best characterized as the result of numerous and varied sources, each of which might seem to make a relatively small addition to global atmospheric greenhouse gas concentrations.

- The extent of the analyses should be commensurate with the quantity of greenhouse gas emissions generated by the proposed action.

- Carbon footprint and resilience to climate change are relevant factors in evaluating distinctions between the various alternatives.

- Analysis may include both the Jane Dough Unit's contribution to atmospheric greenhouse gas levels and the potential effects of climate change on the Jane Dough Unit.

These concepts are more fully developed in the "Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews" (CEQ, 2016). Evaluation of cumulative impacts of greenhouse gas emissions requires the use of a global climate model. The U.S. Global Change Research Program (GCRP) report (GCRP, 2014) provides a synthesis of the results of numerous climate modeling studies. The NRC staff concludes that the cumulative impacts of greenhouse emissions around the world as presented in the GCRP report are an appropriate basis for its evaluation of cumulative impacts. Based primarily on the scientific assessments of the GCRP and National Research Council, the EPA Administrator issued a determination in 2009 (74 FR 66496) that greenhouse gases in the atmosphere may reasonably be anticipated to endanger public health and welfare, based on observed and projected effects of greenhouse gases, their effect on climate change, and the public health and welfare risks and effects associated with such climate change. Based on the effects set forth in the GCRP report and the emissions threshold criteria and general approach implemented in the final EPA "Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule" (75 FR 31514), the NRC staff concludes that the national and worldwide cumulative impacts of greenhouse gas emissions are noticeable but not destabilizing (i.e., MODERATE).

Jane Dough Unit's Contribution to Atmospheric Greenhouse Gas Levels

The NRC staff considers that the Jane Dough Unit generates low levels of greenhouse gases relative to other sources. The Jane Dough Unit would generate an estimated total of 3,784 metric tons [4,171 short tons] of carbon dioxide (see EA Appendix B, Table B–5). For NEPA reviews, previous CEQ guidance identified 25,000 metric tons [27,558 short tons] of carbon dioxide equivalents as a reference point for determining whether quantitative analysis is appropriate and considering whether a proposed project potentially emits large levels of greenhouse gases (CEQ, 2014).). Similarly, in the Tailoring Rule, EPA established thresholds for greenhouse gas emissions to define whether sources are subject to EPA air permitting. Although not legally binding standards, the threshold for new sources was 90,718 metric tons [100,000 short tons] of carbon dioxide equivalents per year and for modified existing sources the threshold was 68,039 metric tons [75,000 short tons] of carbon dioxide equivalents per year. Because emission estimates for the Jane Dough Unit are below the CEQ reference point and EPA thresholds, the NRC staff concludes that the Jane Dough Unit would generate low levels of greenhouse gases relative to other sources (i.e., the project is not considered a large emitter or

source of greenhouse gases) and would have a SMALL impact on air quality in terms of greenhouse gas emissions.[3]

Mitigation is one response strategy for addressing climate change. EA Section 6.5 identifies potential mitigation measures identified by the NRC staff but not committed to by the licensee. These mitigation measures include minimizing unnecessary travel and minimizing vehicle and equipment idle time. The NRC staff acknowledges that any reduction of greenhouse gas emissions at the project level would be reflected in a reduction of the overall greenhouse gas levels. However, the need to implement mitigation for a given project should take into account the relative amount of greenhouse gases produced by that project. As previously described, the NRC staff concludes that the Jane Dough Unit would generate low levels of greenhouse gases relative to other sources.

Cumulative impacts include the incremental effects from the Jane Dough Unit when added to the aggregate effects of other past, present, and reasonably foreseeable future actions. The NRC staff concludes that the Jane Dough Unit would have a SMALL incremental impact on air quality in terms of greenhouse gas emissions when added to the MODERATE cumulative impacts anticipated from other greenhouse gas emissions from past, present, and reasonably foreseeable future actions. The NRC staff further concludes that the cumulative impacts would be noticeable but not destabilizing (i.e., MODERATE), with or without the greenhouse gas emissions of the Jane Dough Unit.

As described earlier in this section, the carbon footprint of the various alternatives is a relevant factor when evaluating potential impacts for the various alternatives. The No-Action Alternative eliminates the proposed project as a source of gaseous emissions that would contribute to the ambient greenhouse gas levels. The elimination of all project-level greenhouse gas emission distinguishes the No-Action Alternative from the proposed action alternative, which would generate low levels of greenhouse gases relative to other sources.

Potential Effect of Climate Change on the Jane Dough Unit

The NRC staff acknowledges that climate change may have impacts across a wide variety of resource areas, including air, water, ecological, and human health. The GCRP describes these potential impacts in the report Highlights of Climate Change Impacts in the United States: The Third National Climate Assessment (GCRP, 2014). In this section, the discussion of impacts from climate change on the environment focuses on those aspects of climate change that may affect the Jane Dough Unit (i.e., areas where the impacts of climate change and the Jane Dough Unit overlap).

Based on the information in EA Section 3.7.1, the overall effect of projected climate change on the Jane Dough Unit would be SMALL. The temperature and precipitation projections discussed in EA Section 3.7.1 extend to the latter part of this century. Any changes in temperature and precipitation over the much shorter project lifespan are expected to be smaller. Much of the activity associated with ISR occurs below ground, whereas temperature and

[3] Although CEQ's revision to this guidance document removed this numerical threshold, the NRC staff still considers the number useful for establishing the relative quantity of greenhouse gas emissions. Likewise, although EPA's Tailoring Rule was invalidated for other reasons, the NRC staff still considers the thresholds described in that rule to be useful as a point of comparison to the current proposal.

precipitation are parameters primarily associated with the surficial and atmospheric environment. Changes to groundwater availability are another potential overlapping effect with climate change since the Jane Dough Unit would utilize groundwater. However, potential changes to the Jane Dough Unit environment and resources, such as groundwater availability, are not expected to be altered over the lifespan of the project in a manner that would change the magnitude of the environmental impacts from what has already been evaluated in this EA.

Resilience to climate change impacts can be a factor that distinguishes alternatives. As described in the preceding paragraph, changes to groundwater availability are a potential overlapping effect with climate change since the proposed project would utilize groundwater. The No-Action Alternative eliminates the need to utilize groundwater to support ISR activities. Therefore, the No-Action Alternative is more resilient to climate change impacts in terms of water usage than the proposed action alternative because the No-Action Alternative does not utilize any groundwater.

Mitigation is one response strategy for addressing climate change. The other major response strategy is adaptation, which refers to actions to prepare for and adjust to new conditions created by climate change. As described previously in this section of the EA, the NRC staff considers the overall effect of projected climate change in relation to the Jane Dough Unit to be SMALL. The NRC staff is not aware of any adaption measures for climate change impacts associated with the Jane Dough Unit.

5.8 Noise

The cumulative impacts assessment for noise considered a study area with an 8 km [5 mi] radius around the Jane Dough Unit. This study area is different than that analyzed in the Nichols Ranch ISR Project which used an 8 km [5 mi] radius around the Nichols Ranch Unit. The study areas have similar land coverage but do not entirely overlap. As stated in GEIS Section 4.3.7, sound levels as high as 132 dBA will taper off to the lower limit of human hearing (20 dBA) at a distance of 6 km [3.7 mi] in the Wyoming East Uranium Mining region (NRC, 2009). The timeframe for the analysis is from 2015 to 2031. Though the timeframe for the Nichols Ranch SEIS analysis of cumulative impacts ended in the year 2020, the NRC staff considers the results of the analysis for noise to extend to 2031 because most of the cumulative impacts on noise in the study area were considered to be from future ISR projects, CBM projects, and oil and gas operations, which are expected to continue at the same intensity or lower for the foreseeable future.

The NRC staff evaluated noise associated with ISR activities for the Nichols Ranch ISR Project (NRC, 2011b) and determined that potential cumulative effects from activities within an 8 km [5 mi] radius around Nichols Ranch would be SMALL. The NRC staff also concluded that the Nichols Ranch ISR Project would have a SMALL incremental effect on noise when considered with all other past, present, and reasonably foreseeable actions in the noise study area.

The ongoing and reasonably foreseeable future actions within the noise cumulative impacts study area are CBM and oil and gas wells (Uranerz, 2014b). In addition, ISR projects could contribute to noise within the study area from additional traffic, construction and operations deliveries, and yellowcake and byproduct transport. Oil and gas and CBM operations generate noise during construction of drill pads, well drilling, and operation of compressor stations. Noise levels associated with operation of compressor stations would be expected to be below 55 decibels (dBA) at distances of 488 m [1,600 ft] and beyond (BLM, 2003). Noise levels associated with drill pad construction and well drilling would be expected to decrease to 54 dBA

at 610 m [2,000 ft] from the drill site (BLM, 2003). A noise level of 55 dBA is the level that protects human receptors against interference and annoyance with an adequate margin of safety (EPA, 1974). There are few human noise receptors (e.g., residences or communities) in the cumulative impacts noise study area; however, some of the residents are located less than 0.4 km [0.25 mi] from transportation routes that access project sites (Uranerz, 2014b). Noise may also have impacts on wildlife. For further information on the cumulative impacts on terrestrial ecology and licensee mitigation measures and monitoring, see EA Section 5.6 and EA Chapter 6 (Mitigation and Monitoring). Additionally, noise levels would be mitigated by administrative and engineering controls to maintain noise levels in work areas below Occupational Safety and Health Administration (OSHA) regulatory limits. Consistent with the determination for the Nichols Ranch ISR Project, the NRC staff has concluded that the cumulative impact of noise within the study area resulting from all ongoing and reasonably foreseeable future actions would be MODERATE due to extensive ISR, oil and gas, and CBM operations.

The nearest two residences to the Jane Dough Unit are located at a distance of approximately 1.6 km [1 mi] (Uranerz, 2014b). Wyoming State Highway 50 and U.S. Highway 387 are located farther than 3.2 km [2 mi] from the Jane Dough Unit. Considering the noise levels and distances detailed earlier in this section, noise generated at the Jane Dough Unit site would not be audible at those residences. Given the close proximity of the proposed action to the Nichols Ranch CPP, the anticipated traffic to support the Jane Dough Unit would not significantly increase noise to local roads within audible distance from residences. The licensee has stated that no further oil and gas development would take place in the Nichols Ranch ISR Project area (Uranerz. 2014a). As discussed in EA Section 4.8, the potential effects as a result of noise at the Jane Dough Unit resulting from concurrent activities (i.e. oil and gas activities, and vehicle traffic) taking place would be SMALL for all phases of the project. The NRC staff concludes that the Jane Dough Unit would have a SMALL incremental effect on noise when added to the MODERATE cumulative impacts from all ongoing and reasonably foreseeable future actions in the noise study area.

5.9 Cultural and Historic Resources

The geographic study area considered for the analysis of cumulative impacts to historical and cultural resources is incorporated by reference from the Nichols Ranch ISR SEIS (NRC, 2011b). The Nichols Ranch ISR Project cumulative impacts study area incorporates Campbell and Johnson counties. This study area was selected because the Jane Dough Unit is in both Campbell and Johnson counties (see EA Figure 2-1). Therefore, the NRC staff concludes that this study area and analysis is bounding and appropriate for the Jane Dough Unit historical and cultural cumulative impact analysis. The timeframe selected for the Jane Dough Unit analysis begins in 2015 and ends in 2031. Though the timeframe for the Nichols Ranch SEIS analysis of cumulative impacts ended in the year 2020, the NRC staff considers the results of the analysis for historical and cultural resources to extend to 2031 because most of the cumulative impacts on historical and cultural resources in the study area were considered to be from future grazing activities and energy development (e.g., ISR projects, CBM projects, and oil and gas operations), which are expected to continue at the same intensity or lower for the foreseeable future.

Past, present, and reasonably foreseeable impacts on historical and cultural resources were discussed in the Nichols Ranch ISR Project SEIS (NRC, 2011b). The Nichols Ranch ISR Project analysis noted that impacts to historical and cultural resources could occur from the following: (i) increased erosion due to land use grazing activities, (ii) increased energy

development (e.g. oil & gas, ISR, and CBM), and (iii) increased land area access and surface-disturbing activities associated new projects. Therefore, the NRC staff concluded that impacts to historical and cultural resources resulting from past, present, and reasonably foreseeable future land use activities, ISR projects, CBM projects, and oil and gas operations would be MODERATE. This conclusion also applies to the Jane Dough Unit analysis.

As discussed in EA Section 4.9, of the 14 sites identified within the Jane Dough Unit, 2 sites (Deadwood Road and Bozeman Trail) are eligible for listing on the National Register of Historic Places (NRHP). Although construction activities have the potential to affect archaeological sites, the two eligible sites are outside of the direct area of potential effect (APE). The licensee has committed to fence off the sites and avoid them throughout the project lifecycle. The operations, aquifer restoration, and decommissioning phases are not anticipated to impact the eligible sites because the construction phase represents the upper bound of surface-disturbing activities. As part of the Nichols Ranch ISR license (NRC, 2015e), Uranerz is committed to an inadvertent discovery plan to address the potential identification of previously unrecorded historic and cultural resources during all phases of the project at the Jane Dough Unit. The inadvertent discovery plan includes a stoppage of work and notification of appropriate authority parties (federal, tribal, and state agencies) (NRC, 2015e). Areas of importance to Native American tribes can also be identified during tribal consultation between the NRC staff and the tribes. To date, the tribal consultations have not resulted in the identification of specific areas or resources within the Jane Dough Unit. In addition, the Jane Dough Unit is approximately 9.7 km [6.0 mi] from the Pumpkin Buttes. Therefore, because it is beyond the 3.2 km [2.0 mi] radius of Programmatic Agreement (PA) between BLM and WY SHPO, the licensee is not required to abide by mitigation measures stipulated in the PA. As stated in Section 4.9, the NRC staff concludes that for all phases of the Jane Dough Unit, the impact to historical and cultural resources would be SMALL.

Based on this information, the NRC staff concludes that the cumulative impacts to historical and cultural resources as the result of the addition of the Jane Dough Unit to the existing Nichols Ranch ISR license would have a SMALL incremental effect on the MODERATE cumulative impacts resulting from past, present, and reasonably foreseeable future projects.

5.10 Visual and Scenic Resources

Consistent with the evaluation for the Nichols Ranch Project (NRC, 2011b), potential cumulative impacts to visual and scenic resources were assessed within a 3.2km [2 mi] radius of the Jane Dough Unit. This study area is different than that analyzed in the Nichols Ranch ISR Project which used an 8 km [5 mi] radius around the Nichols Ranch Unit. The study areas have similar land coverage but do not entirely overlap. The timeframe evaluated for the cumulative impacts analysis is 2015 to 2031. Though the timeframe for the Nichols Ranch SEIS analysis of cumulative impacts ended in the year 2020, the NRC staff considers the results of the analysis for visual and scenic resources to extend to 2031 because most of the cumulative impacts on visual and scenic resources in the study area were considered to be related to energy development activities (e.g., ISR projects, CBM projects, and oil and gas operations), which are expected to continue at the same intensity or lower for the foreseeable future.

At present, human-made features within and in the immediate vicinity of the Jane Dough Unit include roads, power lines, telephone and electric lines and poles, fence lines, and CBM and oil and gas wells, and reservoirs. The primary visual features on the landscape (i.e., the background distance zone) are CBM and oil and gas production facilities, which are visible due to their vertical profile (i.e., they are taller than ISR wellheads). Energy development is

expected to continue over the next 20 years within the PRB region. Past, present and reasonably foreseeable future projects could include construction of uranium recovery facilities, transportation infrastructure, a coal-fired power plant, major transmission lines, coal technology projects, wind power projects, oil and gas facilities, and CBM processing plants. Each of these activities could have an impact on visual and scenic resources, although these would be anticipated to be developed offsite. Therefore, the NRC staff concludes that the cumulative impacts from past, present, and reasonably foreseeable future actions on visual and scenic resources in the study area would be SMALL.

The NRC staff previously evaluated incremental effects on cumulative impacts that overlap the Jane Dough Unit's study area in the Nichols Ranch SEIS (NRC, 2011b) and determined that incremental cumulative impacts from the Nichols Ranch Unit would be SMALL. Because there would be no construction or operations of a CPP at the Jane Dough Unit, the incremental cumulative impacts to visual and scenic resources would be less than those impacts determined for the Nichols Ranch Unit (NRC, 2011b). As discussed in EA Section 4.10, potential effects from the Jane Dough Unit activities would be mitigated by the licensee's commitment to reclaim and reseed disturbed areas, use dust suppression methods and neutral paint colors for structures, recontour surface disturbances that do occur to blend in with the natural terrain, etc., which would reduce the visual and scenic impacts associated with the Jane Dough Unit and would be consistent with the VRM Class III objectives. Therefore, the NRC staff concludes that the Jane Dough Unit would have a SMALL incremental effect on visual and scenic resources when added to the SMALL cumulative impacts from all ongoing and reasonably foreseeable future actions in the study area.

5.11 Socioeconomics and Environmental Justice

As described in EA Section 5.1.1, the timeframe for this cumulative socioeconomics resource impact analysis for the Jane Dough Unit begins in 2015 and ends in 2031, and the Nichols Ranch ISR Project Analysis extends to 2020. To the extent the overlap ends, the same conclusion still applies as the because the geographic boundary that the NRC staff uses to analyze potential socioeconomic impacts for the Jane Dough Unit is the same boundary (Campbell and Johnson Counties) considered for the Nichols Ranch ISR Project (NRC, 2011b). This area is considered appropriate because the licensee proposes to use the same number of workers, commuting from the same locations, residing within the same area (see EA Section 4.11).

The NRC staff previously evaluated cumulative socioeconomic impacts for the Nichols Ranch ISR Project using BLM's estimates on cumulative social and economic effects in the PRB through 2020 (NRC, 2011b). NRC staff determined that based on assessments of population, employment, housing, school enrollment, public services, and local finances, the Nichols Ranch ISR Project would have a SMALL incremental socioeconomic effect within Campbell and Johnson Counties when added to the MODERATE cumulative impacts expected from other past, present, and reasonably foreseeable future actions within Campbell and Johnson Counties. The small incremental impact is based on the small number of workers required to support the Nichols Ranch ISR Project. The activities leading to the moderate cumulative impact finding are due to increased population from employment in energy development activities, namely coal mining, CBM, oil and gas production, and uranium ISR facilities.

For the Jane Dough Unit, the NRC staff considered demographics, population growth trends, median household income, per capita income, vacant housing units, employment, poverty, tax rates, and public services in Campbell and Johnson Counties (see EA Sections 3.11 and 4.11).

Based on updated BLM estimates and the NRC staff's determination of cumulative socioeconomic impacts for the Nichols Ranch ISR Project, the NRC staff determines that the potential cumulative impact on socioeconomic resources resulting from past, present, and reasonably foreseeable future actions in Campbell and Johnson Counties could range from SMALL to MODERATE due to expected continued energy development within the study area through 2031 (BLM, 2013b). Potential cumulative impacts to population and local finance would be MODERATE; potential cumulative impacts to employment would be SMALL to MODERATE, and potential cumulative socioeconomic impacts to housing, education, and public services would be SMALL.

The licensee has stated that they would employ the same number of workers, commuting from the same locations, residing within the same area as the employees at the Nichols Ranch Project. In addition, the Jane Dough Unit would extend ISR activities for a short period of time (5 years) beyond the planned Nichols Ranch ISR activities (Uranerz, 2016). For reasons detailed in EA Sections 3.11 and 4.11, the NRC staff does not anticipate the Jane Dough Unit to have a significant effect on socioeconomic characteristics within the study area. Therefore, consistent with the NRC findings for the Nichols Ranch ISR Project, the potential socioeconomic impacts from the Jane Dough Unit would be SMALL. Due to the limited duration of the Jane Dough Unit and planned activities, and because no additional workers would be added to the Nichols Ranch work force, the NRC staff anticipates that the potential incremental socioeconomic effects from the Jane Dough Unit would be less than the incremental socioeconomic effects experienced in Campbell and Johnson Counties from the Nichols Ranch Project. Therefore, the NRC staff concludes that the Jane Dough Unit would contribute a SMALL incremental effect on socioeconomic resources when added to the SMALL to MODERATE impacts expected from past, present, and reasonably foreseeable actions.

Environmental Justice

Past, present, and reasonably foreseeable future actions described in EA Section 5.1.2 could potentially contribute to cumulative disproportionately high and adverse human health or environmental effects in the PRB. However, the geographic area considered in this cumulative environmental justice analysis includes a 6.4 km [4 mi] radius around the Jane Dough Unit, consistent with the NRC guidance described in EA Section 4.11. The NRC staff conducted an environmental justice analysis in the Nichols Ranch ISR SEIS (NRC, 2011b) and determined that there would not be disproportionately high and adverse human health and environmental effects on minority and low-income populations residing in the vicinity of the proposed Nichols Ranch ISR Project. Potential impacts to minority and low-income populations from the construction, operations, aquifer restoration, and decommissioning of the Jane Dough Unit are discussed in EA Section 4.11.

No minority or low-income populations have been identified as residing near the Jane Dough Unit. The percentage of minority populations living within a 6.4-km [4-mi] radius of the Jane Dough Unit are significantly less compared to those minority populations recorded at the county and state level. The percentage of low-income populations living within a 6.4 km [4 mi] radius of the Jane Dough Unit are comparable to the low-income populations recorded at the county and state level. The NRC staff concluded in EA Section 4.11 that there would be no disproportionately high and adverse impacts on minority and low-income populations from the construction, operations, aquifer restoration and decommissioning of the Jane Dough Unit. Therefore, the Jane Dough Unit would not contribute to disproportionate human-health and environmental impacts on minority and low income populations near the Jane Dough Unit.

5.12 Public and Occupational Health and Safety

Cumulative effects on public and occupational health and safety were evaluated within an 80 km [50 mi] radius of the Jane Dough Unit. This distance was chosen to be inclusive of areas in the region where uranium milling has been practiced. The timeframe for the analysis is 2015 to 2031 (EA Section 5.2).

Other past, present, and reasonably foreseeable future uranium recovery facilities in the vicinity of the Jane Dough Unit and within the broader regional area are described in EA Section 5.1.2.1. Within an 80 km [50 mi] radius of the Jane Dough Unit, there are several licensed ISR facilities and several other existing or planned uranium recovery projects in various stages of development (EA Section 3.12). If constructed and operated, all of these facilities would have similar radiological and nonradiological impacts on public and occupational health and safety to those at the Jane Dough Unit. These facilities would result in localized incremental increases in annual radiological doses to the nearby populations; however, these radiological doses are not expected to significantly overlap and increase those of other facilities and are not expected to affect the Jane Dough Unit, as described in the following analysis.

The public and occupational health and safety impacts from the Jane Dough Unit would be SMALL and are discussed in detail in EA Section 4.12. During normal activities associated with all phases of the project lifecycle, radiological and nonradiological worker and public health and safety impacts would be SMALL. Annual radiation doses to individuals beyond the Jane Dough Unit boundary would be far below applicable NRC regulations. For accidents, radiological and nonradiological impacts to workers may be MODERATE if the appropriate mitigation measures and other procedures intended to ensure worker safety are not followed. Typical protection measures, such as radiation and occupational monitoring, respiratory protection, standard operating procedures for spill response and cleanup, and worker training in radiological health and emergency response, would be required as a part of the licensee's NRC-approved Radiation Protection Program. These procedures and plans would reduce the overall radiological and nonradiological impacts to workers from accidents to SMALL.

As stated in EA Section 4.12, during normal operations, radon (Rn-222) would be the only significant radionuclide released at the Jane Dough Unit. The primary sources of radon (Rn-222) would be Jane Dough wellfield venting and process operations at the Nichols Ranch CPP (predominantly from vent stacks on the ion-exchange columns and various tanks). As further described in EA Section 4.12, the licensee's maximum calculated dose (TEDE) to a member of the public from direct Jane Dough Unit operations is at the west boundary of the Jane Dough Unit. This maximum calculated dose is 0.04 mSv/yr [4 mrem/yr]. For the effects of processing Jane Dough solutions, a higher dose of 0.15 mSv/yr [15 mrem/yr] was calculated at the western boundary of the Nichols Ranch Project. Both of these calculated doses are within the range of results from similar calculations at other operating ISR facilities in the United States (NRC, 2009). Beyond the project boundary, the magnitude of the licensee's dose estimates for residences at various locations and distances is significantly reduced and consistent with the NRC staff expectations [the airborne radon (Rn-222) becomes more dispersed as the distance from release points increases]. Additionally, all of the licensee's calculated doses to nearby residences were less than or equal to 0.004 mSv/yr [0.4 mrem/yr]. The low magnitude of these calculated doses and the significant attenuation of dose with distance support the NRC staff's conclusion that the combined exposures from the Jane Dough Unit and other operating and potential ISR facilities in the study area would remain far below the 10 CFR Part 20 public dose limit of 1.0 mSv/yr [100 mrem/yr] and have a negligible contribution to the 6.2 mSv [620 mrem] average yearly dose received by a member of the public from all sources.

Additionally, several inactive and decommissioned conventional uranium mills are in the 80 km [50 mi] radius. However, because of their relative distances, none of these projects are considered to represent an appreciable additional source of radiation exposure in or around the Jane Dough Unit that would significantly increase the estimated radiation exposure from the Jane Dough Unit. Other than CBM activities, there are no major sources of nonradioactive, chemical releases to air or water-receiving bodies in the immediate area surrounding the Jane Dough Unit. The potential effects from nonradiological releases on air quality and water resources are described in EA Sections 5.7 and 5.5.

As described in EA Section 4.12, both worker and public radiological exposures are addressed in the NRC regulations at 10 CFR Part 20. These regulations apply to all licensed ISR facilities. Licensees are required to implement an NRC-approved radiation protection program to protect workers and ensure that radiological doses are "as low as reasonably achievable" (ALARA). For example, the licensee's radiation protection program includes commitments for implementing management controls, engineering controls, radiation safety training, radon monitoring and sampling, and audit programs (Uranerz, 2014b). Measured and calculated doses for workers and the public are commonly only a fraction of regulated limits. GEIS analysis of three separate accident scenarios (thickener failure and spill, pregnant lixiviant and loaded resin spills, and yellowcake dryer accident release) would also result in hypothetical public doses that are less than the NRC regulatory limits and would produce SMALL potential impacts (NRC, 2009) (see EA Section 4.12). The estimated worker dose resulting from an unmitigated accident at a CPP exceeds the NRC limits; however, such accidents are unlikely and would be expected to be prevented by safety procedures and practices.

The chemicals (hazardous and nonhazardous) used at ISR facilities including those proposed for use at the Jane Dough Unit or at the Nichols Ranch Project for processing Jane Dough Unit solutions do not differ from those evaluated in the GEIS. The use of hazardous chemicals at ISR facilities is controlled under several regulations (see EA Section 4.12 for a list of these regulations) that are designed to provide adequate protection to workers and the public. The handling and storage of chemicals at these facilities would follow standard industrial safety standards and practices. Industrial safety aspects associated with the use of hazardous chemicals are regulated by the WDEQ and Wyoming Department of Workforce Services. Nonradiological worker safety would be addressed through occupational health and safety regulations and practices.

Other past, present, and reasonably foreseeable future actions in the vicinity of the Jane Dough Unit that could contribute to nonradiological public and occupational health and safety impacts include oil and gas exploration, coal mining, and other mineral extraction activities (EA Section 5.1.2). Increased hazards to human health and safety would occur during development and operation of these projects from the inherent hazards associated with construction, operations, and maintenance activities. However, these hazards would be minimized by implementation of various mitigations, including complying with industry standards, using proper equipment, implementing access controls, developing and implementing health and safety programs involving procedures and training for normal operations and emergencies, and complying with applicable federal and state occupational and public safety regulations (BLM, 2012c, 2003). Hazardous materials that are likely to be used during these ongoing and reasonably foreseeable future projects include diesel fuel, gasoline, explosives, hydraulic fluids, motor oil/grease, solvents, water and well treatment chemicals, lead-acid batteries, biocides, herbicides, and compressed gasses used for welding (e.g., acetylene or propane) (BLM, 2012c). A large-scale release of diesel fuel or several of the other substances used at the projects may have implications for public health and safety. The location of the release

would be the primary factor in determining its importance. Involved workers are the most likely to be affected by accidents involving hazardous materials; however, the risks of such incidents would be limited by the implementation of common safety practices and regulatory controls (BLM, 2012c; 2003). Based on the remote location of these other activities, the NRC staff concludes that the probability of a release within a populated area that could result in public injury or fatality would be low.

Based on the preceding analysis, the NRC staff has determined that the cumulative impact on public and occupational health and safety in the study area resulting from all past, present, and reasonably foreseeable future actions would be SMALL. As described in in the preceding analysis, the estimates of combined radiological exposures from currently operating and proposed future ISR facilities in the study area are far below the regulatory public dose limit of 1.0 mSv/yr [100 mrem/yr] and have a negligible contribution to the 6.2 mSv [620 mrem] average yearly dose for a member of the public from all sources. Nonradiological exposures to workers and the general public from hazardous chemicals and materials resulting from past, present, and reasonably foreseeable future actions would be minimized by the application of common safety practices and compliance with applicable federal and state occupational and public safety regulations.

In conclusion, the overall cumulative impacts are the incremental impacts from the Jane Dough Unit when added to the impacts from other past, present, and reasonably foreseeable future actions. As described in the preceding analysis, the incremental direct and indirect impacts of the Jane Dough Unit on public and occupational health would be SMALL and the impacts from all past, present, and reasonably foreseeable future actions would also be SMALL. Therefore, the NRC staff concludes that the Jane Dough Unit would contribute a SMALL incremental impact on the SMALL cumulative impacts on public and occupational health when added to all other past, present, and reasonably foreseeable future actions in the study area, assuming all appropriate mitigations mentioned previously would be implemented.

5.13 Waste Management

The cumulative impacts on waste management resources are considered within an 80 km [50 mi] radius of the Jane Dough Unit. This distance was chosen to encompass nearby operating ISR facilities that could generate nonhazardous solid waste that would be destined for disposal at the same facility expected to be used by the Jane Dough Unit for disposal of similar waste. The timeframe for the analysis is 2015 to 2031.

Waste management impacts from the Jane Dough Unit would be SMALL and are discussed in detail in EA Section 4.13. The Jane Dough Unit would generate radiological and nonradiological liquid and solid wastes that must be handled and disposed of properly. Waste streams and the types and volumes of wastes to be disposed are described in EA Section 4.13. The primary radiological materials that must be disposed would be from decommissioning the Jane Dough Unit and the liquid and solid byproduct material generated by processing the Jane Dough solutions at the Nichols Ranch Project (for example, waste treatment solids, process-contaminated structures and soils). As discussed in EA Section 4.13, liquid byproduct material generated during operations is composed of production bleed, waste brine streams from elution and precipitation, resin transfer wash, filter backwash water, plant washdown water, and aquifer restoration water. Some liquid byproduct material streams would be treated using ion exchange and reverse osmosis. The licensee plans to dispose of all liquid byproduct material streams using Class I deep disposal wells. State and federal permitting actions, NRC license conditions, and NRC and state inspections ensure that proper waste disposal practices

would be used to comply with safety and environmental requirements to protect workers, the public, and the environment.

As described in EA Section 4.13, the overall impacts from the disposal of process-related liquid byproduct material at the Jane Dough Unit would be SMALL based on the licensee's commitment to provide adequate onsite disposal capacity in WDEQ-permitted Class I deep disposal wells (located on the Nichols Ranch Unit) and compliance with applicable permits and regulations. In addition, impacts associated with disposal of solid byproduct material would be SMALL based on the required preoperational disposal agreement made between the licensee and the licensed disposal facility that would ensure adequate disposal capacity is available for the duration of the project. Hazardous waste disposal impacts at the Jane Dough Unit would be SMALL based on the low volumes of waste generated and disposal in accordance with applicable regulations. Impacts from disposal of nonhazardous solid waste would be SMALL during the construction, operations, aquifer restoration, and decommissioning phases of the Jane Dough Unit based on estimated volumes and the available capacity of local municipal solid waste landfills.

Other past, present and reasonably foreseeable uranium recovery facilities in the vicinity of the Jane Dough Unit and within the broader regional area are described in EA Section 5.1.2. As noted previously, within an 80 km [50 mi] radius of the Jane Dough Unit, there are three operating ISR facilities (Willow Creek, Smith Ranch, Nichols Ranch) and one ISR facility that is licensed but not operating (Moore Ranch). Additionally there is one operating ISR expansion (North Butte), one licensed and not operating expansion (Reynolds Ranch), and five other ISR expansions that are in the planning or licensing stages. These current and potential facilities would generate solid and liquid wastes similar to the Jane Dough Unit, which could contribute to waste management effects within the cumulative impacts study area. The cumulative nonhazardous waste volume from the applicable licensed or planned ISR facilities and expansions in the study area within the vicinity of the Gillette landfill (including Nichols Ranch and Jane Dough Units) was conservatively estimated to be approximately 137,700 m^3 [180,000 yd^3]. This volume was found to be approximately 7 percent of the estimated remaining capacity of the Gillette landfill of 1.9 million m^3 [2.5 million yd^3] {calculated as the product of 18 years of remaining capacity and the average annual disposal volume of 106,280 m^3 [138,900 yd^3]}. Because the total estimated volume of nonhazardous solid waste from the Jane Dough Unit when added to other current and proposed ISR projects in the region is a small fraction of the remaining capacity of the Campbell County landfill in Gillette, Wyoming, the NRC staff concludes that the cumulative impact would be SMALL.

Generation of solid byproduct material at the planned and potential ISR facilities and expansions in the cumulative impacts study area could impact licensed disposal facility resources. Before ISR operations begin, the NRC requires ISR facilities to have an agreement in place with a licensed disposal facility to accept byproduct material; thereby ensuring adequate capacity is available. These agreements limit the impact on byproduct material waste management resources, resulting in a SMALL impact for the Jane Dough Unit and any other operating or planned ISR facilities.

Liquid byproduct material is typically managed at ISR facilities using onsite resources such as Class I deep disposal wells. The licensee has been granted a permit from WDEQ for eight Class I deep disposal wells for disposal of liquid byproduct material resulting from the processing and treatment activities at the Nichols Ranch ISR Project where the Jane Dough Unit solutions would be processed. Additional deep disposal well use in the region by other operating or planned ISR facilities is expected as additional ISR facilities are licensed. The

WDEQ-permitting process for these wells evaluates the suitability of proposals to ensure that groundwater resources are protected and potential environmental effects are limited to acceptable levels. Based on the assumption that WDEQ would not permit deep disposal wells that would have a significant potential to impact groundwater resources, the NRC staff concludes that the cumulative impacts of using Class I deep disposal wells at the Nichols Ranch facility for the liquid byproduct waste produced at the Jane Dough Unit, along with the potential impacts from present and reasonably foreseeable future actions, would be SMALL.

Other ongoing and reasonably foreseeable future activities in the vicinity of the Jane Dough Unit, such as coal mining (EA Section 5.1.2.2) and oil and gas production (EA Section 5.1.2.3) would produce additional nonradiological waste materials. These projects would use and generate hazardous materials and would need to dispose of solid and hazardous wastes. Each project would also be responsible for complying with applicable federal and state regulations and site-specific permitting requirements or conditions that control management of generated wastes. A recent evaluation of past, present, and reasonably foreseeable future actions in the PRB (BLM, 2011) projected future development trends for conventional oil and natural gas, CBM, and coal mining to year 2030. Conventional oil and natural gas production was projected to increase from the present to year 2030 (BLM, 2011). CBM production is currently below levels that were previously projected (BLM, 2003) and were expected to decline between the current timeframe and 2030. Coal mining was noted as declining since 2009 and, while future uncertainties were noted, projected to increase by 2030 to at least the previous peak (2009) levels (low estimate) or increase by as much as 38 percent above 2009 production levels (high estimate). These projections suggest that the level of activity, and therefore combined waste generation from these activities, is unlikely to increase during the timeframe of the analysis. Additionally, coal mines are not large generators of hazardous waste (BLM, 2012c), and therefore hazardous waste generation and potential effects to disposal resources are not expected to change from these activities. Regarding the generation of nonhazardous solid waste, the annual volumes disposed at local landfills {106,280 m^3 [138,900 yd^3] at Campbell County landfill and 191,280 m^3 [250,000 yd^3] at the Casper landfill} reflect the current regional cumulative demand for disposal capacity, and the available landfills have projected capacity to operate beyond year 2030 (EA Section 3.13). Therefore, potential impacts from other ongoing and reasonably foreseeable future activities in the vicinity of the Jane Dough Unit on these resources would be SMALL.

Based on the preceding analysis, the NRC staff determines that the cumulative impact on waste management resources resulting from all past, present, and reasonably foreseeable future actions in the study area is SMALL. As described in the preceding analysis, the required disposal agreements for byproduct material from NRC-licensed ISR facilities would ensure disposal capacity is available to all ISR facilities prior to operations. The projected volume of nonhazardous solid waste from the Jane Dough Unit, when combined with other current and potential future ISR facilities, is a small percentage of available disposal capacity over the duration of the Jane Dough Unit. Projected trends for oil and gas, CBM, and coal mining indicate these other regional activities suggest declining production except for coal, which could grow modestly between the current timeframe and year 2030.

In conclusion, the overall cumulative impacts are the incremental impacts from the Jane Dough Unit when added to the impacts from other past, present, and reasonably foreseeable future actions. As described in the preceding analysis, the incremental impacts of the Jane Dough Unit would be SMALL and the impacts from all past, present, and reasonably foreseeable future actions would also be SMALL. Therefore, the NRC staff concludes that the Jane Dough Unit would have a SMALL incremental effect when added to the SMALL impacts on waste

management resources from other past, present, and reasonably foreseeable future actions in the study area (assuming all appropriate mitigations are followed).

1

6 MONITORING AND MITIGATION

As discussed in Section 8.0 of Generic Environmental Impact Statement for *In-Situ* Leach Uranium Milling Facilities (GEIS) (NRC, 2009), monitoring programs are developed for in situ uranium recovery (ISR) facilities to verify compliance with standards for the protection of worker health and safety in operational areas and for protection of the public and environment beyond the facility boundary. Monitoring programs provide data on operational and environmental conditions so prompt corrective actions can be implemented when adverse conditions are detected. These programs help limit potential environmental impacts at ISR facilities and the surrounding areas.

In accordance with the U.S. Nuclear Regulatory Commission (NRC) regulations in Title 10 of the *Code of Federal Regulations*, Part 40 (10 CFR Part 40), Appendix A, Criterion 7, a preoperational monitoring program is required to establish facility baseline conditions. After establishing the baseline program, ISR facility operators are required to conduct an operational monitoring program to measure or evaluate compliance with standards and to evaluate the environmental impact of an operating ISR facility. Although not a requirement, NRC Regulatory Guide 4.14 (NRC, 1980b) provides guidance for implementing monitoring programs at uranium mills (which includes ISR facilities) that are acceptable to the NRC staff (NRC, 2011b).

The planned monitoring and mitigation programs included under the Nichols Ranch ISR license are further described in Chapter 6 of the Nichols Ranch ISR Project Supplemental Environmental Impact Statement (SEIS) (NRC, 2011b). The licensee has stated it would design and implement the same programs on the Jane Dough Unit (Uranerz, 2016a), and therefore the following sections are a summary of monitoring and mitigation programs that would apply to the Jane Dough Unit.

6.1 Wellfield and Pipeline Flow and Pressure Monitoring

The density and spacing of monitoring wells for the Jane Dough Unit would be determined during the geologic and hydrologic assessment of a proposed wellfield. Monitoring wells would be installed in the ore zone at a density of one monitoring well per 1.6 ha [4 ac] in wellfields.

As described in the technical report (Uranerz, 2014a) the licensee would have an extensive program of wellfield and pipeline flow and pressure monitoring at the Jane Dough Unit, similar to what is currently used on the Nichols Ranch Unit (NRC, 2011b). The licensee would monitor injection and production well flow rates and pressures at each header house to balance injection and production in each wellfield. Individual well flow readings would be recorded and the overall wellfield flow rates would be balanced daily. All trunklines would be equipped with electronic pressure gauges. Data would be monitored at the central processing plant (CPP) located on the Nichols Ranch Unit (NRC, 2011b).

Wellfield and plant operators would be alerted if high or low pressure and flow alarms exceeded specified ranges. Automatic shutoff valves would stop the flow in the event of significant changes of volume or pressure. The wellfield and pipeline flow monitoring would alert the operators to detect malfunctions that could lead to either wellfield infrastructure or pipeline failures, thereby minimizing the potential impact to groundwater (NRC, 2011b).

6.2 Groundwater and Surface Water Monitoring

The groundwater monitoring program for the Jane Dough Unit would be designed and implemented in the manner as outlined in the Nichols Ranch ISR Project SEIS (NRC, 2011b). By license condition for the Nichols Ranch ISR Project, which would apply to the Jane Dough Unit after operations begin, the ore zone monitoring wells would be sampled four times on a twice per month basis to establish wellfield baseline water quality. Groundwater monitoring would: (i) be designed to detect lixiviant excursions outside the producing wellfield into the overlying, underlying or adjacent aquifers, (ii) include sampling of the monitoring and underlying aquifer monitoring wells and would be conducted approximately twice per month, (iii) include analysis for chloride, total alkalinity, and conductivity, which are the excursion indicators, and (iv) measure and record static water levels. The licensee would also submit quarterly static water level measurements and monitoring data to Wyoming Department of Environmental Quality (WDEQ) and maintain copies onsite for NRC inspection (Uranerz, 2014a; NRC, 2011b). Under the operational surface water monitoring program, the licensee will continue to collect water samples from the same locations that were sampled to establish pre-operational baseline concentrations. These samples will be collected whenever water is present.

To ensure the protection of surface water from unexpected leaks, the licensee would monitor each production and injection well as to detect a change in flow, pressure, or both, which could indicate a leak or rupture in the system. If a leak occurred, the system would be shut down and remediation conducted as appropriate.

6.3 Preoperational Water Quality Monitoring

The licensee collected groundwater samples from wells located throughout the Jane Dough Unit to evaluate preoperational water quality as part of the site characterization (see EA Sections 3.5 and 4.5). The purpose of the preoperational sampling is to evaluate the overall groundwater quality within the Jane Dough Unit under normal preoperational conditions. The licensee also conducted pumping tests of the aquifers to characterize aquifer behavior. Single-well and multi-well pumping tests were performed at the Jane Dough Unit to determine the hydraulic characteristics of the underlying aquifers. The test results provided a preliminary baseline of groundwater behavior in the Jane Dough Unit. Information on well samples can be found in the licensee's technical report (Uranerz, 2014b), revised technical report (Uranerz, 2015), and the responses to NRC staff requests for additional information (Uranerz, 2016a).

6.4 Environmental Monitoring

The licensee concluded from its preoperational vegetation sampling program for the Nichols Ranch ISR license application and through modeling that the ingestion pathway would not be a significant contributor to radiological dose. Therefore, the licensee does not intend to conduct vegetation, food, or fish sampling, because the predicted dose to an individual from these pathways would be less than 5 percent of the applicable radiation protection standard. The licensee also states that the Jane Dough Unit would represent a similar, if not lower, potential dose via ingestion pathway. As such, for the Jane Dough Unit no additional vegetation, food or fish samples were collected (Uranerz, 2014a, b, 2016a).

As part of the Nichols Ranch ISR Project license the licensee has conducted wildlife studies that include annual raptor and sage-grouse surveys to identify the occurrence of new nests and leks and to assess whether known nests or leks are still active (Uranerz, 2007; 2014a). The licensee

also stated that it would survey areas of planned activity (i.e., wellfields) for the life of the project and within a 1.6 kilometers (km) [1 mile (mi)] radius of the activity to protect against unforeseen conditions, such as a new nest or a new lek being affected by ISR operations (Uranerz, 2007; 2014a).

6.5 Mitigation

The licensee has committed to using the same mitigation measures it currently implements on the Nichols Ranch Unit for the Jane Dough Unit as applicable (Uranerz, 2016a); for example, berms to reduce soil erosion and runoff into ephemeral streams, and dust suppression on roads. Further information on mitigation measures can be found in the Chapter 4 of Nichols Ranch ISR SEIS (NRC, 2011b) and the licensee's environmental and technical reports (Uranerz, 2014a,b, 2015), and the responses to NRC staff requests for additional information (Uranerz, 2016a). While NRC cannot impose mitigation outside its regulatory authority under the Atomic Energy Act, the NRC staff has identified mitigation measures in EA Table 6-1 that could potentially reduce the impacts of the Jane Dough Unit. These additional mitigation measures are not requirements being imposed upon the licensee. For the purposes of the National Environmental Policy Act, and consistent with 10 CFR 51.71(d) and 51.80(a), the NRC staff discloses measures that could potentially reduce or avoid environmental impacts of the addition of the Jane Dough Unit.

Table 6-1. Summary of Mitigation Measures Identified by NRC

Resource Area	Activity	Proposed Mitigation Measures
Land Use	Land disturbance	Use best management practices (BMPs) to control waste disposal, erosion, and runoff to limit the effect of facility operation on surrounding land use.
Transportation	Transportation safety	Use accepted industry codes and standards for handling and transporting hazardous chemicals. Implement safe driving training for personnel and truck drivers. Use check-in/check-out or global positioning satellite technology to track shipments.
Geology and Soils	Soils	Maintain a log of all spills occurring at the site, whether or not these spills are reportable to U.S. Nuclear Regulatory Commission (NRC) per Title 10 of the *Code of Federal Regulations* Part 40.60. Implement alternatives or mitigation measures to manage drilling fluid during well drilling operations, including (i) lining mud pits with an impermeable membrane, (ii) disposing of potentially contaminated drilling mud and other fluids offsite, and (iii) using portable tanks or tubs to contain drilling mud and other fluids.
Surface Water Resources	Water quality	Collect monthly preoperational water quality samples from streams and quarterly preoperational water quality samples from impoundments.

Table 6-1. Summary of Mitigation Measures Identified by NRC		
Resource Area	**Activity**	**Proposed Mitigation Measures**
Groundwater Resources	Contamination and excursions	Locate all boreholes and wells within 305 meters [1,000 feet] of a wellfield, if possible, and properly plug and abandon them.
Ecology	Restoration/ reclamation	Use weed control techniques that incorporate BMPs approved by Wyoming Department of Environmental Quality (WDEQ). Fence off young vegetation until it has reestablished.
	Fencing and screening	Cover openings such as vent pipes with either netting or other methods to prevent bats, birds, or small mammals from being trapped.
	Transmission lines	Adhere to timing and spatial restrictions within specified distances of occupied and unoccupied migratory bird and raptor nests, as determined by appropriate regulatory agencies [e.g., U.S. Fish and Wildlife Service (FWS), Wyoming Game and Fish Division, and Bureau of Land Management]. Develop a written, FWS-reviewed bird mitigation and monitoring plan that is incorporated into the mine permit before beginning project activities.
	Reduce human disturbances	Allow snakes and lizards that are encountered to retreat. Inform employees of applicable wildlife laws and penalties associated with unlawful taking and harassment of wildlife. Train employees on (i) the types of wildlife in the area susceptible to collisions with motor vehicles, (ii) the circumstances when collisions are most likely to occur, and (iii) measures that should be taken to avoid wildlife–vehicle collisions. Sign and gate, as needed, all new and improved roads related to the Jane Dough Unit to minimize traffic. Comply with applicable state and local requirements to design or treat mud pits and ponds to prevent the development of favorable mosquito habitat (to reduce possible transmission of West Nile virus).

Table 6-1. Summary of Mitigation Measures Identified by NRC		
Resource Area	**Activity**	**Proposed Mitigation Measures**
Air Quality	Fugitive dust and combustion emissions from construction equipment and vehicles	Implement fuel-saving practices, such as minimizing vehicle and equipment idle time. Utilize fossil-fuel vehicles that meet the latest emission standards. Utilize newer, cleaner-running equipment (e.g., using drill rig engines and construction equipment engines with higher tier levels). Utilize add-on controls such as catalyst and diesel particulate filters for the drill rigs. Minimize unnecessary travel. Ensure that diesel-powered construction equipment and drill rigs are properly tuned and maintained. Limit access to construction sites, staging areas, and wellfields to authorized vehicles only, through designated treated roads. Implement a fugitive dust control plan. Cover trucks carrying soil and debris to reduce dust emissions from the back of trucks. Burn low-sulfur fuels in all diesel engines and generators. Train workers to comply with the speed limit, use good engineering practices, minimize disturbed areas, and employ other BMPs, as appropriate. To the extent practicable, avoid conducting soil-disturbing activities, and travel on unpaved roads during periods of unfavorable meteorological conditions (e.g., high winds). Implement any permit conditions identified in the WDEQ air permit, if applicable. Perform road maintenance (i.e., promptly remove earthen material on paved roads). Apply erosion mitigation methods on disturbed lands.

Table 6-1. Summary of Mitigation Measures Identified by NRC		
Resource Area	**Activity**	**Proposed Mitigation Measures**
Noise	Exposure of workers and the public to noise	Maintain noise levels in work areas to below Occupational Safety and Health Administration regulatory limits.
Cultural and Historic Resources	Disturbance of prehistoric archaeological sites and sites eligible for listing on the National Register of Historic Places (NRHP)	Stop work upon discovery of previously undocumented historic and cultural resources, and notify appropriate federal, tribal, and state agencies with regard to mitigation measures. Avoid historic properties within the Jane Dough Unit that are currently listed or eligible for listing on the NRHP. Prior to construction, develop an Unexpected Discovery Plan that would outline the steps required in the event that unexpected historical and cultural resources are encountered at the site.
Visual and Scenic	Potential visual intrusions in the existing landscape character	Limit the number of drill rigs operating during wellfield construction. To the extent possible, use existing secondary roads within the project area to access wellfields, potential irrigation areas, and other facility infrastructure.
Socioeconomics	Effects on surrounding communities	Coordinate emergency response activities with local authorities, fire departments, medical facilities, and other emergency services before operations begin.
Occupational and Public Health and Safety	Effects from facility operation	Design task procedures to reduce potential accidents. Develop contingency plans with county and municipal governments to ensure adequate medical, fire, and emergency services are available in case of a major accident.
Waste Management	Disposal Capacity	Dispose of decommissioning nonhazardous solid waste at the Casper landfill in the event that the disposal capacities of the Campbell County landfill are limited or otherwise unavailable at the time of decommissioning.

7 AGENCIES AND PERSONS CONSULTED

The U.S. Nuclear Regulatory Commission (NRC) staff consulted with other agencies regarding the proposed action in accordance with NUREG–1748 (NRC, 2003a). These consultations were intended to (i) ensure that the requirements of Section 7 of the Endangered Species Act and Section 106 of the National Historic Preservation Act (NHPA) were met and (ii) provide the designated state liaison agencies the opportunity to comment on the proposed action.

7.1 Wyoming State Historic Preservation Office

On August 10, 2016, the NRC staff contacted the Wyoming State Historic Preservation Office (WY SHPO) and requested review of the proposed Area of Potential Effect (APE) and Class III Cultural Resources report. The WY SHPO responded via a letter dated August 30, 2016, that it concluded, based on available information, that no properties listed in or eligible for listing in the National Register of Historic Places would be affected by proposed action (WY SHPO, 2016).

7.2 U.S. Fish and Wildlife Service

On September 15, 2015, the NRC staff sent a letter to the U.S. Fish and Wildlife Service (FWS) Ecological Services in Cheyenne, Wyoming, describing the proposed action and requesting a list of threatened and endangered species and critical habitats that could potentially be affected by the proposed action (NRC, 2015d). The FWS informed the NRC staff that a current list of threatened and endangered species and critical habitats could be obtained via the online Information Planning, and Conservation (IPaC) system. A comprehensive list was obtained via IPaC (FWS, 2016). The FWS identified two federally threatened mammal species, Canada lynx (*Lynx canadensis*) and northern long-eared bat (NLEB) (*Myotis septentrionalis*), that may occur in the Jane Dough Unit.

7.3 Wyoming Department of Environmental Quality

A copy of the draft EA was sent to the State of Wyoming Department of Environmental Quality (WDEQ) on December 20, 2016 (ML16351A084). On January 25 2017, WDEQ notified the NRC staff via email (ML17025A408) that they had no comments on the draft EA. Therefore, no changes were made to the EA as a result of the WDEQ comments.

1

8 CONCLUSION

Based on its review of the proposed action, and in accordance with the requirements in 10 CFR Part 51, the U.S. Nuclear Regulatory Commission (NRC) staff has determined that license amendment for the Nichols Ranch In Situ Recovery (ISR) project license authorizing the construction and operation of the Jane Dough Unit would not significantly affect the quality of the human health, safety, and environment. In its license amendment request, Uranerz has proposed the addition of two production units on the Jane Dough Unit, which is contiguous with the Nichols Ranch Unit. No significant changes in Uranerz's authorized operations for the Nichols Ranch ISR Project were requested. Approval of the proposed action would not result in an increased radiological risk to public health or the environment. The NRC staff has determined that pursuant to 10 CFR 51.31, preparation of an environmental impact statement (EIS) is not required for the proposed action and, pursuant to 10 CFR 51.32, a finding of no significant impact (FONSI) is appropriate.

Pursuant to 10 CFR 51.33, the NRC staff made an environmental assessment (EA) and FONSI. In doing so, the NRC staff determined that preparation of the EA and FONSI furthers the purposes of the National Environmental Policy Act (NEPA). The NRC staff performed an EA and based on its results, the NRC is issuing a FONSI.

1

9 LIST OF PREPARERS

This section documents all individuals who were involved with the preparation of this Environmental Assessment (EA). Contributors include staff from the U.S. Nuclear Regulatory Commission (NRC) and consultants.

9.1 U.S. Nuclear Regulatory Commission Contributors

Dave Brown: Safety Project Manager, All Sections

Jill Caverly: NEPA Reviewer, Project Manager, All Sections

Lloyd Desotell: Hydrogeologist, Water Resources

Ashley Waldron: EA Project Manager, All Sections

9.2 Center for Nuclear Waste Regulatory Analyses (CNWRA®) Contributors

Cynthia Dinwiddie: Groundwater Resources, Geology and Soils

Miriam Juckett: Program Manager, NEPA Reviewer, All Sections

Patrick LaPlante: Waste Management, Public and Occupational Health

Amy Hester Minor: Ecological Resources, Socioeconomics, Visual and Scenic, Environmental Justice

Marla Morales: Principal Investigator, All Sections

James Prikryl: Surface Water Resources, NEPA Reviewer

Bradley Werling: Meteorology, Climatology, Air Quality

9.3 CNWRA Consultants and Subcontractors

Erin Hudson: Cultural and Historic Resources, National Historic Preservation Act Section 106 Support

1

10 REFERENCES

10 CFR Part 20. *Code of Federal Regulations*, Title 10, Energy, Part 20, "Standards for Protection Against Radiation."

10 CFR Part 40. *Code of Federal Regulations*, Title 10, *Energy*, Part 40, "Domestic Licensing of Source Material."

10 CFR Part 40 Appendix A. *Code of Federal Regulations*, Title 10, *Energy*, Part 40 Appendix A, "Criteria Relating to the Operation of Uranium Mills and to the Disposition of Tailings or Wastes Produced by the Extraction or Concentration of Source Material from Ores Processed Primarily from their Source Material Content."

10 CFR Part 51. *Code of Federal Regulations*, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

36 CFR Part 60. *Code of Federal Regulations*, Title 36, *Parks, Forests, and Public Property*, Part 60, Section 4. "Criteria for Evaluation."

40 CFR Part 81. Code of Federal Regulations, Title 40, Protection of the Environment, Part 81.342, "South Dakota."

40 CFR 81.351. *Code of Federal Regulations*, Title 81, *Protection of the Environment*, Part 81. Section 351, "Wyoming."

40 CFR Part 142. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 142 "National Primary Drinking Water Regulations Implementation."

40 CFR Part 143. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 143 "National Secondary Drinking Water Regulations."

40 CFR 1508.7. *Code of Federal Regulations*, Title 40, *Protection of Environment,* Part 1508.7, "Cumulative Impacts."

69 FR 52040. "Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions." *Federal Register*. Vol. 69, No. 163, pp. 52,040–52,048. Washington, DC: U.S. Government Printing Office. August 24, 2004.

70 FR 12710. "Final List of Bird Species to Which the Migratory Bird Treaty Act Does Not Apply." U.S. Fish and Wildlife Service. *Federal Register.* Vol. 70, No. 49. 2005.

74 FR 66496. "Endangerment and Cause or Contribute Findings for Greenhouse Gases." *Federal Register*. Vol. 74, No. 239. pp. 66,496–66,546.

75 FR 31514. "Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule." *Federal Register*. Vol. 75, No. 106. pp. 31,514–31,608.

76 FR 56951. "Licenses, Certifications, and Approvals for Materials Licensees: *Federal Register*. Vol. 76, No. 179. pp. 56,951–56,966.

ACHP (Advisory Council of Historic Preservation). "Consultation with Indian Tribes in the Section 106 Review Process: A Handbook." Advisory Council on Historic Preservation. Washington, DC: Advisory Council on Historic Preservation. 2012.

APLIC (Avian Power Line Interaction Committee). "Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006." ML12243A391. Washington, DC: Edison Electric Institute; Sacramento, California: Avian Power Line Interaction Committee and the California Energy Commission. 2006.

BLM (Bureau of Land Management). "Resource Management Plan and Final Environmental Impact Statement for the Buffalo Field Office Planning Area." Buffalo, Wyoming: Bureau of Land Management, Buffalo Field Office. 2015a. <https://eplanning.blm.gov/epl-front-office/eplanning/planAndProjectSite.do?methodName=dispatchToPatternPage&currentPageId=48300> (7 July 2016).

_____. "Task 3A Report for the Powder River Basin Coal Review Cumulative Air Quality Effects." Casper, Wyoming: Bureau of Land Management, High Plains District Office. 2014. <http://www.blm.gov/style/medialib/blm/wy/programs/energy/coal/prb/coalreview/task3a.Par.8822.File.dat/Task3Afinal.pdf> (7 July 2016).

_____. "Environmental Assessment for Uranerz Energy Corporation's Proposed Hank Unit Uranium In-Situ Recovery Project, Campbell County, Wyoming." WY–070–EA13–226. Buffalo, Wyoming: Bureau of Land Management Buffalo Field Office. 2013a.

_____. "Task 3D Report for the Powder River Basin Coal Review Cumulative Environmental Effects." Casper, Wyoming: Bureau of Land Management, High Plains District Office. 2013b. <http://www.blm.gov/style/medialib/blm/wy/programs/energy/coal/prb/coalreview/task_3d_update__12.Par.14742.File.dat/03F-Task3D.pdf> (7 July 2016).

_____. "Interim Management Guidance for Migratory Bird Conservation Policy on Wyoming Bureau of Land Management (BLM) Administered Public Lands Including the Federal Mineral Estate." Cheyenne, Wyoming. Bureau of Land Management. 2012a. <http://www.blm.gov/style/medialib/blm/wy/resources/efoia/IMs/2013.Par.71274.File.dat/wy2013-005.pdf > (27 July 2016).

_____. "Environmental Assessment for School Creek Lease WYW172413 Modification." Casper, Wyoming: Bureau of Land Management, High Plains District Office. 2012b. <http://www.blm.gov/style/medialib/blm/wy/information/NEPA/hpdo/school_creek.Par.41363.File.dat/SC_ea.pdf> (8 July 2016).

_____. "Task 1D Report for the Powder River Basin Coal Review Current Environmental Conditions, Section 2.9 Hazardous Materials and Solid Waste." Casper, Wyoming: Bureau of Land Management. 2012c. <http://www.blm.gov/style/medialib/blm/wy/programs/energy/coal/prb/coalreview.Par.84563.File.dat/Task1D-13chap2-9.pdf> (7 July 2016).

_____. "Task 2 Report for the Powder River Basin Coal Review – Past and Present and Reasonably Foreseeable Development Activities." Casper, Wyoming: Bureau of Land Management, High Plains District Office. 2011. <http://www.blm.gov/wy/st/en/programs/energy/Coal_Resources/PRB_Coal/prbdocs/coalreview/task_2_update__120.html> (7 July 2016).

_____. "Final Environmental Impact Statement for the Wright Area Coal Lease Applications, Volume 1 of 2, Chapters 1 – 4." Casper, Wyoming: Bureau of Land Management. 2010. <http://www.blm.gov/style/medialib/blm/wy/information/NEPA/hpdo/Wright-Coal/feis.Par.33083.File.dat/01WrightCoalVol1.pdf> (8 July 2016).

_____."Programmatic Agreement Between Bureau of Land Management and Wyoming State Historic Preservation Officer Regarding Mitigation of Adverse Effects on the Pumpkin Buttes TCP from Anticipated Federal Minerals Development." ML092640122. Washington, DC: U.S. Department of Interior Bureau of Land Management. 2009a.

_____. "Final Environmental Impact Statement for the South Gillette Area Coal Lease Applications." WYW172585, WYW173360, WYW172657, and WYW161248. Cheyenne, Wyoming: Bureau of Land Management High Plains District Office. 2009b. Volume 1 and Volume 2. <http://www.blm.gov/style/medialib/blm/wy/information/NEPA/hpdo/south_gillette/feis.Par.57426.File.dat/vol1.pdf>; and <http://www.blm.gov/style/medialib/blm/wy/information/NEPA/hpdo/south_gillette/feis.Par.41361.File.dat/vol2.pdf> (8 July 2016).

_____. "Update Of The Task 3D Report For The Powder River Basin Coal Review Cumulative Environmental Effects." Casper, Wyoming: Bureau of Land Management, High Plains District Office. 2009b. <http://www.blm.gov/wy/st/en/programs/energy/Coal_Resources/PRB_Coal/prbdocs/coalreview/task_3d_update__12.html> (12 July 2016).

_____. "Proposed Resource Management Plan and Final Environmental Impact Statement for the Casper Field Office Planning Area." Buffalo, Wyoming: Bureau of Land Management, Buffalo Field Office. 2007. <http://www.blm.gov/wy/st/en/programs/Planning/rmps/casper/feis_prmp.html> (7 July 2016).

_____. "Task 1D Report for the Powder River Basin Coal Review Current Environmental Conditions." Casper, Wyoming: Bureau of Land Management. 2005a. <http://www.blm.gov/wy/st/en/programs/energy/Coal_Resources/PRB_Coal/prbdocs/coalreview/Task1D.html> (7July 2016).

_____. "Chapter 5: Potential Impacts of Wind Energy Development and Analysis of Mitigation Measures." Final Programmatic Environmental Impact Statement on Wind Energy Development on BLM-Administered Lands in the Western United States. FES 05-11. ML12243A271. Washington, DC: Bureau of Land Management, U.S. Department of the Interior. 2005b.

_____. "Task 1D Report for the Powder River Basin Coal Review Current Environmental Conditions." Casper, Wyoming: Bureau of Land Management. 2005c. <http://www.blm.gov/wy/st/en/programs/energy/Coal_Resources/PRB_Coal/prbdocs/coalreview/Task1D.html> (11 July 2016).

_____. "Final Environmental Impact Statement and Proposed Plan Amendment for the Powder River Basin Oil and Gas Project." Buffalo, Wyoming: Bureau of Land Management. 2003. <http://www.blm.gov/wy/st/en/info/NEPA/documents/bfo/prb_eis.html> (14 July 2016).

Bullard, D. (2016). Wyoming Long-Term Industry Projections, 2014-2024. Research & Planning, Wyoming Department of Workforce Services. Retrieved from http://doe.state.wy.us/LMI/projections.htm

CCPW (Campbell County Public Works). "Campbell County/Public Works/Landfill/Statistics." Gillette, Wyoming: Campbell County. 2014. <http://www.ccgov.net/1043/Statistics> (11 July 2016).

_____. "Summary of Teleconference with Mark Swan, Environmental Services Manager, Campbell County Public Works, Concerning Landfill Capacity for the Proposed Nichols Ranch ISR Project." ML102600569. Memo to file (September 20, 2010) from C. Pineda, U.S. Nuclear Regulatory Commission. Gillette, Wyoming: Campbell County Department of Public Works. 2010.

CEQ (Council on Environmental Quality). "Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews." Washington, DC: Council on Environmental Quality. 2016. < https://www.whitehouse.gov/sites/whitehouse.gov/files/documents/nepa_final_ghg_guidance.pdf > (14 September 2016).

_____. "Considering Cumulative Effects Under the National Environmental Policy Act." ML13343A349. Washington, DC: Executive Office of the President, Council on Environmental Quality. 1997.

Countess, R. "Methodology for Estimating Fugitive Windblown and Mechanically Resuspended Road Dust Emissions Applicable for Regional Scale Air Quality Modeling." ML13213A294. Westlake Village, California: Countess Environmental. 2001.

Denholm, P., M. Hand, M. Jackson, and S. Ong. "Land-Use Requirements of Modern Wind Power Plants in the United States." Technical Report NREL/TP-6A2-45834. 2009. Golden, Colorado: National Renewable Energy Laboratory. <http://www.nrel.gov/docs/fy09osti/45834.pdf> (12 July 2016).

Duke Energy. "Top of the World Windpower." 2015. <http://www.duke-energy.com/commercial-renewables/top-of-the-world-windpower.asp> (8 July 2016).

EIA (U.S. Energy Information Administration). "Annual Energy Outlook 2015 with Projections to 2040." DOE/EIA-0383. Washington, DC: U.S. Environmental Protection Agency, Energy Information Administration, Office of Coal, Nuclear, Electric, and Alternate Fuels. 2015. <http://www.eia.gov/forecasts/aeo/pdf/0383(2015).pdf> (8 July 2016).

Energy Fuels. "Energy Fuels Announces 2015 Results." Energy Fuels Inc. Lakewood, Colorado. 2016. <http://www.energyfuels.com/news-pr/energy-fuels-announces-2015-results/> (28 September 2016).

EPA (U.S. Environmental Protection Agency). "Environmental Impact Database." Washington, DC: U.S. Environmental Protection Agency. 2016. <https://cdxnodengn.epa.gov/cdx-enepa-II/public/action/eis/search/search#results> (7 July 2016).

_____. "A Citizen's Guide to Radon." EPA402/K-12/002. Washington, DC: U.S. Environmental Protection Agency. 2012. <http://www.epa.gov/radon/pubs/citguide.html> (6 July 2016)

_____. "Technical Report on Technologically Enhanced Naturally Occurring Radioactive Materials from Uranium Mining: Mining and Reclamation Background." Vol. 1. EPA–402–R–08–005. Washington, DC: U.S. Environmental Protection Agency, Office of Radiation and Indoor Air/Radiation Protection Division. 2008a.

_____. "Health and Environmental Impacts of Uranium Contamination in the Navajo Nation: Five-Year Plan." Requested by House Committee on Oversight and Government Reform. Washington, DC: U.S. Environmental Protection Agency. 2008b.

_____. "Technical Resource Document: Extraction and Beneficiation of Ores and Minerals—Uranium." Vol. 5. EPA 530-R-94-032. Washington, DC: U.S. Environmental Protection Agency, Office of Solid Waste/Special Waste Branch. 1995.

_____. "Information on Levels of Environmental Noise Requisite to Protect Health and Welfare With an Adequate Margin of Safety." EPA 550/9-74-005. ML12241A393. Washington, DC: U.S. Environmental Protection Agency. 1974.

FWS (U.S. Fish and Wildlife Service). "List of Threatened and Endangered Species That May Occur in Your Proposed Project Location, and/or May Be Affected By Your Proposed Project." Consultation Code: 06E13000-2016-SLI-0247. Cheyenne, Wyoming: U.S. Fish and Wildlife Service, Wyoming Ecological Services Field Office. 2016. <https://ecos.fws.gov/ipac/project/UGMYFUALEJCXXHT4HA7ICW2EIY/regulatoryDocuments> (5 October 2016).

_____. "Wyoming Ecological Services Species." Cheyenne, Wyoming: U.S. Fish and Wildlife Service, Wyoming Ecological Services. 2015. <https://www.fws.gov/wyominges/Species_WYESlist.php> (5 October 2016).FWS. "Reserve Pit Management: Risks to Migratory Birds." Cheyenne, Wyoming: U.S. Fish and Wildlife Service. 2009. < https://www.fws.gov/mountain-prairie/contaminants/documents/reservepits.pdf> (27 July 2016)

GCRP (U.S. Global Change Research Program). "Highlights of Climate Change Impacts in the United States: The Third National Climate Assessment." Washington, DC: U.S. Global Change Research Program, U.S. Government Printing Office. 2014.

Heidel, Bonnie. "Survey of Spiranthes diluvialis (Ute ladies' tresses) in Eastern Wyoming (Campbell, Converse, Goshen, Laramie, Niobrara and Platte counties) 2005–2006." Laramie, Wyoming: U.S. Department of Interior, Bureau of Land Management. 2007 <http://www.uwyo.edu/wyndd/_files/docs/reports/wynddreports/u07hei04wyus.pdf> (29 June 2016).

Hutson, S.S., N.L. Barber, J.F. Kenney, K.S. Linsey, D.S. Lumia, and M.A. Maupin. "Estimated Use of Water in the United States in 2000." Reston, Virginia: U.S. Geological Survey. 2004.

Mead, Matthew. *Greater Sage-Grouse Core Area Protection*. EO No. 2015-4. Cheyenne, Wyoming: Office of the Governor, State of Wyoming Executive Department. 2015.

<https://wgfd.wyo.gov/WGFD/media/content/PDF/Habitat/Sage%20Grouse/SG_Executive_Order.pdf> (29 June 2016).

NCRP (National Council on Radiation Protection and Measurements). "Ionizing Radiation Exposure of the Population of the United States." Report No. 160. Bethesda, Maryland: National Council on Radiation Protection and Measurements. 2009.

NRC. (U.S. Nuclear Regulatory Commission). "License Applications for New Uranium Recovery Facilities, Expansions, Restarts, and Renewals." Washington, DC: U.S. Nuclear Regulatory Commission. 2016. <http://www.nrc.gov/materials/uranium-recovery/license-apps/ur-projects-list-public.pdf>
(7 July 2016).

_____. "Site Visit to the Proposed Jane Dough Project Area Amendment to the Nichols Ranch ISR Project Campbell and Johnson Counties, Wyoming, September 15, 2015." ML16019A210. Washington, DC: U.S. Nuclear Regulatory Commission. 2015a.

_____. "Locations of Uranium Recovery Sites Undergoing Decommissioning." Washington, DC: U.S. Nuclear Regulatory Commission. 2015b. <http://www.nrc.gov/info-finder/decommissioning/uranium/> (7 July 2016).

_____. "Locations of Uranium Recovery Facilities." Washington, DC: U.S. Nuclear Regulatory Commission. 2015c. <http://www.nrc.gov/info-finder/materials/uranium/index.html>
(7 July 2016).

_____. "Letter to L. Chang, from M. Sattelberg. Re: Threatened and Endangered Species for the Expansion of the Jane Dough In Situ Uranium Recovery Project Through License Amendment for the Uranerz Energy Corporation-Johnson and Campbell Counties." ML15303A097. Washington, DC: U.S. Nuclear Regulatory Commission. 2015d.

_____. Letter from A. Persinko, NRC to M. Thomas, Uranerz Energy Corporation, dated August 28, 2015, RE: Uranerz Energy Corporation, Nichols Ranch In-Situ Recovery (ISR) Project, License Amendment, License Condition 9.7, Proposal to Train Plant Operators and Other Suitable Personnel to Perform Daily Inspections, Materials License SUA-1597 (TAC J00727). ADAMS Accession No. ML15215A412. 2015e.

_____. "Letter to D. Old Coyote, Apsaalooke (Crow) Nation, from M. Bailey, NRC. Re: Notice of Receipt of License Application and Invitation for Section 106 Consultation Pursuant to the National Historic Preservation Act Regarding the Uranerz Energy Corporation License Amendment Application for the Proposed Jane Dough Unit Expansion to the Nichols Ranch In Situ Uranium Recovery Facility in Campbell and Johnson Counties, Wyoming. ML14342A803. Washington, DC: U.S. Nuclear Regulatory Commission. 2014. (21 similar letters sent to additional Tribes – see Appendix A of this EA).

_____. Letter from K. McConnell, NRC to M. Thomas, Uranerz Energy Corporation, dated July 19, 2011, Re: Materials License SUA-1597, Uranerz Energy Corporation, Nichols Ranch Project In Situ Recovery Facility, Campbell and Johnson Counties, Wyoming (TAC J00553). ADAMS Accession No. ML111640238. 2011a.

_____. NUREG–1910, Supplement 2 "Environmental Impact Statement for the Nichols Ranch ISR Project in Campbell and Johnson Counties, Wyoming, Supplement to the Generic

Environmental Impact Statement for *In-Situ* Leach Uranium Milling Facilities." ML103440120. Washington, DC: U.S. Nuclear Regulatory Commission. 2011b.

_____. NUREG–1910, "Generic Environmental Impact Statement for Uranium Milling Facilities—Final Report." ML091480244 and ML091480188. Washington, DC: U.S. Nuclear Regulatory Commission. 2009.

_____. "Environmental Assessment for the Addition of the Reynolds Ranch Mining Area to Power Resources, Inc.'s Smith Ranch/Highlands Uranium Project Converse County, Wyoming." Washington, DC: U.S. Nuclear Regulatory Commission. 2006.

_____. NUREG–1748, "Environmental Review Guidance for Licensing Actions Associated With NMSS Programs." Washington, DC: U.S. Nuclear Regulatory Commission. 2003a.

_____. NUREG–1569, "Standard Review Plan for *In-Situ* Leach Uranium Extraction License Applications – Final Report." Washington, DC: U.S. Nuclear Regulatory Commission. June 2003b.

_____. NUREG–0706, "Final Generic Environmental Impact Statement on Uranium Milling Project M–25." ML032751663, ML0732751667, and ML032751669. Washington, DC: U.S. Nuclear Regulatory Commission. September 1980a.

_____. Regulatory Guide 4.14, "Radiological Effluent and Environmental Monitoring at Uranium 18 Mills." Rev. 1. Washington, DC: U.S. Nuclear Regulatory Commission. April 1980b.

PacifiCorp. "Three Buttes Windpower." Portland Oregon: PacifiCorp. 2015. <http://www.pacificorp.com/es/re/tb.html> (8 July 2016).

_____. "Dave Johnston Plant." Portland Oregon: PacifiCorp. 2011a. <http://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/EnergyGeneration_FactSheets/RMP_GFS_Dave_Johnston.pdf> (8 July 2016).

_____. "Our Wind Energy Resources." Portland Oregon: PacifiCorp. 2011b. <http://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/12-35_PC_RenewableEnergyFlyer.pdf> (8 July 2016).

_____. "Glenrock III Wind Project." Portland Oregon: PacifiCorp. 2011c. <http://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/EnergyGeneration_FactSheets/RMP_GFS_Glenrock_III.pdf> (8 July 2016).

Richey, V. "Letter from V. Richey, Cheyenne and Arapaho Tribes, to C. Roman, NRC, dated February 17, 2017. Re: Availability of the draft cultural resource sections for the proposed Jane Dough unit at the Nichols Ranch In Situ Uranium Recovery project in Johnson and Campbell Counties, Wyoming, Source Materials License Number SUA-1597 (Docket Number 040-09067). ADAMS Accession No. ML17065A245. 2017.

SDDENR. "South Dakota Ambient Air Monitoring Annual Plan 2016." South Dakota Department of Environment and Natural Resources. 2016. <http://denr.sd.gov/des/aq/aqnews/SD%20Annual%20plan%202016.pdf> (15 July 2016).

_____. "South Dakota's Regional Haze State Implementation Program." ML12243A371. Pierre, South Dakota: South Dakota Department of Environment and Natural Resources. 2011.

Sharp, W.N. and A.B. Gibbons. "Geology and Uranium Deposits of the Pumpkin Buttes Area of the Powder River Basin, Wyoming." U.S. Geological Survey Bulletin 1107H. Washington DC: U.S. Government Printing Office. pp. 541–638. 1964.

STB (Surface Transportation Board). "Final Environmental Impact Statement, Finance Docket No. 33407—Dakota, Minnesota & Eastern Railroad Corporation, Construction into the Powder River Basin, Powder River Basin Expansion Project." ML12243A381. Washington, DC: Surface Transportation Board, Section of Environmental Analysis. 2001.

Taylor, R.L., D.E. Naugle, and L.S. Mills. "Viability Analyses for Conservation of Sage-Grouse Populations: Buffalo Field Office, Wyoming, Final Report." Missoula, Montana: University of Montana. 2012. <http://www.powderriverbasin.org/assets/Uploads/files/cbm-studies/PVA-Sage-Grouse-FinalReport.pdf> (12 July 2016).

Uranerz. "Nichols Ranch ISR Project. Source Materials License SUA–1597, Request for Additional Information on Jane Dough License Amendment (TAC No. 1007265, J00875)" and "Nichols Ranch ISR Project - Uranium Solution Mine, Volume 1." ML16148A147, ML16148A153, ML16148A166, ML16207A054, ML16232A096, ML16253A032, ML16263A080, ML16263A167, ML16263A177. Casper, Wyoming: Uranerz Energy Corporation. 2016a.

_____. "Re: Uranerz Energy Corporation, Nichols Ranch Project, Source Materials License SUA- 1597, License Condition 9.5 Financial Assurance Annual Update, Docket No. 40-9067, and NRC Request for Additional Information, Uranerz Energy Corporation, Nichols Ranch Project, Source Materials License SUA-1 597, Annual Financial Assurance Estimate Adjustment (TAC NO. L00758)." ML16020A520. Casper, Wyoming: Uranerz Energy Corporation. 2016b.

_____. "The Uranerz Energy Corporation, Nichols Ranch ISR Project, Source Materials License SUA-1597, Revised License Amendment Request- Chapter 2.0-Site Characterization and Chapter 3.0-Description of Facilities." ML15118A063, ML15118A093, ML15118A095, ML15118A105, ML15118A103, ML15118A178, ML15118A184, ML15118A192, ML15118A194, ML15118A187, ML15118A188, and ML15118A190, ML15182A013, ML15118A122. Casper, Wyoming: Uranerz Energy Corporation. 2015.

_____. "The Uranerz Energy Corporation, Nichols Ranch ISR Project, Source Materials License SUA-1597, License Amendment Application, Environmental Report." ML14164A323, ML14164A274. Casper, Wyoming: Uranerz Energy Corporation. 2014a.

_____. "The Uranerz Energy Corporation, Nichols Ranch ISR Project, Source Materials License SUA-1597, License Amendment Application, Technical Report." ML14164A229, ML14309A118. Casper, Wyoming: Uranerz Energy Corporation. 2014b.

_____. "Semi-Annual Report Uranerz Energy Corporation Nichols Ranch ISR Project SUA-1597." ML14241A024. Casper, Wyoming: Uranerz Energy Corporation. 2014c.

_____. "Nichols Ranch ISR Project U.S. N.R.C. Source Material License Application." Technical Report and Environmental Report. ML080080594, ML083230892, ML091000572, ML090850289, ML090850370, ML090970719, ML090850597, ML090840186, ML090820583, ML091610148, and ML102650539. Casper, Wyoming: Uranerz Energy Corporation. 2007.

USCB (U.S. Census Bureau). "American Fact Finder." Washington, DC: U.S. Census Bureau. 2016. <http://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml> (5 July 2016).

USDA (U.S. Department of Agriculture). "National Cooperative Soil Survey standards" Natural Resource Conservation Service. U.S. Department of Agriculture. Washington. D.C. 1993. <http://www.nrcs.usda.gov/wps/portal/nrcs/detail//?cid=nrcs142p2_053544> (27 July 2016)

USGS (U.S. Geological Survey). "Gap Analysis Program (GAP) Species Viewer." Reston, Virginia: U.S. Geological Survey 2016. <http://gis1.usgs.gov/csas/gap/viewer/species/Map.aspx> (5 October 2016).

_____. "2010-2011 Minerals Yearbook." Reston, Virginia: U.S. Geological Survey. 2015. <http://minerals.usgs.gov/minerals/pubs/state/2010_11/myb2-2010_11-wy.pdf> (8 July 2016).

WDEQ (Wyoming Department of Environmental Quality). "Reno Junction Wind Energy Project." Cheyenne, Wyoming: Wyoming Department of Environmental Quality. 2016a. <http://deq.wyoming.gov/isd/application-permits/resources/reno-junction-wind-energy-project/> (8 July 2016).

_____. "Wyoming Ambient Air Monitoring Annual Network Plan 2016." Cheyenne, Wyoming: Wyoming Department of Environmental Quality. 2016b.

_____. "TFN 5 5/166, Uranerz Energy Corporation, Nichols Ranch ISR Project, Permit to Mine No. 778." ML15225A438. Cheyenne, Wyoming: Wyoming Department of Environmental Quality. 2015a.

_____. "Wyoming Ambient Air Monitoring Annual Network Plan 2015." Cheyenne, Wyoming: Wyoming Department of Environmental Quality. 2015b.

_____. "Underground Injection Control Program Class I and V Wells." Rules and Regulations, Water Quality Program, Chapter 27. Cheyenne, Wyoming: WDEQ. 2015c.

_____. "Noncoal In Situ Mining." Rules and Regulations, Land Quality – Non Coal Program, Chapter 11." Cheyenne, Wyoming: Wyoming Department of Environmental Quality. 2013a.

_____. "Uranerz Energy Corporation – NICH DW–1 Injection Well Permit 10-392 Authorization to Inject." Letter (October 22, 2012) from D. Fischer to M. Thomas (Uranerz Energy Corporation). Sheridan, Wyoming: State of Wyoming Department of Environmental Quality-Groundwater Section. 2013b.

_____. "Uranerz Energy Corporation – NICH DW–4 Injection Well Permit 10-392 Authorization to Inject." Letter (December 20, 2013) from D. Fischer to M. Thomas (Uranerz Energy Corporation). Sheridan, Wyoming: State of Wyoming Department of Environmental Quality-Groundwater Section. 2013c.

_____. "Guideline No. 4: In Situ Mining Noncoal." Cheyenne, Wyoming: Wyoming Department of Environmental Quality, Land Quality Division. 2013d.

_____. "State of Wyoming Department of Environmental Quality Underground Injection Control Permit Issued Under Wyoming Water Quality Rules and Regulations, Chapter 13, Class I

Injection Well." Permit 10-392. Cheyenne, Wyoming: State of Wyoming Department of Environmental Quality-Water Quality Division. 2012a.

_____. "Air Quality Division Standards and Regulations, Chapter 2 – Ambient Standards." Cheyenne, Wyoming: Wyoming Department of Environmental Quality. 2012b.

_____. "Noncoal Rules and Regulations, Chapter 3 – Noncoal Mine Environmental Performance Standards." Cheyenne, Wyoming: Wyoming Department of Environmental Quality Land Quality Division. 2006a.

_____. "Coal Rules and Regulations, Chapter 4 – Environmental Performance Standards for Surface Coal Mining Operations." Cheyenne, Wyoming: Wyoming Department of Environmental Quality Land Quality Division. 2006b.

WGFD (Wyoming Game and Fish Department). "2016 Species of Greatest Conservation Need." Cheyenne, Wyoming: Wyoming Game and Fish Department. 2016. <https://wgfd.wyo.gov/WGFD/media/content/PDF/Habitat/SWAP/SGCN_2017List.pdf> (29 June 2016).

_____. "SG Lek Observations 1948–2015." Cheyenne, Wyoming: Wyoming Game and Fish Department. Non-public. 2015.

_____. "2014 Big Game Job Completion Report Sheridan Region." Cheyenne, Wyoming: Wyoming Game and Fish Department. 2014. <https://wgfd.wyo.gov/WGFD/media/content/PDF/Hunting/JCRS/JCR_BGSHERCOMP_2014.pdf> (29 June 2016).

_____. "Wyoming State Wildlife Action Plan 2010." ML12241A410. Cheyenne, Wyoming: Wyoming Game and Fish Department. 2010. <http://wgfd.wyo.gov/web2011/Departments/Wildlife/pdfs/SWAP_2010_FULL_OCT0003090.pdf> (25 November 2015).

WMA (Wyoming Mining Association). "The 2014–2015 Concise Guide to Wyoming Coal." Cheyenne, Wyoming: Wyoming Mining Association. 2015. <http://www.wyomingmining.org/wp-content/uploads/2014/09/2014-15-Concise-Guide-to-Wyoming-Coal.pdf> (7 July 2016).

_____. "Recent News: Bentonite." Cheyenne, Wyoming: Wyoming Mining Association. 2015b. <http://www.wyomingmining.org/minerals/bentonite/> (8 July 2016).

WOGCC (Wyoming Oil and Gas Conservation Commission). "Report to the Joint Minerals, Business and Economic Development Committee." Casper, Wyoming: Wyoming Oil and Gas Conservation Commission. 2015. <http://legisweb.state.wy.us/InterimCommittee/2015/09-1022APPENDIXJ.PDF> (8 July 2014).

WSGS (Wyoming State Geological Survey). "Wyoming's Oil and Gas Resources, Summary Report." Laramie, Wyoming: Wyoming State Geologic Survey. 2015. <http://www.wsgs.wyo.gov/products/wsgs-2015-oilgas-summary.pdf> (8 July 2016).

WYDOT (Wyoming Department of Transporation). "2014 Automatic Traffic Recorder Report." Cheyenne, Wyoming: Wyoming Department of Transportation, Planning Program. 2014. <https://www.dot.state.wy.us/home/planning_projects/Traffic_Data.default.html> (22 July 2015).

WYNDD (Wyoming Natural Diversity Database). "Mountain Plover in Wyoming." Laramie, Wyoming: University of Wyoming. 2010. <http://www.uwyo.edu/wyndd/_files/docs/mtn-plover/occurrence_data_map_v2.pdf>
(5 July 2016).

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.

WY SHPO (Wyoming State Preservation Office). Letter to L. Chang. "Re: Jane Dough Expansion of the Nichols Ranch In Situ Uranium Recovery Project, Johnson and Campbell Counties (SHPO File #0816ECK009)." ML16263A122. Cheyenne, Wyoming. 2016.

Wyoming Weed and Pest Council. "Wyoming Weed & Pest Control Act State Designated Weeds and Pests." Gillette, Wyoming: 2016.
<http://www.wyoweed.org/images/Designated_List.pdf> (29 June 2016).

1

APPENDIX A

CONSULTATION CORRESPONDENCE

APPENDIX A—CONSULTATION CORRESPONDENCE

A.1 Consultation Correspondence

The Endangered Species Act of 1973, as amended, and the National Historic Preservation Act of 1966 require that Federal agencies consult with applicable State and Federal agencies and groups prior to taking action that may affect threatened and endangered species, essential fish habitat, or historic and archaeological resources. This appendix contains consultation documentation related to these Federal acts.

Table A-1. Chronology of Consultation Correspondence

Sender	Recipient	Date of Letter	ADAMS Accession Number
U.S. Nuclear Regulatory Commission (M. Bailey)	Apsaalooke (Crow) Nation (D. Old Coyote)	December 15, 2014	ML14342A803
U.S. Nuclear Regulatory Commission (M. Bailey)	Cheyenne and Arapaho Tribes (E. Hamilton)	December 15, 2014	ML14342A755
U.S. Nuclear Regulatory Commission (M. Bailey)	Cheyenne River Sioux Tribe (K. Keckler)	December 15, 2014	ML14307B588
U.S. Nuclear Regulatory Commission (M. Bailey)	Chippewa Cree Tribe (R. Morsette)	December 15, 2014	ML14342A772
U.S. Nuclear Regulatory Commission (M. Bailey)	Crow Creek Sioux Tribe (B. Suzue, Sr.)	December 15, 2014	ML14342A830
U.S. Nuclear Regulatory Commission (M. Bailey)	Eastern Shoshone Tribe (D. St. Clair, Jr.)	December 15, 2014	ML14343A337
U.S. Nuclear Regulatory Commission (M. Bailey)	Flandreau-Santee Sioux Tribe (A. Reider)	December 15, 2014	ML14343A371
U.S. Nuclear Regulatory Commission (M. Bailey)	Fort Belknap Tribe (M. Blackwolf)	December 15, 2014	ML14343A673
U.S. Nuclear Regulatory Commission (M. Bailey)	Fort Peck Tribes (F. Azure)	December 15, 2014	ML14343A689
U.S. Nuclear Regulatory Commission (M. Bailey)	Kiowa Indian Tribe of Oklahoma (A. Poppah)	December 15, 2014	ML14344A744
U.S. Nuclear Regulatory Commission (M. Bailey)	Lower Brule Sioux Tribe (M. Jandreau)	December 15, 2014	ML14344A760
U.S. Nuclear Regulatory Commission (M. Bailey)	Mandan, Hidatsa & Arikara Nation (M. Fox)	December 15, 2014	ML14345A189
U.S. Nuclear Regulatory Commission (M. Bailey)	Northern Arapaho Tribe (D. Neal)	December 15, 2014	ML14344A785
U.S. Nuclear Regulatory Commission (M. Bailey)	Northern Cheyenne Tribe (J. Robinson)	December 15, 2014	ML14345A220
U.S. Nuclear Regulatory Commission (M. Bailey)	Oglala Sioux Tribe (B. Brewer)	December 15, 2014	ML14345A230
U.S. Nuclear Regulatory Commission (M. Bailey)	Rosebud Sioux Tribe (C. Scott)	December 15, 2014	ML14345A237
U.S. Nuclear Regulatory Commission (M. Bailey)	Santee Sioux Tribe of Nebraska (R. Trudell)	December 15, 2014	ML14345A293
U.S. Nuclear Regulatory Commission (M. Bailey)	Sisseton-Wahpeton Oyate Tribes (R. Shepherd)	December 15, 2014	ML14345A033
U.S. Nuclear Regulatory Commission (M. Bailey)	Spirit Lake Tribe (L. McDonald)	December 15, 2014	ML14345A081
U.S. Nuclear Regulatory Commission (M. Bailey)	Standing Rock Sioux Tribe (D. Archambault)	December 15, 2014	ML14345A143

Table A-1. Chronology of Consultation Correspondence			
Sender	**Recipient**	**Date of Letter**	**ADAMS Accession Number**
U.S. Nuclear Regulatory Commission (M. Bailey)	Turtle Mountain Band of Chippewa (R. McCloud)	December 15, 2014	ML14345A202
U.S. Nuclear Regulatory Commission (M. Bailey)	Yankton Sioux Tribe (T. Cournoyer)	December 15, 2014	ML14345A208
U.S Nuclear Regulatory Commission (L. Chang)	Wyoming State Historic Preservation Office (M. Hopkins)	September 16, 2015	ML15258A205
U.S Nuclear Regulatory Commission (L. Chang)	U.S. Fish and Wildlife Service (M. Sattelburg)	September 16, 2015	ML15258A180
U.S. Fish and Wildlife Service (M. Sattelburg)	U.S. Nuclear Regulatory Commission	October 9, 2015	ML15303A097
Wyoming State Historic Preservation Office (R. Currit)	U.S. Nuclear Regulatory Commission (L. Chang)	January 7, 2016	ML16007A350
U.S. Nuclear Regulatory Commission (L. Chang)	Apsaalooke (Crow) Nation (E. Chief)	May 19, 2016	ML16141A754
U.S. Nuclear Regulatory Commission (L. Chang)	Cheyenne/Arapaho Tribes of Oklahoma (M. Sutton)	May 19, 2016	ML16141A855
U.S. Nuclear Regulatory Commission (L. Chang)	Cheyenne River Sioux Tribe (S. Vance)	May 19, 2016	ML16141A800
U.S. Nuclear Regulatory Commission (L. Chang)	Chippewa Cree Tribe (A. Windy Boy)	May 19, 2016	ML16141A773
U.S. Nuclear Regulatory Commission (L. Chang)	Crow Creek Sioux Tribe (D. Zephier)	May 19, 2016	ML16141A764
U.S. Nuclear Regulatory Commission (L. Chang)	Eastern Shoshone Tribe (R. Dushane)	May 19, 2016	ML16141A893
U.S. Nuclear Regulatory Commission (L. Chang)	Flandreau-Santee Sioux Tribe (G. Hundred)	May 19, 2016	ML16141A733
U.S. Nuclear Regulatory Commission (L. Chang)	Fort Belknap Tribe (M. Wolf)	May 19, 2016	ML16141A743
U.S. Nuclear Regulatory Commission (L. Chang)	Fort Peck Tribe (D. Youpee)	May 19, 2016	ML16141A712
U.S. Nuclear Regulatory Commission (L. Chang)	Kiowa Indian Tribe of Oklahoma (D. Tsonetokoy, Sr.)	May 19, 2016	ML16141A693
U.S. Nuclear Regulatory Commission (L. Chang)	Lower Brule Sioux Tribe (B. Molyneaux)	May 19, 2016	ML16141A926
U.S. Nuclear Regulatory Commission (L. Chang)	Mandan, Hidatsa & Arikara Nation (E. Breast)	May 19, 2016	ML16141A258
U.S. Nuclear Regulatory Commission (L. Chang)	Northern Arapaho Tribe (Y. Soldier Wolf)	May 19, 2016	ML16141A660
U.S. Nuclear Regulatory Commission (L. Chang)	Northern Cheyenne Tribe (T. Limpy)	May 19, 2016	ML16141A624
U.S. Nuclear Regulatory Commission (L. Chang)	Oglala Sioux Tribe (T. Lonehill)	May 19, 2016	ML16141A376
U.S. Nuclear Regulatory Commission (L. Chang)	Rosebud Sioux Tribe (R. EagleBear)	May 19, 2016	ML16141A366
U.S. Nuclear Regulatory Commission (L. Chang)	Santee Sioux Tribe of Nebraska (R. Thomas)	May 19, 2016	ML16141A325

Table A-1. Chronology of Consultation Correspondence			
Sender	**Recipient**	**Date of Letter**	**ADAMS Accession Number**
U.S. Nuclear Regulatory Commission (L. Chang)	Sisseton-Wahpeton Oyate Tribes (D. Desrosiers)	May 19, 2016	ML16141A313
U.S. Nuclear Regulatory Commission (L. Chang)	Spirit Lake Tribe (E. Longie)	May 19, 2016	ML16141A283
U.S. Nuclear Regulatory Commission (L. Chang)	Standing Rock Sioux Tribe (J. Eagle)	May 19, 2016	ML16141A265
U.S. Nuclear Regulatory Commission (L. Chang)	Turtle Mountain Band of Chippewa (B. Nadeau, Sr.)	May 19, 2016	ML16141A234
U.S. Nuclear Regulatory Commission (L. Chang)	Yankton Sioux Tribe (P. Little)	May 19, 2016	ML16134A015
U.S. Nuclear Regulatory Commission (L. Chang)	Northern Cheyenne Tribe (T. Limpy)	August 10, 2016	ML16218A215
U.S. Nuclear Regulatory Commission (L. Chang)	Fort Belknap Tribe (M. Black Wolf)	August 10, 2016	ML16218A355
U.S. Nuclear Regulatory Commission (L. Chang)	Cheyenne/Arapaho Tribes of Oklahoma (M. Sutton)	August 10, 2016	ML16218A212
U.S. Nuclear Regulatory Commission (L. Chang)	Oglala Sioux Tribe (T. Lonehill)	August 10, 2016	ML16218A206
U.S. Nuclear Regulatory Commission (L. Chang)	Chippewa Cree Tribe (A. Windy Boy, Sr.)	August 10, 2016	ML16218A220
U.S. Nuclear Regulatory Commission (L. Chang)	Wyoming State Historic Preservation Office (M. Hopkins)	August 10, 2016	ML16169A291
U.S. Nuclear Regulatory Commission (L. Chang)	Wyoming State Historic Preservation Office (E. King)	August 30, 2016	ML16263A122
Northern Arapaho THPO (Y. Soldier Wolf)	U.S. Nuclear Regulatory Commission (L. Chang)	October 7, 2016	ML16292A324
U.S. Nuclear Regulatory Commission (C. Roman-Cuevas)	Wyoming Department of Environmental Quality (M. Rogaczewski)	December 20, 2016	ML16351A084
Wyoming Department of Environmental Quality (M. Rogaczewski)	U.S. Nuclear Regulatory Commission (A. Waldron and D. Brown)	January 25, 2017	ML17025A408
U.S. Nuclear Regulatory Commission (C. Roman-Cuevas)	Northern Arapaho Tribe (Y. Solider Wolf)	January 27, 2017	ML17026A221
U.S. Nuclear Regulatory Commission (C. Roman-Cuevas)	Chippewa Cree Tribe (A. Windy Boy, Sr.)	January 27, 2017	ML17027A367
U.S. Nuclear Regulatory Commission (C. Roman-Cuevas)	Lower Brule Sioux Tribe (B. Molyneaux)	January 27, 2017	ML17027A371
U.S. Nuclear Regulatory Commission (C. Roman-Cuevas)	Spirit Lake Tribe (E. Longie)	January 27, 2017	ML17027A372

Table A-1. Chronology of Consultation Correspondence			
Sender	**Recipient**	**Date of Letter**	**ADAMS Accession Number**
U.S. Nuclear Regulatory Commission (C. Roman-Cuevas)	Turtle Mountain Band of Chippewa (B. Nadeau, Sr.)	January 27, 2017	ML17027A374
U.S. Nuclear Regulatory Commission (C. Roman-Cuevas)	Cheyenne/Arapaho Tribes of Oklahoma (M. Sutton)	January 27, 2017	ML17027A373
U.S. Nuclear Regulatory Commission (C. Roman-Cuevas)	Apsaalooke (Crow) Nation (E. Chief)	January 27, 2017	ML17027A375
U.S. Nuclear Regulatory Commission (C. Roman-Cuevas)	Fort Peck Tribe (D. Youpee)	January 27, 2017	ML17027A377
U.S. Nuclear Regulatory Commission (C. Roman-Cuevas)	Crow Creek Sioux Tribe (D. Zephier)	January 27, 2017	ML17030A129
U.S. Nuclear Regulatory Commission (C. Roman-Cuevas)	Kiowa Indian Tribe of Oklahoma (D. Tsonetokoy, Sr.)	January 27, 2017	ML17030A150
U.S. Nuclear Regulatory Commission (C. Roman-Cuevas)	Mandan, Hidatsa & Arikara Nation (E. Breast)	January 27, 2017	ML17030A154
U.S. Nuclear Regulatory Commission (C. Roman-Cuevas)	Standing Rock Sioux Tribe (J. Eagle)	January 27, 2017	ML17030A161
U.S. Nuclear Regulatory Commission (C. Roman-Cuevas)	Flandreau-Santee Sioux Tribe (G. Hundred)	January 27, 2017	ML17030A171
U.S. Nuclear Regulatory Commission (C. Roman-Cuevas)	Fort Belknap Tribe (M. Blackwolf)	January 27, 2017	ML17030A176
U.S. Nuclear Regulatory Commission (C. Roman-Cuevas)	Yankton Sioux Tribe (P. Little)	January 27, 2017	ML17030A179
U.S. Nuclear Regulatory Commission (C. Roman-Cuevas)	Santee Sioux Tribe of Nebraska (R. Thomas)	January 27, 2017	ML17030A186
U.S. Nuclear Regulatory Commission (C. Roman-Cuevas)	Eastern Shoshone Tribe (R. Dushane)	January 27, 2017	ML17030A212
U.S. Nuclear Regulatory Commission (C. Roman-Cuevas)	Rosebud Sioux Tribe (R. EagleBear)	January 27, 2017	ML17030A223
U.S. Nuclear Regulatory Commission (C. Roman-Cuevas)	Sisseton-Wahpeton Oyate Tribes (D. Desrosiers)	January 27, 2017	ML17030A229
U.S. Nuclear Regulatory Commission (C. Roman-Cuevas)	Oglala Sioux Tribe (T. Lonehill)	January 27, 2017	ML17030A233
U.S. Nuclear Regulatory Commission (C. Roman-Cuevas)	Cheyenne River Sioux Tribe (S. Vance)	January 27, 2017	ML17030A248

Table A-1. Chronology of Consultation Correspondence			
Sender	**Recipient**	**Date of Letter**	**ADAMS Accession Number**
Cheyenne & Arapaho Tribes (V. Richey)	U.S. Nuclear Regulatory Commission (C. Roman-Cuevas)	February 17, 2017	ML17065A245

APPENDIX B

EMISSION INVENTORY

APPENDIX B—EMISSION INVENTORY

B.1 Emission Inventory

This section describes the emission inventory for the Jane Dough Unit and, for fugitive dust emissions, the entire Nichols Ranch ISR Project. This description is divided into three sections: (i) fugitive dust emission estimates [environmental assessment (EA) Section B.1.1], (ii) combustion emission estimates (EA Section B.1.2), and (iii) total emission estimates (EA Section B.1.3). There are no stationary source emissions associated with the Jane Dough Unit.

Emissions associated with In Situ Recovery (ISR) project phases (i.e., construction, operations, groundwater restoration, and wellfield and site reclamation) would occur simultaneously at the Nichols Ranch, Hank, and Jane Dough Units (see EA Figure 2-2). The peak year emission estimate represents the highest amount of emissions the Nichols Ranch, Hank, and Jane Dough Units would generate in any one project year. The project schedule displayed in EA Figure 2-2 does not include the construction phase. Construction for each of the Jane Dough Unit wellfields is estimated at 1 to 2 years. With regard to air emission estimates, the U.S. Nuclear Regulatory Commission (NRC) staff assumed that wellfield construction would last an entire year before the wellfield operations phase starts, as well as the portion of the year leading up to the start of the operation phase. Jane Dough Production Unit #1 construction lasts 18 months (i.e., all 2018 and the first half of 2019) and Production Unit #2 lasts 15 months (i.e., all of 2021 and the first quarter of 2022).

B.1.1 Fugitive Dust Estimates

EA Table B–1 contains the Nichols Ranch Unit, Hank Unit, and Jane Dough Unit particulate matter PM_{10} fugitive dust estimates. Estimates are divided into two categories: (i) nonwellfield emissions and (ii) wellfield emissions. Nonwellfield fugitive dust emissions are caused by mobile sources traveling on the unpaved access and haul roads. Wellfield fugitive dust emissions are caused by mobile sources traveling on unpaved roads within the property boundary other than the access and haul roads. The licensee provided nonwellfield emission estimates (Uranerz, 2014). The Wyoming Department of Environmental Quality (WDEQ) permit requires the licensee to implement dust suppression measures on the access and haul roads (WDEQ, 2009). The nonwellfield emission estimates in EA Table B–1 include a 50 percent reduction in fugitive dust emissions on the access and haul roads because of the WDEQ permit-required dust suppression mitigation.

The NRC staff estimated the wellfield fugitive emissions for the Nichols Ranch, Hank, and Jane Dough Units using information from the Dewey-Burdock ISR Project Supplemental Environmental Impact Statement (SEIS) (NRC, 2014). EA Table B–2 contains the Dewey-Burdock project on-site particulate matter PM_{10} fugitive dust emission estimates by phase, as well as, the wellfield and nonwellfield contributions. The NRC staff assumed that the relative contribution for nonwellfield sources to the total emissions is the same for the Dewey-Burdock ISR Project and all three Nichols Ranch ISR Project production units (i.e., Nichols Ranch, Hank, and Jane Dough Units). By using these relative contributions (i.e., percentages) in EA Table B–2, the wellfield emissions for the operations, aquifer restoration, and decommissioning phases were calculated from the nonwellfield emissions provided by the licensee. The footnotes in EA Table B–1 contain the details concerning these calculations. The licensee did not provide a separate nonwellfield emission estimate for the construction phase, so the wellfield estimate methodology was different than for the other

Table B–1. Particulate Matter PM_{10} Annual Fugitive Dust Emission Estimates in Short Tons*

Units	Phase	Emission Type†	Project Year																				
			2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Jane Dough	I&O‡	Non-wf	9.55	9.55	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	7.15
	Con	Non-wf§	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		WFǁ	0	0	0	0	0	90.7	45.35	0	90.7	22.7	0	0	0	0	0	0	0	0	0	0	0
	Ops	Non-wf	0	0	0	0	0	0	4.85	6.45	6.45	11.3	12.9	12.9	8.05	6.45	4.85	0	0	0	0	0	0
		WF¶	0	0	0	0	0	0	17.7	23.54	23.54	41.24	47.08	47.08	29.38	23.54	17.7	0	0	0	0	0	0
	Aq Rest	Non-wf	0	0	0	0	0	0	0	0	0	0	0	0	1.6	2.15	3.05	2.7	1.25	0	0	0	0
		WF#	0	0	0	0	0	0	0	0	0	0	0	0	3.2	4.3	6.1	5.4	2.5	0	0	0	0
	Decom	Non-wf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.15	0.25	0.25	0.15	0	0
		WF**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.69	2.82	2.82	1.69	0	0
	TOTAL – Jane Dough Unit		0	0	0	0	0	105.0	82.2	44.3	134.9	89.5	74.3	74.3	56.5	50.7	46.0	24.2	21.1	17.4	16.1	0	0
Nichols	Con	Non-wf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		WFǁ	22.5	5.6	22.5	16.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ops	Non-wf	0	1.05	1.6	2.0	3.2	3.2	2.4	1.6	1.6	0.8	0	0	0	0	0	0	0	0	0	0	0
		WF¶	0	3.8	5.8	7.3	11.7	11.7	8.7	5.8	5.8	2.9	0	0	0	0	0	0	0	0	0	0	0
	Aq Rest	Non-wf	0	0	0	0	0	0	0.25	0.55	0.55	0.8	1.05	0.4	0	0	0	0	0	0	0	0	0
		WF#	0	0	0	0	0	0	0.5	1.1	1.1	1.6	2.1	0.8	0	0	0	0	0	0	0	0	0
	Decom	Non-wf	0	0	0	0	0	0	0	0	0	0	0	0.1	0.1	0	0	0	0	0	0	0	0
		WF**	0	0	0	0	0	0	0	0	0	0	0	1.1	1.1	0	0	0	0	0	0	0	0
Hank	Con	Non-wf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		WFǁ	0	0	0	0	0	0	0	0	0	0	0	26.8	6.7	26.8	13.4	0	0	0	0	0	0
	Ops	Non-wf	0	0	0	0	0	0	0	0	0	0	0	0	2.85	3.8	3.8	3.8	1.9	0	0	0	0
		WF¶	0	0	0	0	0	0	0	0	0	0	0	0	10.4	13.9	13.9	13.9	6.9	0	0	0	0
	Aq Rest	Non-wf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.55	1.05	1.6	2.15	1.45	0.25	0
		WF#	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.1	2.1	3.2	4.3	2.9	0.5	0
	Decom	Non-wf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0.25	0.05
		WF**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.1	2.8	0.56
Grand Total - Jane Dough, Nichols, and Hank units			32.1	20.0	44.2	40.5	29.2	119.9	94.1	53.3	144.0	95.6	77.4	103.5	77.7	95.2	78.8	45.1	34.7	23.8	21.7	18.1	7.8

Sources: Modified from IML (2013), NRC (2014), and Uranerz (2016)

*Applicant and appendix table mass expressed in English units only (dual units used in EA text with metric being primary). To convert short tons to metric tons, multiply by 0.907.

†Non-wf stands for "Nonwellfield" which refers to emissions caused by mobile sources traveling on unpaved access and haul roads. WF stands for "Wellfields" which refers to emissions caused by mobile sources traveling on unpaved roads within the property boundary other than the access and haul roads. Non-wf emissions are reduced 50% because of dust control mitigation on access and haul roads. The WF emissions are not reduced in this table.

‡I & O stands for "In and Out" which refers to vehicle traffic entering and exiting the site collectively for all four phases.

§Construction phase non-wellfield emission estimates are zero because the applicant included these values in the operations phase nonwellfield emissions.

ǁThe full year construction phase wellfield emissions for each unit (e.g., Jane Dough Unit #1 in 2018) is calculated as follows: (operations nonwellfield emissions + operations wellfield emissions) * 1.513 where 1.513 is the relationship between the total (i.e., wellfield and nonwellfield) construction phase and operation phase emission levels from the Dewey-Burdock ISR project (see EA Table B–2). Partial year emissions (e.g., Jane Dough Unit #1 in 2019) are prorated per the project schedule in EA Figure 2-2.

¶The operation phase wellfield emissions for each unit is calculated as follows: (operations nonwellfield emissions) / 0.548 where 0.548 is the relationship between the nonwellfield operation phase and total operation phase (wellfield and nonwellfield) emission levels from the Dewey-Burdock ISR project (see EA Table B–2).

#The aquifer restoration phase wellfield emissions for each unit is calculated as follows: (aquifer restoration nonwellfield emissions) / 1.00 where 1.00 is the relationship between the nonwellfield aquifer restoration phase and total restoration phase (wellfield and nonwellfield) emission levels from the Dewey-Burdock ISR project (see EA Table B-2).

**The decommissioning phase wellfield emissions for each unit is calculated as follows: (decommissioning non-wellfield emissions) / 0.177 where 0.177 is the relationship between the nonwellfield decommissioning phase and total decommissioning phase (wellfield and nonwellfield) emission levels from the Dewey-Burdock ISR project (see EA Table B–2).

Table B–2. Dewey-Burdock ISR Project Onsite Particulate Matter PM_{10} Annual Fugitive Dust Emission Estimates in Short Tons*

Emissions	Phase			
	Construction	Operation	Aquifer Restoration	Decommissioning
Non-wellfield[†]	17.7	55.28	7.7	10.62
Wellfield[‡]	134.95	45.58	0	49.49
Total	152.65[§]	100.86	7.7	60.11
Percent Non-wellfield[‖]	11.6	54.8	100.0	17.7

Source: Modified from IML (2013) and NRC (2014)
*Licensee supplied and appendix table mass expressed in English units only (dual units used in EA text with metric being primary). To convert short tons to metric tons, multiply by 0.907.
[†]Nonwellfield emissions are attributed to the following sources: Resin-hauling semi-truck, product transport truck, passenger vehicles and light duty pickup.
[‡]Well-field emissions are attributed to all of the other sources not identified as non-wellfield emission sources.
[§]The contribution of the construction phase relative to the operation phase is 151.3%. This is calculated by dividing the total construction phase emission (152.36 tons) by the total operation phase emission (100.86) and multiplying by 100.
[‖]Calculated for each phase using the following equation: (non-wellfield emission/total emission) * 100.

phases. The NRC staff assumed that the relative contribution of each phase to the total (i.e., all phases) emissions is the same for the Dewey-Burdock ISR Project and three Nichols Ranch ISR Project production units. By using the relative contribution (i.e., percentages) of the total (i.e., wellfield and nonwellfield) construction and operation phase emissions in EA Table B–2, the emissions for the construction phase were calculated from the emissions for the operation phase. The footnotes in EA Table B–1 contain the details for this calculation. The wellfield emission estimates in EA Table B–1 do not include a 50 percent reduction in wellfield emissions because the WDEQ permit does not require dust suppression within the wellfields.

As described in EA Table B–1, the peak year particulate matter PM_{10} emission estimate for the Jane Dough Units would be 122.4 metric tons [134.9 short tons]. The NRC staff estimated the particulate matter $PM_{2.5}$ emissions based on the amount of particulate matter PM_{10} generated from travel on unpaved roads. The study performed for the Western Regional Air Partnership by Midwest Research Institute recommends estimating the particulate matter $PM_{2.5}$ emissions levels from travel on unpaved roads at 10 percent of the particulate matter PM_{10} emission levels (Midwest Research Institute, 2006). Applying this percentage to the Jane Dough Unit particulate matter PM_{10} estimates from EA Table B–1 results in an estimated particulate $PM_{2.5}$ of 12.2 metric tons [13.5 short tons] per year. The peak year particulate matter PM_{10} emission estimate for all three Nichols Ranch ISR Project production units combined would be 130.6 metric tons [144.0 short tons].

B.1.2 Combustion Emission Estimates

The NRC staff estimated the Jane Dough Unit combustion emissions using information from the Nichols Ranch ISR SEIS (NRC, 2011). All ISR phases generate air emissions. However, for purposes of estimating the emissions in the Nichols Ranch SEIS, combustion emissions were attributed to three activities: (i) production unit construction, (ii) production unit decommissioning, and (iii) deep disposal well drilling. The NRC staff assumes that the emission levels for these three activities are the same for the Nichols Ranch ISR Project and Jane Dough Unit. EA Table B–3 contains the emission estimates used in the Nichols Ranch SEIS for these three activities.

- Construction of a single wellfield and drilling of a single Class I deep disposal well generated about the same level of emissions.

- The decommissioning phase generated about twice the emission levels of either the construction of a single production unit or the drilling of a single deep disposal well.

- Currently, the Nichols Ranch Unit contains two Class I deep disposal wells (Uranerz, 2016).

The expectation is that the existing two Class I deep disposal wells at the Nichols Ranch Unit would be able to handle all of the waste from both the Nichols Ranch and Jane Dough Units without the need for any additional Class I deep disposal wells (Uranerz, 2016). For the combustion emission inventory used in this EA, the NRC staff conservatively assumes that at most two additional Class I deep disposal wells would be needed to support Jane Dough Unit operations. Based on the project schedule (see EA Figure 2-2), there would be no overlap between the construction and decommissioning phases of either production unit. Based on the emission levels of the three activities and the project schedule, the NRC staff determined that the Jane Dough Unit peak year for combustion emissions occurs when one production unit is constructed and two Class I deep disposal wells are drilled. EA Table B–4 contains the Jane Dough Unit peak year combustion emission estimates.

The Nichols Ranch ISR SEIS combustion emission estimates did not include particulate matter $PM_{2.5}$. This value can be estimated based on the amount of particulate matter PM_{10} generated from combustion emissions. In the EPA report "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling–Compression-Ignition" (EPA, 2004), particulate matter $PM_{2.5}$ combustion emissions are estimated to be 97 percent of the particulate matter PM_{10} emission levels. Particulate matter $PM_{2.5}$ combustion emission values in EA Table B–3 and EA Table B–4 are generated using this 97 percent conversion factor.

Table B–3. Nichols Ranch SEIS Analyses Annual Combustion Emission Estimates in Short Tons*

	Pollutant						
Activity[†]	Carbon Dioxide	Carbon Monoxide	Nitrogen Oxides	Particulate Matter $PM_{2.5}$[‡]	Particulate Matter PM_{10}	Sulfur Dioxide	Volatile Organic Compounds
Construction – Single Production Unit[§]	290	1.7	7.9	0.54	0.56	0.52	0.64
Construction – Single Deep Disposal Well	340	2.0	6	0.19	0.20	0.10	0.20
Decommissioning – Single Production Unit[‖]	600	3.5	16	1.2	1.2	1.1	1.3

Source: modified from NRC (2011)
*Licensee supplied and appendix table mass expressed in English units only (dual units used in EA text with metric being primary). To convert short tons to metric tons, multiply by 0.907.
[†]In the Nichols Ranch SEIS, no combustion emissions were attributed to the operation or aquifer restoration phases.
[‡]Particulate matter $PM_{2.5}$ emissions are estimated to be 97% of the particulate matter PM_{10} emissions.
[§]Production unit combustion emissions for the construction phase are attributed to drilling rigs (excluding the deep disposal wells) and construction equipment.
[‖]Production unit combustion emissions for the decommissioning phase are attributed to construction equipment.

Table B–4. Peak Year* Combustion Emission Estimates in Short Tons† for the Jane Dough Amendment Analysis						
Pollutant						
Carbon Dioxide	Carbon Monoxide	Nitrogen Oxides	Particulate Matter $PM_{2.5}$‡	Particulate Matter PM_{10}	Sulfur Dioxide	Volatile Organic Compounds
970	5.7	19.9	0.92	0.96	0.72	1.04

Source: Modified from NRC (2011)
*Peak year for Jane Dough comprised of construction of one production unit and drilling of two Class I deep disposal wells.
†Licensee supplied and appendix table mass expressed in English units only (dual units used in EA text with metric being primary). To convert short tons to metric tons, multiply by 0.907.
‡Particulate matter $PM_{2.5}$ emissions are estimated to be 97 percent of the particulate matter PM_{10} emissions.

B.1.3 Total Emission Estimates

EA Table B–5 contains the total emission estimates for the Jane Dough amendment, which combines the fugitive dust estimates from Section B.1.1 for just the Jane Dough Unit with the Jane Dough Unit combustion emission estimates from Section B.1.2. The carbon dioxide emission estimate in EA Table B–5 also includes the indirect emissions associated with electricity consumption. The NRC staff estimated the Jane Dough amendment indirect carbon dioxide emissions using information from the Dewey-Burdock ISR SEIS. For the Dewey-Burdock ISR Project, indirect carbon dioxide emissions were about 4.3 times the mobile source carbon dioxide combustion emissions (NRC, 2014). The NRC staff estimated the Jane Dough amendment indirect emission level by multiplying the Jane Dough mobile source emission level by 4.3. NRC staff assumed that this would bound the Jane Dough amendment emission level because the Dewey-Burdock ISR project indirect emissions include electricity consumption from the central processing plant which is a source not present for the Jane Dough Unit. EA Table B–5 also includes the emission estimates used in the Nichols Ranch SEIS (NRC, 2011) and GEIS (NRC, 2009) analyses since the analysis in EA Section 4.7.1 compares the Jane Dough amendment emission estimates to the emission estimates from these two analyses.

Table B–5. Annual Estimated Emissions in Short Tons* Used for the Jane Dough EA, Nichols Ranch SEIS, and GEIS Analyses							
	Pollutant						
Analysis	Carbon Dioxide	Carbon Monoxide	Nitrogen Oxides	Particulate Matter $PM_{2.5}$	Particulate Matter PM_{10}	Sulfur Dioxide	Volatile Organic Compounds
Jane Dough EA†	4,171	5.7	19.9	14.4	134.9	0.72	1.04
Nichols Ranch SEIS†	3,100	18	58	13.6	135.9	1.4	2.4
GEIS‡	Not available	70.2	84.0	1.1	11.0	7.0	10.8

Sources: Modified from Uranerz (2016) and NRC (2009 and 2011)
*Licensee supplied and appendix table mass expressed in English units only (dual units used in EA text with metric being primary). To convert short tons to metric tons, multiply by 0.907.
†Peak year emission estimates.
‡Construction phase emission estimates. Particulate emission estimate not specified as $PM_{2.5}$ or PM_{10}. Conservatively estimated all as PM_{10} and estimated $PM_{2.5}$ value as 10% of the PM_{10} value.
§Hydrocarbons rather than volatile organic compounds.

B.2 Description of the Affected Environment

This section contains four tables (EA Tables B–6 through B–9) that update the climate and air quality information presented in EA Section 3.7.

Table B–6. Nichols Ranch Meteorological Station Temperature Data*

Month	Daily Mean Temperature (°F)†
January	26.9
February	26.7
March	40.2
April	42.4
May	54.3
June	67.5
July	74.3
August	72.7
September	61.9
October	46.5
November	36.1
December	26.4

Source: Uranerz (2014)
*Data collected over a 2 year period from June 2011 to July 2013.
†Licensee supplied and appendix table temperature expressed in English units only (dual units used in EA text with metric being primary). To convert Fahrenheit to Celsius, subtract 32, multiple by 5, and divide by 9.

Table B-7. National Ambient Air Quality Standards (NAAQS)

Pollutant	Primary/Secondary*	Averaging Time	Level†	Form
Carbon Monoxide	Primary	1 hour	35 ppm	Not to be exceeded more than once per year
	Primary	8 hours	9 ppm	Not to be exceeded more than once per year
Lead	Primary and Secondary	Rolling 3-month average	0.15 µg/m^3	Not to be exceeded
Nitrogen Dioxide	Primary	1 hour	100 ppm	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	Primary and Secondary	Annual	53 ppb	Annual mean
Ozone	Primary and Secondary	8 hours	0.070 ppm	Annual fourth highest daily maximum 8-hour concentration, averaged over 3 years
Particulate Matter $PM_{2.5}$	Primary and Secondary	24 hours	35 µg/m^3	98th percentile, averaged over 3 years
	Primary	Annual	12 µg/m^3	Annual mean, averaged over 3 years
	Secondary	Annual	15 µg/m^3	Annual mean, averaged over 3 years

Table B-7. National Ambient Air Quality Standards (NAAQS)				
Pollutant	**Primary/Secondary***	**Averaging Time**	**Level†**	**Form**
Particulate Matter PM_{10}	Primary and Secondary	24 hours	150 µg/m^3	Not to be exceeded more than once per year on average over 3 years
	Primary	Annual	50 µg/$m^{3‡}$	Annual mean, averaged over 3 years
Sulfur Dioxide	Primary	1 hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	Secondary	3 hour	0.5 ppm	Not to be exceeded more than once per year

Source: Modified from EPA (2016)
*Primary standards are established to protect public health and secondary standards are established to protect welfare by guarding against environmental and property damage.
†ppm is parts per million, ppb is parts per billion, and to convert µg/m^3 to oz/yd^3 multiply by 2.7×10^{-8}
‡There is no longer an annual PM_{10} particulate matter NAAQS. This limit represents Wyoming's supplemental standard.

Table B-8. Prevention of Significant Deterioration Classes I and II Standards				
Pollutant	**Averaging Time**	**Class I Level (µg/m^3)***	**Class II Level (µg/m^3)***	**Form**
Nitrogen Dioxide	Annual	2.5	25	Annual mean
Particulate Matter $PM_{2.5}$	24 hours	2	9	Not to be exceeded more than once per year
	Annual	1	4	Annual mean
Particulate Matter PM_{10}	24 hours	8	30	Not to be exceeded more than once per year
	Annual	4	17	Annual mean
Sulfur Dioxide	3 hours	25	512	Not to be exceeded more than once per year
	24 hours	5	91	Not to be exceeded more than once per year
	Annual	2	20	Annual mean

Source: Modified from 40 CFR 52.21
*To convert µg/m^3 to oz/yd^3multiply by 2.7×10^{-8}

Table B-9. Ambient Air Quality Data for National Ambient Air Quality Standards (NAAQS) Pollutants from Monitoring Stations Inside the Region of Influence*

Pollutant†	Averaging Time	Units‡	Monitoring Station§	Monitoring Results Over a 3 Year Period‖		
				2013	2014	2015
Nitrogen Dioxide	1 hour	ppb	Antelope Site 7	na	na	35
			Bell Ayr BA-4	35	35	32
			Campbell County	32	32	32
			Converse County	na	na	8
Nitrogen Dioxide	Annual	ppb	Antelope Site 7	na	na	3
			Bell Ayr BA-4	7	7	6
			Campbell County	3	3	3
			Converse County	na	na	0
Ozone	8 hour	ppm	Campbell County	0.065	0.061	0.060
			Converse County	na	na	0.060
Particulate Matter $PM_{2.5}$	24 hours	$\mu g/m^3$	Antelope Site 3	8	na	na
			Antelope Site 7	na	na	19
			Bell Ayr BA-4	14	11	19
			Black Thunder BTM 36-2	14	10	22
Particulate Matter $PM_{2.5}$	Annual	$\mu g/m^3$	Antelope Site 3	2.9	na	na
			Antelope Site 7	na	na	4.2
			Bell Ayr BA-4	na	5.3	5.1
			Black Thunder BTM 36-2	4.2	3.9	5.0
Particulate Matter PM_{10}	24 hour	$\mu g/m^3$	Campbell County	39	52	135
			Converse County	na	na	42
			Gillette	36	25	39
			Wright	53	56	66
Particulate Matter PM_{10}	Annual¶	$\mu g/m^3$	Campbell County	12	11	12
			Converse County	na	na	8
			Gillette	14	11	11
			Wright	16	14	15

Source: Modified from WDEQ (2016)
*The region of influence is the 80-km [50 mi] radius around the proposed Jane Dough Unit.
†Only those pollutants that were monitored by WDEQ at monitoring stations within the region of influence are listed in this table. No measurements were taken for carbon monoxide, lead, and sulfur dioxide at these monitoring stations.
‡ppm is parts per million, ppb is parts per billion, and to convert $\mu g/m^3$ to oz/yd^3 multiply by 2.7×10^{-8}
§Not all monitoring stations analyzed for all pollutants.
‖na stands for not available.
¶There is no longer an annual PM_{10} particulate matter NAAQS. This limit represents Wyoming's supplemental standard.

B.3 REFERENCES

40 CFR Part 52. Code of Federal Regulations, Title 40, Protection of the Environment, Part 52. Section 21, "Prevention of Significant Deterioration of Air Quality."

EPA. "National Ambient Air Quality Standards (NAAQS) Table." Washington, DC: U.S. Environmental Protection Agency. 2016. <https://www.epa.gov/criteria-air-pollutants/naaqs-table> (30 June 2016).

_____. "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling − Compression-Ignition." EPA420–P–04–009, NR–009c. Washington, DC: U.S. Environmental Protection Agency.
< https://www3.epa.gov/otaq/models/nonrdmdl/nonrdmdl2010/420r10018.pdf > (25 July, 2016). 2004.

IML. "Ambient Air Quality Final Modeling Protocol and Impact Analysis Dewey-Burdock Project Powertech (USA) Inc., Edgemont, South Dakota." ML13196a061, ML13196a097, ML13196a118. Sheridan, Wyoming: Inter-Mountain Laboratories, Inc., IML Air Science. 2013.

Midwest Research Institute. "Background Document for Revisions to Find Fraction Ratios Used for AP-42 Fugitive Dust Emission Factors." Kansas City, Missouri. < https://www3.epa.gov/ttnchie1/ap42/ch13/bgdocs/b13s02.pdf> (25 July 2016). 2006.

NRC. NUREG–1910, Supplement 4 "Environmental Impact Statement for the Dewey-Burdock Project in Custer and Fall River Counties, South Dakota, Supplement to the Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities." ML14024A477. Washington, DC: U.S. Nuclear Regulatory Commission. January 2014.

_____. NUREG–1910, Supplement 2 "Environmental Impact Statement for the Nichols Ranch Project in Campbell and Johnson Counties, Wyoming, Supplement to the Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities." ML103440120. Washington, DC: U.S. Nuclear Regulatory Commission. January 2011.

_____. NUREG–1910, "Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities." ML091480244 and ML091480188. Washington, DC: U.S. Nuclear Regulatory Commission. May 2009.

Uranerz. "Nichols Ranch ISR Project. Source Materials License SUA–1597, Request for Additional Information on Jane Dough License Amendment (TAC No. 1007265, J00875)." ML16148A166. Casper, Wyoming: Uranerz Energy Corporation. 2016.

_____. "Nichols Ranch ISR Project. U.S. N.R.C Source Material SUA–1597 Jane Dough Amendment Volume IV: Environmental Report." ML14164A323. Casper, Wyoming: Uranerz Energy Corporation. 2014.

WDEQ. "Wyoming Ambient Air Monitoring Annual Network Plan 2016." Cheyenne, Wyoming: Wyoming Department of Environmental Quality. < http://deq.wyoming.gov/media/attachments/Air%20Quality/Monitoring/Annual%20Network%20Plans/Annual-Network-Plan_2016-Final.pdf> (25 July 2016). 2016.

_____. "Letter from D. Finley, Administrator, Wyoming Department of Environmental Quality, to M. Thomas, Uranerz Energy Corporation. "Re: Permit No. CT-8644." ML101610747. Cheyenne, Wyoming: Wyoming Department of Environmental Quality. 2009.