Nichols Ranch ISR Project
U.S.N.R.C Source Material
SUA-1597
Jane Dough Amendment

Volume IV
Environmental Report

Chapters 1.0-10.0

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JANE DOUGH UNIT

URANIUM SOLUTION MINE

Campbell and Johnson Counties, Wyoming

Volume IV
(Environmental Report)

U.S.N.R.C. Source Material License Application

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ABBREVIATIONS AND ACRONYMS LIST

ALARA	As Low As Is Reasonably Achievable	Nmiss	function of numeric missing values
AUMs	Animal unit month	NO_2	Nitrogen dioxide
BLM	Bureau of Land Management	NRC	Nuclear Regulatory Commission
BPT	Best Practical Technology	NRCS	*National Resources Conservation Service*
$CaCO_3$	Calcium Carbonate		
CBNG	Coalbed Natural Gas	NRHP	National Register of Historic Places
CFR	*Code of Federal Regulations*		
CO	Carbon monoxide	NUREG	Nuclear Regulatory Guide
CO_2	Carbon dioxide	NWS	National Weather Service
CPA's	Core population areas	O_3	Ozone
CPP	Central processing plant	Pb	Lead
CR	Cameco Resources	Pb-210	Lead-210
CR-SRH	Cameco's Smith RanchHighlands	pCi/g	pico Curies per gram
		pCi/l	pico Curies per liter
dBA	A-weighted decibels	PM	Particulate matter
EA	Environmental Assessment	PM_{10}	Particulate matter
EIS	Environmental Impact Statement	$PM_{2.5}$	Particulate matter
		POD	Plan of Development
EPA	Environmental Protection Agency	ppm	parts per million
		PRB	Powder River Basin
F-Scale	Fujita-scale	PSD	Prevention of Significant Deterioration
GEIS	Generic Environmental Impact Statement		
		Ra-226	Radium-226
GPS	Global Positioning System	Rn-222	Radon-222
H_2O_2	Hydrogen peroxide	RO	Reverse Osmosis
HCL	Hydrochloric acid	RSO	Radiation Safety Officer
IML	InterMountain Labs	RTVs	Restoration Target Values
ISR	In situ recovery	SB	Subsurface Soil Site
LAS	License Area Sample Site	SD	Sediment Sample Site
mrem	milli roentgen equivalent	SEIS	Supplemental Environmental Impact Statement
NAAQS	National Ambient Air Quality Standards		
NAGPRA	*Native American Graves Protection and Repatriation Act*	SERP	Safety and Environmental Review Panel
		SO_2	Sulfur dioxide
NaOH	Sodium hydroxide	SOPs	Standard Operating Procedures
NEPA	*National Environmental Policy Act*		
		SS	Surface Soil Site
NH_3	Ammonia	Stdev	Standard Deviation

ABBREVIATIONS AND ACRONYMS LIST (Continued)

SWPP	Stormwater Pollution Prevention
TCP	Traditional Cultural Property
TDS	Total Dissolved Solids
TEPC	Threatened, Endangered, Proposed, and Candidate
Th-230	Thorium-230
UCLs	Upper Control Limits
Uranerz	Uranerz Energy Corporation
USACE	U.S. Army Corps of Engineer's
USFWS	U.S. Fish and Wildlife Service
WDEQ-LQD	Wyoming Department of Environmental Quality-Land Quality Division
WGFD	Wyoming Game and Fish Department
WOGCC	Wyoming Oil and Gas Commission
WSGIT	Wyoming Sage Grouse Implementation Team
WSHPO	Wyoming State Historical Preservation Office
WYPDES	Wyoming Pollutant Discharge Elimination System
yellowcake	U_3O_8

1.0 INTRODUCTION

1.1 GENERAL

Uranerz Energy Corporation (Uranerz) plans to license the Jane Dough Unit (Township 43 North, Range 76 West, portions of Sections 20, 21, 27, 28, 29, 30, 31, 32, 33, and 34) and use the in situ recovery (ISR) extraction/mining method. The Jane Dough Unit is an amendment to the original Nichols Ranch ISR project and will add wellfield areas to the overall production of the project. This is the same method that is used by Uranerz at the adjacent Nichols Ranch Unit and Hank Unit for the Nichols Ranch ISR Project.

The Jane Dough Unit ore zones will be incorporated in the existing Nichols Ranch ISR Project into one license. The Nuclear Regulatory Commission (NRC) requires a license under 10 CFR Part 40 in order to "receive title to, receive, possess, use, transfer, deliver…any source…material" therefore a source license must be obtained by Uranerz to produce U_3O_8 (yellowcake).

A "Permit to Mine" must also be obtained from the Wyoming Department of Environmental Quality–Land Quality Division (WDEQ-LQD) under the Wyoming Environmental Quality Act, Article 4. Any permitting or licensing activities required by the Environmental Protection Agency (EPA) would be carried out by the WDEQ as they are a primacy state with the EPA.

Uranerz plans on starting production in the Jane Dough Unit in 2016. Figure 3-11 (see map pocket) of the Uranerz, Jane Dough Unit NRC Source Material License Application Technical Report provides a schedule of planned activities for the Jane Dough Unit.

1.2 PURPOSE AND NEED FOR PROPOSED ACTION

The purpose and the need for the proposed action are to obtain a license for the construction and operation of facilities for ISR mining and processing. The uranium product produced at the Jane Dough Unit would be used in the manufacturing of nuclear fuel to be used by the nuclear power industry. The uranium produced would allow for a domestic source of uranium to be used in United States nuclear power reactors helping to reduce the need to use foreign energy sources.

1.3 THE PROPOSED ACTION

The Jane Dough Unit is located in the Pumpkin Buttes Mining District of the Powder River Basin (PRB) in the state of Wyoming in the counties of Johnson and Campbell. The recovered uranium would be transported via pipelines to the central processing plant in the Nichols Ranch Unit where the uranium would be processed.

The Jane Dough Unit contains approximately 3,680 acres. The project site is approximately 46 air mi south/southwest of Gillette, Wyoming and approximately 61 air mi to the north/northeast of Casper, Wyoming. The general location of the project is shown in Figures 1-1 and 1-3 (see map pocket) of the NRC Technical Report.

Extraction of the uranium ore contained in the Wasatch formation of the PRB would be through the in situ recovery method of mining. A sodium carbonate/sodium bicarbonate solution and an oxidizing agent such as oxygen would be injected and recovered through a complex of well patterns. 4-spot, 5-spot, and 7-spot well patterns would be used in the ore recovery process. The wellfield at the Jane Dough Unit is divided into production areas. Construction for each production area is estimated to take approximately one year and each area would require approximately six months to ramp up to full production. It will take an estimated 3-4.25 years to extract the uranium from the Jane Dough Unit.

The NRC has approved the licenses for the Uranerz central processing plant and the plant is on-line except for final processing and drying. The central processing plant has a nameplate capacity to produce 2,000,000 pounds per year of yellowcake. Once the uranium has been "loaded" onto resin beads, the uranium could be processed to yellowcake at the central processing plan or it could be transported via trucks to Cameco Resources Inc.'s Smith Ranch-Highland central processing plant for the processing of yellowcake. Cameco Resource Inc.'s Smith Ranch Highland central processing plant is located about 17 miles north of Glenrock Wyoming in east-central Wyoming. Uranerz and Cameco Resources Inc. entered into an agreement in 2013 in which Uranerz could transport uranium-loaded resin beads to Cameco Resource Inc.'s Smith Ranch-Highland Central Processing Plant (CPP), if needed. Uranerz is also approved by NRC for

its own dryer and will also use its own dryer in the Nichols Ranch CPP should this equipment be installed. Initially, Uranerz will transport uranium-loaded resin beads from the Nichols Ranch CPP to Cameco Resource Inc.'s Smith Ranch Highland CPP but at some point this activity would not be necessary or conducted.

Once mining is completed in a production area, reclamation of that production area would begin. Figures 3-11 (see map pockets) of the NRC Technical Report show the production areas for the Jane Dough Unit. Groundwater would be restored to its pre-mining conditions (as is reasonably achievable) or to its class of use by utilizing groundwater restoration methods such as groundwater sweep, groundwater transfer, and reverse osmosis. Groundwater reclamation is anticipated to take approximately three years from start to finish. Solid material such as pipelines, buildings, etc. would either be reused in different production areas or decommissioned and removed for disposal at a NRC licensed disposal facility or nearby landfill.

1.4 APPLICABLE REGULATORY REQUIREMENTS, PERMITS, AND REQUIRED CONSULTATIONS

Various state and federal permits and licenses that are needed or are in-hand for the Nichols Ranch ISR Project are listed in Chapter 10.0, Table 10-2 of the Uranerz, Nichols Ranch ISR Project NRC Source Material License Application Technical Report. Prior to the start of mining (the injection of lixiviant into the ore zone aquifer), Uranerz would obtain all permits, licenses, and approvals required by the WDEQ and the NRC. The list of additional state and federal permits and licenses required for the Jane Dough Unit is listed in Table 10-2a in the Nichols Ranch ISR Project NRC Source Material License Application Technical Report.

The general area of the Jane Dough Unit has also been subject to numerous federal environmental reviews over the past few years. The Nichols Ranch ISR project area (without the Jane Dough Unit) was subject to an environmental impact statement (EIS) completed by the NRC in 2011. In addition, the Bureau of Land Management (BLM) is currently preparing an environmental assessment (EA) for the Hank Unit due to separate jurisdictional requirements associated with BLM-administered lands in the Hank Unit. With the presence of coalbed natural gas (CBNG)

extraction on the land in and adjacent to the permit boundary of the Jane Dough Unit, the area has been subject to one EIS and two EAs. All of these documents conducted for CBNG-related projects were completed by the BLM. The environmental analyses for the CBNG activities can be found at the following BLM website link: http://www.blm.gov/wy/st/en/info/NEPA/documents/bfo.html.

Anadarko's Dry Willow Phase III EA and Phase V EA contain areas where the Jane Dough Unit is located. Anadarko's Dry Willow Phase I EA and Phase II EA contain areas where the Hank Unit is located and WPX Rocky Mountain Energy LLC (formerly Williams Production) underwent an EA for the Tex Draw Project which contains the land where the Nichols Ranch Unit is located. The Powder River Basis (PRB) EIS covers the entire Powder River Basin and Exhibits and tables detailing the location of all CBNG wells that have been completed and those that are permitted in and adjacent to the permit boundaries are located in Appendix D6, Hydrology, that is attached to this report.

Detailed additional information on wildlife, cultural and paleontological resources, vegetation, soils, geology, hydrology, wetlands, land use, history, and a background radiological assessment of the Jane Dough Unit can also be found in the attached Appendix D. This information is required by the WDEQ-LQD for an amendment to an existing Permit to Mine.

2.0 ALTERNATIVES

2.1 DETAILED DESCRIPTION OF THE ALTERNATIVES

2.1.1 No Action Alternative

The no action alternative is one alternative that must be considered under the provisions of the National Environmental Policy Act (NEPA). No action means that the proposed activity of the Jane Dough Unit would not take place because the NRC would not issue a license for Jane Dough Unit. Under the No Action Alternative, uranium ISR extraction would not take place in the Jane Dough Unit and no environmental impacts associated with the in situ recovery extraction would occur.

2.1.2 Proposed Action

Uranerz has secured a license for the central processing plant and accompanying wellfields for an ISR operation with ion exchange columns under NRC license SUA-1597. The applications for the Jane Dough Unit amendment, operating and reclamation, will be submitted to the NRC and the WDEQ-LQD.

The Jane Dough Unit is located in the Pumpkin Buttes Mining District of the Powder River Basin in the state of Wyoming in the counties of Johnson and Campbell. No processing of uranium would occur in the Jane Dough Unit; rather, uranium would be pumped via pipelines from the extraction areas to the existing central processing plant located at the Nichols Ranch Unit.

The current land surface ownership of the Jane Dough Unit includes approximately 3,860 acres of private ownership.

Uranerz estimates the yellowcake content for the Jane Dough Unit to 2,735,000 pounds. The central processing plant at Nichols Ranch has a nameplate capacity to produce 2,000,000 pounds per year of yellowcake. Jane Dough Unit only consists of production areas and therefore

production and recovery will be dependent on the Nichols Ranch Unit CPP. Construction for the two production areas is estimated at approximately one year each and it is estimated to take six months to ramp up to the full. It will take an estimated 4.25 years to extract the uranium from the Jane Dough Unit. Refer to Figure 3-11 (see map pocket in the NRC Technical Report) of the Uranerz, Jane Dough Unit NRC Source Material License Application Technical Report for a schedule of planned activities for the Jane Dough Unit.

The plans for project waste management and disposal are twofold. Uranerz is permitted, through the State of Wyoming and the EPA Underground Injection Control Program, to install up to eight deep disposal wells for the Nichols Ranch ISR Project. The deep disposal wells would receive liquid waste. Uranerz also has an agreement with an approved waste disposal facility for 11e(2) byproduct material.

A detailed description of the proposed Jane Dough Unit facilities including process and wellfield descriptions can be found in Chapter 3.0, Description of the Facilities, in the NRC Technical Report. Details concerning the reclamation and restoration activities for the proposed Jane Dough Unit can be found in Chapter 6.0, Reclamation Plan of the NRC Technical Report.

2.1.3 Alternatives Considered But Eliminated From Detailed Analysis

2.1.3.1 Conventional Underground or Open-pit Mining

Alternated methods of mining available for the Jane Dough Unit include underground and open-pit mining. Both of these methods were not considered for the project since they are not economically feasible for mining of the uranium because of the much larger capital investment required, the grade of the ore, and the size of the ore zones. Additionally the underground and open-pit mining methods result in greater environmental impacts to the area along with exposing employees and the project area to higher safety and health risks.

The overall impacts of ISR mining compared to conventional and open-pit mining result in several environmental and socioeconomic advantages. These advantages were detailed in an NRC evaluation (NUREG-0925, 1983, Section 2.3.5) and are as follows:

1. The amount of surface area disturbed by in situ mining is significantly less. The amplitude of disruption is also significantly less.
2. Tailings that result from the milling process are not produced. Additionally the amount of solid waste produced by the ISR mining method is generally less than 1% of that produced by conventional milling methods.
3. Air pollution problems caused by ore stock piles, overburden stockpiles, tailings stockpiles, and crushing and grinding operations in conventional and open-pit mining do not exist with the ISR mining method.
4. Radiation exposure at an ISR operation is significantly less than that associated with conventional mining and milling. Operating personnel are not exposed to the radionuclides present in and emanating from the ore and tailings. Conventional mills tailing can contain all of the radium-226 originally present in the ore whereas ISR operations may have less than 5% of the radium in the ore zone being brought to the surface through the recovery process.
5. The entire mine site can be returned to its original land use more rapidly with ISR mining methods than those of underground or open-pit mining methods. ISR mines can remove the solid wastes from the site to a NRC licensed disposal site preventing them from contaminating the surface and subsurface environment. This is not always possible with the size and extent of conventional mining.
6. Solution mining results in significantly less water consumption than conventional mining and milling.
7. Socioeconomic advantages of ISR operations include:

    - Ability to mine lower grade ore
    - Minimum capital investment
    - Less risks to miners
    - Shorter lead time in beginning production, and
    - Minimal staffing requirements

2.1.3.2 Alternative Recovery Solutions

The alkaline recovery solution (lixiviant) consisting of sodium carbonate/carbon dioxide, dissolved oxygen or hydrogen peroxide, and groundwater is the preferred recovery solution to be used in at the Jane Dough Unit. The solution was selected based upon its successful use in recovering uranium and aquifer restoration in the Nichols Ranch ISR Project, several pilot plant projects, and commercial ISR operations in the Powder River Basin.

Alternate recovery solutions include ammonium carbonate solutions and acidic solutions. Both of these solutions have been used in the past in ISR mining operations, but are no longer used because of safety reasons and the difficulties in restoring and stabilizing the affected ore zone aquifers. Because of these reasons, the solutions were not considered for the Jane Dough Unit.

2.1.3.3 Groundwater Restoration Alternatives

Uranerz may utilize, but are not limited to, a combination of groundwater sweeps, groundwater transfer, and Reverse Osmosis for the restoration of groundwater impacted by the Jane Dough Unit. This method is the chosen method for aquifer restoration because of its successful, proven use in ISR mining groundwater restoration. It is also considered to be Best Practicable Technology (BPT) available by the NRC and state regulatory agencies. If future technology advances are made to produce better alternatives for groundwater restoration, then Uranerz would consider incorporating these technologies into groundwater restoration.

2.1.3.4 Liquid Effluent Disposal Alternatives

The proposed disposal of liquid effluents is through the injection of the effluents down a deep disposal well. This method was chosen over other alternatives such as evaporation ponds and land application (irrigation) facilities because of the environmental impacts and additional land disturbance that ponds and irrigation have on the project area. There will be no deep disposal wells located within the Jane Dough Unit.

2.2 CUMULATIVE EFFECTS

Cumulative impacts result from the incremental effects of an action added to other past, present, and reasonably foreseeable future actions, regardless of who is responsible for such actions. Cumulative impacts may result from individually minor but collectively significant actions occurring over a period of time (40 CFR 1508.7).

2.2.1 Land Use

The Proposed Action would not make a significant contribution to the cumulative land use impacts in the region. With only 101 acres of disturbance expected during the life of the Jane Dough Unit, the main disturbance would be to the loss of grazing and wildlife habitat, recreational opportunities, and mineral and energy development during the life of the project. This disturbance would be temporary because of the sequential nature of the mining operation and the restoration and reclamation of the land at the end of the projects life. Because of the nature of ISR mining, project restoration and reclamation, the combination of existing land disturbance, new disturbance related to the project, and disturbance from reasonably foreseeable future actions, no significant cumulative impacts are expected by the proposed project.

2.2.2 Transportation

Shipments of process chemicals to the site and the shipment of product from the site would contribute to minimal transportation risks on the roads in the region of the development and operation of the Jane Dough Unit, but the contribution to the cumulative impacts of past, present, and future actions is not expect to be significant. The overall volume of traffic associated with the Jane Dough Unit would be low. In addition, the development and operation of the Jane Dough Unit would likely only add a limited amount of incremental risk because production of the Jane Dough Unit would occur sequentially to the approved production in the Nichols Ranch ISR project area and would not add additional volume to traffic that would already occur. Approximately one tractor-trailer per day from the Nichols Ranch CPP would utilize the roads in the region of the proposed project along with approximately eight passenger type vehicles. This

volume of traffic results in minimal impact to the existing roads that are used by ranchers and CBNG and conventional oil and gas operators.

2.2.3 Geology and Soil Resources

There are other ISR projects in the region including the Uranerz Nichols Ranch ISR project, Cameco's North Butte ISR project, and Uranium One Inc.'s Willow Creek and Moore Ranch ISR projects. ISR mining activities would not result in the removal of any rock matrix or structure. Therefore, no subsidence would result at the site from the collapse of overlying rock strata in the mining zone which would happen in underground mining operations. In addition, the NRC's Generic Environmental Impact Statement (GEIS) determined that it would be unlikely that ISR operations in the Wyoming East Uranium Milling Region (which includes the Jane Dough Unit and the other ISR projects) could reactivate local faults and extremely unlikely that ISR operations could or would cause earthquakes (NRC 2009). Therefore, the Proposed Action would have no discernible cumulative impacts on geological resources including geological hazards (e.g., earthquakes, subsidence, and mass movements).

The Proposed Action would contribute limited impacts on soil resources in the project area, specially the disturbance of approximately 101 acres of soil resources. Past and current CBNG and conventional oil and gas development have affected soils that would be located in the Jane Dough Unit and surrounding region. Both the uranium and coalbed and conventional oil and gas industry have had to construct access roads to their wells in the project area along with the installation of pipelines and utility corridors. Even though this has affected the soils in the area, it has also helped reduce the amount of soil that Uranerz would have to disturb since engineered and improve exist roads in the project area and region.

The contribution of the 101 acres of disturbance to past, present, and future impacts on soils in the region is not expected to create a significant cumulative impact to soil resources because Uranerz is required to decommission and reclaim all disturbance associated with the Proposed Action. As has been demonstrated at other ISR facilities in Wyoming, the proposed project's contribution to cumulative impacts on soils would likely be small and temporary.

2.2.4 Water Resources

2.2.4.1 Surface Water Resources

No surface water would be discharged or collected as part of ISR activities within the Jane Dough Unit. Potential impacts to onsite ephemeral channels would be from increased surface water runoff, primarily during the construction and decommissioning phases of the proposed project. The channels within and surrounding the proposed Hank Unit are ephemeral in nature and flow only in response to precipitation events or snowmelt (i.e., they are dry a majority of the year). One wetland area exists on the Jane Dough Unit; however, this area would be avoided and not disturbed by ISR activities. Approximately 2.47 miles of Waters of the U.S. occur within the Jane Dough Unit and potential impact to Waters of the U.S. would be mitigated through the implementation of BMP for the Uranerz WYPDES storm water permit that would obtain from the WDEQ-WQD before operations commence, securing of coverage under an individual permit or Nationwide Permit 12 from USACE, and the implementation of appropriate BMPs in the storm water pollution prevention plan.

Furthermore, Uranerz would avoid installing wells in the channels and washes of ephemeral drainages. If a well would be installed in an ephemeral drainage, then appropriate erosion protection controls would be implemented to minimize damage. Such controls would include: grading and contouring, culvert installation, low-water crossing constructed of stone, water contour bars, and designated traffic routes. Other energy development activities within the surface water study area, namely from CBNG production, conventional oil and production, and uranium ISR production could also result in limited impacts to wetlands and Waters of the U.S. However, these potential impacts would be mitigated through implementation of appropriate best management practices that would be required of all operators through the appropriate permitting process that have or would be undertake for development activities in the surface water study area. Therefore, the Jane Dough Unit would have minimal cumulative impacts on surface water resources.

2.2.4.2 Groundwater Resources

Potential environmental impacts on groundwater resources from the proposed Jane Dough Unit would occur primarily during the operation and aquifer restoration phases of the ISR facility lifecycle. The detailed analysis of impacts to groundwater resources from operation of the proposed Jane Dough Unit Project is presented in Section 4.4.1.3 which showed that the water yields in some private wells located outside of the proposed project area that are completed in the ore zone aquifer could potentially be affected by the facility's operation at the Jane Dough Unit. Cumulative impacts that could contribute to the groundwater in the proposed project area include future ISR operations. Five NRC licensed operations exist in the area near the Nichols Ranch ISR Project. This includes the North Butte Satellite ISR permit area is located approximately 9 miles northeast of the Jane Dough Unit. Uranium One Inc.'s Willow Creek (Christensen Ranch/Irigaray) ISR project area is located approximately 6 mile north of the Jane Dough Unit on the northwest side of North Pumpkin Butte. Uranium One Inc.'s Moore Ranch ISR Project is located approximately 6 mile south of the Jane Dough Unit. Cameco's Reynolds Ranch ISR Satellite and Smith Ranch-Highland ISR are located approximately 37 and 42 miles southeast of the Jane Dough Unit, respectively. Additionally, reasonably foreseeable future mining activities by Uranerz have the potential of being in the same aquifer as the Jane Dough Unit ISR Project. The effect of mining in the same aquifers in the region of the Nichols Ranch ISR Project could result in temporary impacts on the groundwater level in the ore zone aquifer and the geochemical change of the ore zone aquifer chemistry, but not so much as to degrade the aquifer's use. Moreover, Uranerz is required to install monitoring wells around and within the proposed wellfield, as part of its license/permit, for early detection, control, and reversal of potential horizontal and vertical excursions. Therefore, the potential risk of impacts on nonexempted aquifers would be low. Furthermore, after production and aquifer restoration were completed and groundwater withdrawals were terminated at the proposed Jane Dough Unit Project, the groundwater levels would recover with time.

BLM estimated that CBNG development in the PRB through the year 2018 would remove about (3 million acre-feet), less than 0.3% of the total recoverable groundwater (nearly 1.4 billion acre-feet) in the Wasatch and Fort Union Formations within the PRB. Water from CBNG production

within the Jane Dough Unit is being collected and transported off-site for disposal (i.e., there is no surface water discharge) (Uranerz 2012).

Cumulative impacts on groundwater resulting from the interaction between ISR activities and CBNG activities may occur but are not likely because CBNG production and ISR activities are conducted in stratigraphically separate aquifers. For the proposed Jane Dough Unit Project, the ISR activities would take place in sandstone aquifers 671 ft above the coal seam. Because of the presence of multiple layers of sand/sandstone and low-permeable silt/shale (confining layers) between the coal seams and uranium ore-bearing aquifers, hydraulic communication between them would be very low. The drawdown induced by groundwater withdrawals from CBNG coal seams would be progressively attenuated across impermeable silt/shale layers within 100 to 200 ft above the coal seams; therefore, the potential risk of impacts of groundwater withdrawals from coal seams on groundwater levels in the uranium ore-bearing aquifers would be low. The possibility of communication between a uranium ore zone aquifer and a coalbed methane coal seam could happen if coal be methane wells located near any of the wellfields is not completed properly. Although this could happen, the chance of it actually occurring is low since the CBNG producers use a well procedure that tests each well's integrity. The well completion procedure used by the CBNG producers is very similar to that used for the ISR wells. Coalbed methane wells in the Jane Dough area are in place and producing. This has allowed Uranerz Energy to monitor the ore zone aquifer to see if any impacts are taking place between the ore zone and the CBNG wells. If any impacts are observed, problems can be addressed and resolved before any mining takes place.

Exhibit 2-1A, Jane Dough CBNG infrastructure (see map pockets) details the current CBNG infrastructure (wells, pipelines, utilities and roads) that occurs in the Jane Dough Unit area.

2.2.5 Ecological Resources

The proposed project would have a minimal ecological impact to the region through the disturbance of land. Approximately 101 acres would be disturbed in the Jane Dough Unit during the life of the proposed project, but the cumulative impact of this disturbance combined with past, present, and future actions would not be significant. Much of the land in and near the Nichols

Ranch ISR Project site has been used by past and current actions such as livestock grazing, uranium extraction, and CBNG and conventional oil and gas development.

Disturbance to vegetation during wellfield development and pipeline construction in the Jane Dough Unit would be temporary since the areas disturbed would be reclaimed and reseeded as soon as possible after these activities occur. Also the land disturbed by the project is small (101 acres) relative to the amount of similar wildlife habitat available in the region. Any land that is disturbed by the project would be reclaimed and revegetated upon completion of the project. Additionally, there are no foreseeable future actions that when combine with the Jane Dough Unit would create significant cumulative impacts on ecological resources.

Cumulative impacts to wildlife, particularly greater sage-grouse and raptors, from the proposed Jane Dough Unit would be less than significant when combined with past, present, and future actions because Uranerz would comply with appropriate mitigation measures to reduce impacts to these species. Greater sage-grouse activity along with raptor nesting is monitored on a yearly basis to assess bird populations and impacts. Uranerz would undertake measures to mitigate any potential impacts that may occur to the greater sage-grouse and raptors inhabiting the proposed Jane Dough Unit. Such avoiding physically disturbing leks and maintaining the 0.25 mile no surface occupancy buffer around all occupied leks, implementing the 2-mile seasonal buffer during the nesting and brood rearing season (as discussed in the mitigation section of this report), and advising project personnel of appropriate speed limits for specific access roads, that they are not allowed to haze or harass the animals, and that they should minimize any direct disturbance to all wildlife whenever possible. These mitigation measures are also being implemented by all other industrial/mineral development activity occurring the general area around the Jane Dough Unit. As a result of the implementation of all ecological mitigation measures described in the Proposed Action, the Jane Dough Unit would not any significant impacts on ecological resources.

2.2.6 Air Quality Resources

The Jane Dough Unit would not have any significant impacts on meteorology or climatology. In addition, the development and operation of the proposed Jane Dough Unit would not result in any

significant cumulative impacts on air quality in the region. Existing air quality in the project vicinity is good with the impacts of the project on air quality being minimal. Other industrial activities in the region include several uranium ISR projects and existing CBNG and conventional oil and gas development.

The BLM recently completed a regional technical study, called the Powder River Basin Coal Review, to help evaluate the cumulative impacts (including on air quality) of mineral and energy development in the PRB (BLM 2011). The current study evaluated conditions as of a baseline year (2004) and projects development levels and potential associated cumulative impacts related to mineral and energy development. The study included existing and future for oil and gas (conventional oil and gas and CBNG), coal mining, uranium ISR projects, wind energy developments, other mineral developments, and industrial facilities projected for 2015 and 2020 (BLM 2011).

The Powder River Basin Coal Review considers existing regional air quality conditions in the study areas to be very good. There are limited air pollution emissions sources (few industrial facilities, including the surface coal mines, and few residential emissions in relatively small communities and isolated ranches) and good atmospheric dispersion conditions (BLM 2011). The available data show that the region complies with the ambient air quality standards for NO_2 and SO_2. There have been no monitored exceedances of the annual PM_{10} standard in the Wyoming Powder River Basin (BLM 2011). The BLM Coal Review air quality study presents results that show the maximum modeled impacts on ambient air quality at the near-field receptors in Wyoming and Montana (BLM 2011). Results shown represent the maximum impact at any point in each receptor group; data are provided for the baseline year (2004) analysis and existing and all reasonably foreseeable future actions (including the Proposed Action) for 2015 and 2020. Peak impacts occur at isolated receptors and are likely due to unique source-receptor relationships. The model results should not be construed as predicting an actual exceedance of any standard, but are at best indicators of potential impacts (BLM 2011d). Based on these results, the Proposed Action would not have a significant impact on air quality.

2.2.7 Noise

The proposed project would generate minimal impacts associated with additional noise in the immediate vicinity of the project area. However, the combination of existing background noise, noise from the project, and noise from reasonably foreseeable future actions is not expected to represent a significant cumulative impact. ISR processing equipment would be housed inside of buildings reducing the amount of noise to the outside environment. Wellfield development would have some noise impacts from the running of drilling equipment, but the noise levels are minimal and only occur part of the time since wellfield development takes place during daylight hours. Therefore, there would be no significant noise impacts from the Proposed Action and any reasonably foreseeable future projects.

2.2.8 Historic, Cultural, and Paleontological Resources

Minimum cumulative impacts to historic, cultural, and paleontological resources would likely result from implementation of the Proposed Action. Past and current activities by the uranium ISR operators and CBNG and conventional oil and gas operators have identified historic, cultural, and paleontological resources in the proposed project area. In addition, steps would be taken by Uranerz to mitigate any impacts to historic, cultural, and paleontological resource sites. If any sites are encountered at any time during wellfield development, proper mitigation measures would be taken to protect the resource and the proper regulatory agencies would be notified so that a path forward could be determined and implemented.

Because of the activities of the proposed project and the past and current activities that have occurred in the project area, minimum significant cumulative effects would occur with the proposed project.

2.2.9 Visual Resources

The Proposed Action would not have any significant cumulative impacts to the visual resources. The Jane Dough Unit is located in a remote area that is privately owned with limited or no public

access. This restricts the number of people that would able to see the Proposed Action. The Jane Dough Unit would not have any impacts on the Pumpkin Buttes TCP (a regionally visually sensitive area) located on and near Pumpkin Buttes. The Jane Dough Unit is located outside of the BLM/WSHPO area of potential effect and therefore, there would be visual impacts to the TCP.

2.2.10 Socioeconomics (Including Environmental Justice)

The proposed Jane Dough Unit would have an overall positive contribution to cumulative socioeconomic impacts in the region. The project would provide jobs, wages, and tax revenues to the state and surrounding communities without major adverse impacts to local infrastructures like hospitals, schools, and community services. Impacts on the current housing shortage in the communities surrounding the project area would not be a concern because no additional employees would work at the Jane Dough. Existing employees that work at the Nichols Ranch ISR project would work at the Jane Dough Unit; thus no additional employees would be required.

No minority and low-income populations have been identified as residing near the proposed Jane Dough Unit. Based on the 2011 NRC SEIS, the percentage of minority populations living in the two nearest block groups are very small when compared to the percentage of minority populations recorded at the state level and much less than the national level. The NRC GEIS also identified no minority population block groups in the Wyoming East Uranium Milling Region near the Jane Dough Unit (NRC 2009).

The economic base of the region is largely comprised of ranching and resource extraction. Low income populations are generally dispersed throughout the study area. Based on this information and the analysis of human health and environmental impacts presented in Chapters 4 and 5, any impacts from the construction, operation, and decommissioning of the proposed Jane Dough Unit, including other past, present, and reasonably foreseeable future actions, would not be disproportionately high and adverse.

2.2.11 Public and Occupational Health

The proposed Jane Dough Unit would have no significant cumulative impact on public and occupational health. With the Jane Dough Unit being located in a remote, sparsely populated area, on private land, public access and interaction with the Proposed Action would be limited to pre-arranged public tours.

The occupational health hazards of exposure to radioactive materials (uranium, radon, etc.) to employees would be minimal. The CPP at the Nichols Ranch ISR project would be design with features such as downflow IX columns and a vacuum dryer to minimize the possibility of radon and uranium escaping into the atmosphere. Facility ventilation would also be designed to keep air circulating throughout the plant to prevent any buildup of radon gas. Localize ventilation would be available for situations when operators and other personnel would be working in such places that they could be exposed to radon gas or uranium dust.

Radiation monitoring would also take place within the CPP at the Nichols Ranch ISR Project. Area and individual monitoring would be conducted to ensure that every employee is free from contamination and their exposure to radioactive materials is as low as reasonably achievable. In the event that an employee or area is deemed contaminated, decontamination measures would be immediately implemented.

Radiological monitoring of the Jane Dough Unit permit boundary would also take place. The monitoring would be compared with base line data collected prior to any ISR activities to ensure that radiological exposure is minimized to the areas surrounding the Jane Dough Unit.

2.2.12 Waste Management

The proposed Jane Dough Unit would have some impacts to licensed NRC disposal facilities and local landfills from the solid wastes generated from the project. The additional solid wastes would add to the volume of waste that would have to be disposed of, but because of the nature of the ISR mining, the amount of waste generated is not substantial or significant. Liquid wastes would not

have significant cumulative impact since these wastes would be disposed of through a permitted deep disposal well at the CPP at the Nichols Ranch ISR project.

2.3 COMPARISON OF THE PREDICTED ENVIRONMENTAL IMPACTS

Table 2-1 outlines the predicted environmental impacts of the proposed Jane Dough Unit compared to the No Action Alternative.

Table ER2-1 Summary Comparison of Potential Environmental Impacts.

Resource	Proposed Action Alternative	No Action Alternative
Land use	ISR operation would only disturb 101 acres over life of project. Restoration and reclamation of disturbed lands would take place during and after mining activities. Temporary loss of grazing and wildlife habitat would occur, but not a significant cumulative impact.	No additional impact beyond those that already exist
Transportation	Traffic from ISR operations is very low. One tractor-trailer per day along with 8 passenger vehicles per day would utilize roads.	No additional impact beyond those that already exist
Geology and Soil Resources	There would be no impacts to geology. ISR operation would disturb approximately 101 acres of land. All disturbed land would be restored and reclaimed after life of project.	No additional impact beyond those that already exist
Water Resources and Wetlands	Surface water resources would be protected by mitigation measures. ISR operation would restore the affected groundwater in the mining ore zone back to pre-mining conditions or class of use. There would be no impacts to wetlands.	No additional impact beyond those that already exist
Ecological Resources	Potential impacts to greater sage-grouse and raptors would be mitigated. There would be minimal impacts to other species. ISR operation would only disturb 101 acres of vegetation over life of project. Restoration and reclamation of disturbed lands would take place during and after mining activities.	No additional impact beyond those that already exist
Air Quality	There would be minimal impacts to air quality due to the nature of ISR.	No additional impact beyond those that already exist
Noise	Minimal noise level increase from drilling operations. Drilling only occurs during daylight hours.	No additional impact beyond those that already exist.
Cultural Resources	There would be no impacts to cultural resources. Surveys have been conducted to identify cultural sites. Measures would be taken to minimize/avoid disturbance of sites.	No additional impact beyond those that already exist.
Visual Resources	There would be minimal impacts on visual resources. The Jane Dough Unit is located on entirely on private land in a remote area with limited or no public access.	No additional impact beyond those that already exist.
Socioeconomic and Environmental Justice	Positive effect on surrounding area through taxes, wages, and jobs. Employees come from surrounding communities. No impacts to housing and public infrastructure. No impacts would result from the project since it is located in an area where there are no concentrated minority populations or centered areas of people living below the property level.	No additional impact beyond those that already exist.
Public and Occupational Health	Minimal risk to public and occupational health. Radiological detectors are placed on the permit boundaries to monitor radiological effects of operation. Groundwater is closely monitored so that an excursion would be detected quickly if one occurs.	No additional impact beyond those that already exist
Waste Management	Impacts would be minimal to disposal facilities since waste generated at ISR operations would be minimal. Estimated landfill waste is 700 to 1,000 yd^3 per year. Estimated contaminated waste is 60 to 90 yd^3 per year. All material can be removed from project site and project life.	No additional impact beyond those that already exist.

3.0 DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1 LAND USE

3.1.1 Site Location and Layout

The Jane Dough Unit is located in the Pumpkin Buttes Mining District of the Powder River Basin in Johnson and Campbell counties, Wyoming. The Jane Dough Unit encompasses approximately 3,680 acres 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. The Jane Dough Unit would consist of two wellfields and associated facilities, but there would be no uranium processing or exchange plant, office building, or maintenance building. Access to the Jane Dough Unit site is either via Wyoming State Highway 50 to Van Buggenum Road to T-Chair Livestock ranch roads, or from U.S. Highway 387 north on the Iberlin road. Figure 2-1 (see map pocket) of the NRC Technical Report shows the general location and access to the project areas.

The current land surface ownership of the Jane Dough Unit includes approximately 3,680 acres of private ownership. Names and addresses of the surface and mineral owners of record within and adjacent (within 0.5 mi of each permit boundary) to the project are provided in Table ER3-1, Appendix A, and B of the attached NRC Technical Report. Appendix A lists and provides a map of all surface and mineral owners located within the two project units. Appendix B lists and provides a map of all surface and mineral owners for lands located within 0.5 mi of the project units. The legal descriptions of the project units are contained in Appendix C including tabulations of all lands in the project units and tabulation of No Right to Mine lands.

3.1.2 Uses of Lands in and Adjacent the Project Area

3.1.2.1 General

The lands within the Jane Dough Unit have historically been used for cattle grazing and wildlife habitat. Presently the lands are used for a variety of purposes. Livestock grazing, oil and gas

Table ER3-1 Nearest Residents to the Jane Dough Unit.

Nearest Residences	Number of Inhabitants	Distance From Permit Area (mi)	Direction
-Chair (Rolling Pin) Ranch	5	1.0	East
Pfister Ranch	3	6.3	Northeast
Pumpkin Buttes Ranch	2	6.3	East
Van Buggenum Ranch	0	8.7	East
Ruby Ranch	2	10.7	East
Dry Fork Ranch	3	1.1	West
Christensen Ranch	1	5.4	South

extraction, coalbed methane extraction, and uranium recovery activities are all currently taking place on or near the Jane Dough Unit. The immediate future land use for the project area and adjacent areas will be continued livestock grazing, in situ uranium recovery, coalbed methane extraction, and oil and gas extraction.

Four NRC licensed in ISR facilities are located within 50 mi of the Jane Dough Unit. The Nichols Ranch ISR facility is located immediately north of the Jane Dough Unit, Uranium One's Christensen Ranch ISR facility is located approximately 7.0 mi north of the Nichols Ranch Unit. Cameco Resources (CR) licensed North Butte amendment area lays approximately 8.0 mi to the north of the Jane Dough Unit. Cameco's Smith Ranch Highlands (CR-SRH) ISR facility is located approximately 44 mi to the Southeast of the Jane Dough Unit.

Two of the licensed facilities, Christensen Ranch and CR-SRH, currently have existing yellowcake processing plants with the CR-SRH being in operation. The Christensen Ranch plant was idle, but is back in production. Cameco's North Butte amendment area consists of satellite and wellfield facilities. Figure 1-4 (see map pocket) of the NRC Technical Report Chapter 1.0, Proposed Activities, shows the location of each facility in relation to the Jane Dough Unit.

After mining activities are completed, the land would be returned to the pre-mining land use of wildlife habitat and livestock grazing. Decommission and reclamation activities of the affected

areas resulting from the uranium recovery activities are detailed in the NRC Technical Report Chapter 6.0 of this application.

3.1.2.2 Livestock Grazing

Livestock grazing is the main activity currently occurring on the project area and adjacent lands. No known sources of mass food production for human consumption exist within 10 kilometer (6.2 miles) of the Jane Dough Unit. The National Resources Conservation Service (NRCS) stocking rate for the Jane Dough Unit ranges from 1.0 to 3.0 animal units per acre, per month on range that varies from average to excellent as listed in the NRCS Technical Guides for the Northern Plains.

3.1.2.3 Recreation

Recreational activities within a fifty mile radius of the Nichols Ranch ISR Project are mainly dispersed outdoor activities such as camping, hiking, fishing, and hunting. All of the land on and adjacent to the Jane Dough Unit is privately owned with no access for the public. There are some limited public lands located on Pumpkin Buttes area but access is restricted because of no public roads or rights-of-way to these areas. Portions of the Thunder Basin National Grassland, located approximately 24 mi to the east/southeast of the project area, and the Bighorn Mountains, approximately 27 air mi to the west, provide areas for recreational activities on public lands. The Powder River, located approximately 9.0 mi to the west of the project area, also provides recreational opportunities for public use. Figure 1-1 (see map pocket) of the NRC Technical Report shows the recreation spots in regard to the proposed project area.

3.1.2.4 Water Rights

Surface and ground-water rights on, adjacent to, and within 3 miles of the Jane Dough Unit are listed in Table JD-D6F.1-1 in Addendum F for the surface water and Tables JD-D6G.1-1 and JD-D6G.1-2 permitted water wells in Appendix JD-D6 of the NRC Technical Report. Table JD-D6G.1-1 lists the wells within the Jane Dough Unit while Table JD-D6G.1-2 in Addendum

JD-D6G list wells in and within three miles of the Jane Dough Unit. Table JD-D6F.1-2 in Addendum JD-D6F lists the abbreviations used by the State Engineers Office for both the surface and ground-water rights.

Figures JD-D6-4 and JD-D6-14 present the locations of the Jane Dough Unit surface rights. Exhibit JD-D6-1 shows the locations of the permitted wells within three miles of the Jane Dough Unit. No adjudicated surface water rights are located in or adjacent to (within 1/2 mile of the project unit) the Jane Dough Unit. The surface water rights that do exist within the proposed mining project area are limited to stock/storage ponds and ephemeral creeks. Groundwater rights in the Jane Dough Unit area are mainly associated with the old monitoring wells and stock wells. No other adjudicated water rights are in the project area and lands adjacent to the project area according to the Wyoming State Engineers Office.

Uranerz also does not hold any adjudicated water rights in the project area. Most wells that are located within the Jane Dough Unit area were previously installed by uranium exploration companies, the T-Chair Livestock Company, or CBNG companies. Several additional wells have been completed in the project areas by Uranerz for use in collecting base line ground water quality data. The current regional ground water use in this area is mainly wells for wildlife and livestock. A few domestic wells exist at the ranch houses. The production of water from coal bed methane has been occurring in the region for approximately 15 years.

Wells in the area of the proposed project area are uniformly distributed over the area excluding monitoring/sampling wells that are permitted by Uranerz. Most of the wells are used for livestock watering through the use of windmills or electric well pumps. Non-mining or oil company well depths vary from 135 feet to 1,593 feet in depth, and most wells are completed in sands other than the ore bearing sands. Those wells that are completed in the ore bearing sand will be abandoned using acceptable WDEQ methods or will be used as monitoring wells if not completed in multiple sands. No wells in or adjacent to the project area are used for domestic water consumption. The extensive ground-water monitoring program utilized during the mining project will detect any problems prior to this wellbeing adversely affected by mining activity.

Seventeen permitted wells that are not related to the mining operations also exist within 1/2 mile of Jane Dough Unit. The Pat #1 well is thought to be completed in the A or B Sands based on its well depth. Water levels in this well could be affected by the Jane Dough Unit operation. Wells East Dry Fork #1, Dry Fork Flowing #3, and Pug well #1 are thought to be completed in the B Sand. Small drawdowns in these wells could be caused by the Jane Dough ISR wellfield. The Taylor #22-1 is thought to be completed in the C Sand and should not have drawdowns from the Jane Dough operations.

Six of the ranch wells within or within one half mile of the Jane Dough permit boundary are completed below the 1 Sand. These wells are Taylor Unit #9, Doughstick #2, Pug Well #2, Chair 12-22, Car Body Well #1, and Brown 21-6. Also Dry Fork Samson #1 is completed in the 1 Sand and below. The Jane Dough wellfield should not have any effects on this well. Taylor #21-3, Seventeen Mile #1, and Fetty Well #1 are thought to be completed in the 1 Sand and should not be affected by Jane Dough.

The Brown 20-9 well is within the Nichols Ranch Unit and flows at approximately one gpm. This well is thought to be completed in the A Sand and has a total depth of 740 feet with perforations from 495 to 695 feet. The Nichols #1 well, which is located in Section 19, is completed down to a depth of 310 feet. This well is likely completed in the C Sand and flows at approximately one gpm.

Based on a conversation with the current owner of the property where the Nichols Ranch once stood, the source of water was a well which was located approximately 200 yards from the old ranch house towards Cottonwood Creek and was thought to be artesian in nature. The depth of the well was not known but it was likely hand dug and fed off the waters of Cottonwood Creek.

3.1.2.5 Industrial - Energy and Mineral Development

Oil and gas and CBNG development have and would be taking place in the proposed project area and on the lands adjacent to the Jane Dough Unit for several years. The Jane Dough Unit lies within the Hartzog/Pumpkin Buttes Oil Fields. Presently there are three conventional oil/gas wells

exist on the lands within the Jane Dough Unit and 47 CBNG wells are located within the Jane Dough Unit. According to the Wyoming Oil and Gas Conservation Commission, no further oil and gas development would take place in the Nichols Ranch ISR Project. The locations of the conventional oil/gas wells and CBNG wells in the Jane Dough Unit are shown in Exhibit JD-D6-4 and JD-D6-3 (see map pocket) of the attached Appendix JD-D6, Hydrology.

3.2 TRANSPORTATION

Access to the Nichols Ranch ISR Project site is either via Wyoming State Highway 50 to Van Buggenum Road to T-Chair Livestock ranch roads, or from U.S. Highway 387 north on the Iberlin road. Figure 2-1 (see map pocket) of the NRC Technical Report shows the general location and access to the project areas. The Van Buggenum Road is a county maintained gravel road that provides access to several ranches located in the project region. This road consists of a 24-ft wide crowned-and-ditched road that is wide enough to handle two tractor trailers passing one another. The speed limit is posted at 45 miles per hour.

Ranch roads occurring on the T-Chair Livestock Company are also gravel crowned-and-ditched roads. Recent activities by coalbed methane producers have improved the major ranch roads that Uranerz would use. These roads range from 15 to 20-ft wide and are constructed and maintained by the landowner and the CBNG producers. These roads would allow for safe passage of both passenger cars and tractor trailers when traveling to and from the Jane Dough Unit. The speed limit for these roads is 30 miles per hour. Figure 2-1 (see map pocket) of Chapter 2.0 of the NRC Technical Report outlines the roads that Uranerz would use for the Jane Dough Unit.

Wellfield access roads would follow existing two track roads and coalbed methane well access roads. If a new wellfield access road is needed, the road would be constructed in such a manner as required by the landowner. The construction of the wellfield road would also be designed to provide year round access to the wellfield in both dry and wet seasons.

Construction of the wellfield access roads consists of blading approximately the top 6.0-inches of soil to each side and constructing a drain on each side with the topsoil windrowed to the outside

of each drain (Actual topsoil depths and volumes would be determined once the decision is made to construct a new wellfield access road since topsoil depths change depending on location.). After the drain is constructed the topsoil would be placed in the bottom of the drain and seeded. Next, a layer of approximately 3.0-inches of gravel, conglomerate or scoria material will be placed on top of the bladed surface to provide an all-weather base. This method of construction would keep the driving surface higher than the adjacent land providing for a good drainage and preventing bogs from forming during the wet season. A 2.0-ft buffer will exist on each side of the road where topsoil would not be placed. This method of construction is fully supported by the landowner and has been used successfully by the landowner. At the conclusion of all mining at the Jane Dough Unit and all restoration in a production area, the wellfield access roads will be reclaimed, or turned over to the landowner if desired.

3.3 GEOLOGY AND SOIL RESOURCES

3.3.1 Geology

Geologic information for the Powder River Basin region and specific geologic information regarding the proposed project area is found in Appendix JD-D5 of the attached NRC Application. The geologic information is also found in Chapter 2.0 of the NRC Technical Report and will not be repeated here.

3.3.2 Soils

Soils within the Jane Dough Unit were inventoried and mapped based on standards of a National Cooperative Soil Survey (U.S. Department of Agriculture 1993) and include an inventory of soil types (soil map units) and soil series based on an Order 3 soil survey conducted in 2011. A soil map delineating the soil types was prepared as directed by the WDEQ, soil samples from potential disturbance areas were collected and analyzed. Physical and chemical characteristics of the topsoil within the potential disturbance areas and estimated depths of salvageable topsoil from the potential disturbance areas for future reclamation purposes were also estimated.

Soils occurring in the Jane Dough Unit are generally fine textured throughout with patches of sandy loam on upland areas and fine-textured soils occurring in or near drainages. The project area contains deep soils on lower toe slopes and flat areas near drainages with shallow and moderately deep soils located on upland ridges and shoulder slopes.

Based on the results of the soil sampling, there are no factors that would limit the suitability of topsoil as a plant growth medium during the reclamation phase. In accordance with WDEQ procedures no soil samples were collected from the Jane Dough Unit; however, soils samples were collected from the Nichols Ranch Unit (located immediately north of the Jane Dough Unit). Laboratory values were compared to Table I-2 of WDEQ-LQD Guideline No. 2 (1994) and the results were determined to be within the suitable range, except for marginal soil texture for four soil profiles from samples collected in the Nichols Ranch Unit. These four soil profiles were determined to have clay soil textures. Additionally, based on a reconnaissance survey conducted by Natural Resource Conservation Service, no prime farmland was identified within the Jane Dough Unit.

Detailed soils information for the Jane Dough Unit is presented in Appendix JD-D7 of the NRC Technical Report and includes a literature review, results, and interpretations of the soil survey, analytical results of soil sampling, and an evaluation of soil suitability as a plant growth medium.

3.4 WATER RESOURCES (INCLUDING SURFACE WATER, WETLANDS, AND GROUNDWATER)

A detailed discussion of the hydrology of the Jane Dough Unit is presented in the attached Appendix JD-D6 and JD-D11 Section 2.7 and 2.8 of Chapter 2.0 of the NRC Technical Report. Appendix JD-D6 contains all information regarding baseline water quality sampling, pump tests, surface and groundwater rights, abandoned drill holes, CBNG wells, and oil/gas wells in and near the Jane Dough Unit and Section 2.8 contains information concerning wetlands. Appendix JD-D6 should be referred to for any water information/questions regarding the Jane Dough Unit. Appendix JD-D11 contains information concerning the radiation component.

3.5 ECOLOGICAL RESOURCES

3.5.1 Topography

The Jane Dough Unit is located in southwest portion of the Powder River Basin in northeast Wyoming (Knight 1994). The project area is composed of two noncontiguous units located west and southwest of the North Middle Butte in the Pumpkin Butte area. The Jane Dough Unit is located on the border between Johnson and Campbell counties. Topography in this area is relatively flat with gently rolling hills and low ridges that drain toward Cottonwood Creek in the north and Seventeenmile Creek that drains the southwest corners of the Jane Dough Unit. Elevations in the Jane Dough Unit range from 4,670 to 4,960 ft AMSL.

3.5.2 Vegetation

3.5.2.1 General

Baseline vegetation studies of the Nichols Ranch ISR Mine permit area were conducted in June and July 2010 in accordance with a vegetation study plan approved by the WDEQ for noncoal permit areas. The sampling design and methods used for the vegetation study followed Rule 1-V (revegetation performance standards): Noncoal Rules, Chapter 3 (WDEQ amended April 25, 2006), WDEQ-LQD Guideline Number 2 (WDEQ 1997), and WDEQ-LQD Draft Guideline 2 (WDEQ 2004).

The project area is composed of seven vegetation/habitat types, with approximately 83% of the project area composed of two vegetation types (sagebrush shrubland and mixed grasslands) (Table ER3-2). Only one wetland area was identified within the Jane Dough Unit, and they would be avoided by project activities (refer to Chapter 10.0 of the NRC Technical Report). No federal threatened, endangered, candidate, or proposed plant species were found, and none are known to occur in the project area. Only one designated noxious weed species (Canada thistle) was found during surveys; both were found in small numbers in disturbed areas. Table ER3-2 presents the results of vegetation studies conducted in July 2010.

Table ER3-2 Vegetation/Habitat Types, Number of Acres, and Sampling Intensity, Jane Dough Unit, 2010.

Vegetation/Habitat Type	Premine No. of Acres	Percent of Project Area	Estimated Affected Acres[1]	Minimum Sample Size[2]	Adequate Sample Size (Nmin) for Vegetative Cover
Sagebrush shrubland	2,682.7	72.9	61.7	20	2.6
Mixed grassland	754.4	20.5	39.3	20	4.7
Bottomland	114.1	3.1	0	20	0.2
Hay meadow	66.2	1.8	0	Not sampled	--
Wetland	2.1	<0.1	0	Not sampled	--
Rock outcrop	5.3	<0.1	<0.1	Not sampled	--
Disturbed lands[3]	55.2	1.5	0	Not sampled	--
Total	3,680.0	100	101		

1 Estimated disturbance from wells, pipelines, and additional access roads is estimated.

2 Based on WDEQ-LQD (2004) and on approved sampling plan for the project submitted WDEQ-LQD prior to sampling.

3 Includes 9.3 acres of previously disturbed lands from CBM pads and ponds, and 12.6 miles (46.6 acres) of roads (30-foot wide disturbance).

Detailed vegetation information for the Jane Dough Unit is presented in Appendix JD-D8 of the NRC Technical Report Application and includes results of vegetation mapping and a description of the vegetation communities, results of cover sampling, a species list, and a discussion of noxious weeds, and selenium indicator species.

3.5.2.2 Federal Threatened, Endangered, Proposed and Candidate Plant Species

The only threatened, endangered, proposed or candidate plant species listed to potentially occur in Johnson and Campbell counties is the Ute Ladies'-tresses (USFWS 2012). Ute Ladies'-tresses prefer moist soils near wetland meadows, springs, lakes and perennial streams where it colonizes early successional point bars or sandy ledges. Soils where Ute ladies'-tresses have been typically found are fine silt/sand, gravels and cobbles, and highly organic and or peaty soils. This species is not found in heavy or tight clay soils or growing in saline or alkaline soils (USFWS 2012). Based on an assessment of suitable habitat for Ute Ladies'-tresses, no suitable habitat occurs within the Jane Dough Unit and subsequently to site specific surveys were conducted.

3.5.3 Wildlife

3.5.3.1 General

The Jane Dough Unit is located within the 10- to 14-inch Northern Plains (10-14NP) zone of northeastern Wyoming (Natural Resources Conservation Service 1988) and the project area provides habitat for wildlife that is typical for the region. The study area has the potential to provide habitat for mule deer, pronghorn antelope, jackrabbit, cottontail rabbit, coyote, bobcat, mountain lion, red fox, badger, raccoon, skunk, chipmunk, rodents, songbirds, waterfowl, eagles, hawks, owls, greater sage-grouse, chukar, wild turkey, Hungarian partridge, mourning dove, magpie, and crow. Most species are yearlong residents; however, some species such as songbirds, and waterfowl are more abundant during migration periods (Cerovski et al. 2004).

Mammal and bird species found during site specific surveys of the project area included pronghorn, mule deer, bobcat, coyote, badger, desert cottontails, white-tailed jackrabbits, greater sage-grouse, and gray partridge. Small mammals included black-tailed prairie dogs and thirteen-lined ground squirrels. Raptors confirmed breeding included great horned owl, long-eared owl, golden eagle, red-tailed hawk, and prairie falcon.

Detailed wildlife information for the Jane Dough Unit area is presented in Appendix JD-D9 of the NRC Technical Report Application and includes a complete species list, methods, and results of site-specific species surveys, potential wildlife impacts and mitigation measures, and information concerning threatened and endangered species.

3.5.3.2 Federal Threatened, Endangered, Proposed and Candidate Animal Species

One federal threatened, endangered, proposed, and candidate (TEPC) animal species is known to occur within or in the vicinity of the Jane Dough Unit (greater sage-grouse a candidate species) (USFWS 2012).

As a preemptive measure to prevent the formal listing of the greater sage-grouse, the Governor of Wyoming initiated a Wyoming Sage Grouse Implementation Team (WSGIT) in July 2007 to make recommendations on management of greater sage-grouse populations relative to development in Wyoming with the goal of maintaining healthy greater sage-grouse populations. The WSGIT and eight local working groups identified and defined core population areas (CPAs) in Wyoming, addressed the need for connectivity among geographically important populations, recommended guidelines for development activities both within and outside of the CPAs, and assessed needs for further research regarding habitat protection and population monitoring (WSGIT 2010a). CPAs encompass habitats and existing populations for at least two-thirds of the greater sage-grouse in Wyoming (WSGIT 2008). WSGIT (2008) predicted that, based on peak male attendance, approximately 83% of the males attending leks in Wyoming were within initially-identified CPAs, as were approximately 61% of the occupied leks in the state. After further review, the CPAs were refined in June 2010--and Version 3.0 of the core area map was released to the public--to exclude some areas of the state where greater sage-grouse habitat was marginal or the level of human development in the area warranted exclusion and to include areas required to maintain connectivity between and among important populations (WSGIT 2010b).

On June 2, 2011, the Governor of Wyoming signed Executive Order 2011-5, updating the previous Executive Order (2010-4) regarding the protection of greater sage-grouse (State of Wyoming 2011). The most restrictive conservation measures and recommendations are for proposed development activities inside of greater sage-grouse CPAs, which are areas identified by the State of Wyoming as high-quality habitat for greater sage-grouse nesting and brood-rearing and necessary to maintain sage-grouse populations. This Executive Order applies to all actions (including issuance of state authorized permits) undertaken by all Wyoming state agencies including permits issued by WDEQ-LQD (State of Wyoming 2010). The Jane Dough Unit is located outside of any greater sage-grouse CPA, connectivity areas, or winter concentration areas (WSGIT 2010b).

One occupied greater sage-grouse lek (38-Cottonwood Creek 1) occurs within the Jane Dough Unit (0.25 miles inside the southeast boundary of the Jane Dough Unit), and three additional occupied greater sage-grouse leks occur within 2.0 miles of the Jane Dough Unit: 38-Cottonwood

Creek 1 Satellite, 38-Cottonwood Creek 2, and 38-Cottonwood Creek 3 (refer to Figure JD-D9-3 in Appendix JD-D9 of the NRC Technical Report). All of these leks have been surveyed annually since 2005 using the WGFD-approved survey methodology. Each lek was visited three times at sunrise and the maximum number of males and female birds were recorded. 38-Cottonwood Creek 1 was active from 2005-2009; 38-Cottonwood Creek 1 Satellite was active in 2006 and 2007; 38-Cottonwood Creek 2 was active in 2005-2010; and 38-Cottonwood Creek 3 was active in 2005-2007. Very little activity has been noted at any of these leks since 2010; however, one male and one female were recorded at 38-Cottonwood Creek 2 in 2010 and one female was recorded at 38-Cottonwood Creek 3 in 2012 (refer to Table JD-D9-2 in Appendix JD-D9).

There are several potential explanations for these decreases, including natural population responses to recent drought conditions in the general area and natural degradation of sagebrush habitat (Knick et al. 2003). However, recent studies have also documented that intensive gas development can have adverse impacts on greater sage-grouse populations (Holloran and Anderson 2005; Lyon 2000; Lyon and Anderson 2003; and Walker, Naugle, and Doherty 2007). A large number of gas (CBNG) wells (between 4 and 12 wells per section) have been drilled throughout the project area over the past 3 years. In addition, there also appears to be an indirect impact associated with an increased number of avian predators (e.g., corvids) and mammalian predators (e.g., foxes, coyotes) associated with increased gas development that have also been documented as having adverse impacts on nesting greater sage-grouse (Hollaran and Anderson 2005; Lyon and Anderson 2003). In addition, work on the adjacent Nichols Ranch ISR project did not begin until late 2011. Therefore, any decrease in the attendance of male greater sage-grouse and related population declines within the general project area are likely the result of a combination of natural and manmade factors not associated with the Jane Dough Unit.

3.6 METEOROLOGY AND AIR QUALITY RESOURCES

3.6.1 Introduction

The Jane Dough Unit is located in northeastern Wyoming, where the climate is generally classified as steppe or semiarid; defined by the American Meteorological Society as the type of climate, in

which precipitation is very slight but sufficient for the growth of short sparse grass. This climate is due in part to the effective barrier to moisture from the Pacific Ocean offered by numerous mountain ranges that run primarily north and south throughout the state, perpendicular to the prevailing west winds. The topography in this portion of Wyoming tends to restrict the passage of storms and thereby restrict precipitation in eastern Wyoming (Curtis and Grimes 2004).

Uranerz installed a meteorological station at the central processing plant within the Nichols Ranch Unit. This meteorological station became operational in July 2011 and data for temperature, wind speed and wind direction have been collected, analyzed, and is presented in Appendix JD-D4. Precipitation data from the Midwest, Wyoming meteorological station (approximately 27 miles southwest of the Jane Dough Unit) is presented as representative of the Jane Dough Unit for a 2 year period of time. To ensure the representativeness of the short-term on-site meteorological data to the long-term meteorological data, the 2-years of on-site meteorological data were compared to long-term data from three representative NWS Station located at the Antelope site, Casper site, and Gillette site. This analysis is presented in Addendum JD-D4-A of Appendix JD-D4 in the NRC Technical Report application and the comparison shows that the on-site data are consistent with long-term conditions.

Average annual lake evaporation, annual evapotranspiration, and humidity data was obtain from Martner (1986).

3.6.2 Temperature

Summer temperatures vary widely across the state of Wyoming, with the typical climate characterized by warm sunny days and cool nights. A discussion on regional temperature data is presented in Appendix JD-D4 in the NRC Technical Report. State record high and low temperatures are 116°F and -66°F, respectively (Curtis and Grimes 2004). Based on 2 years of weather data collected at the Nicholas Ranch meteorological station, the maximum temperature recorded was 100.8°F and the minimum temperature was -9.6°F. On average, for this region of Wyoming, summer temperatures reach 90°F or above about 48 times per year, while winter temperatures fall to 0°F or below about 18 times per year

Table ER3-3 Mean Monthly Temperatures for Jane Dough Unit[1].

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

[1] Data collected at the Nichols Ranch Meteorological Station.

(Martner 1986). On average, there are 100-125 frost-free days a year in the project area, with the length of frost-free days decreasing with increasing elevation (Martner 1986).

The mean monthly temperatures for the Nichols Ranch ISR Project area based on 2 years of data collected in the project area and are summarized in Table ER3-3.

Figure ER3-1 compares monthly average temperature for Year 1, the Baseline Year and Year 2 and the monthly average high and low temperature for both years. Temperatures were similar in Year 1 and 2 with the exception of a cooler spring in 2013 compared to 2012.

3.6.3 Precipitation

Precipitation data was not collected at the Nichols Ranch ISR Project area. The nearest precipitation station is the National Weather Service Midwest 1SW weather station, which is located approximately 27 mi southwest of the project area. Average monthly and annual precipitation values for data collected at the Midwest 1SW weather station for the 30-year period

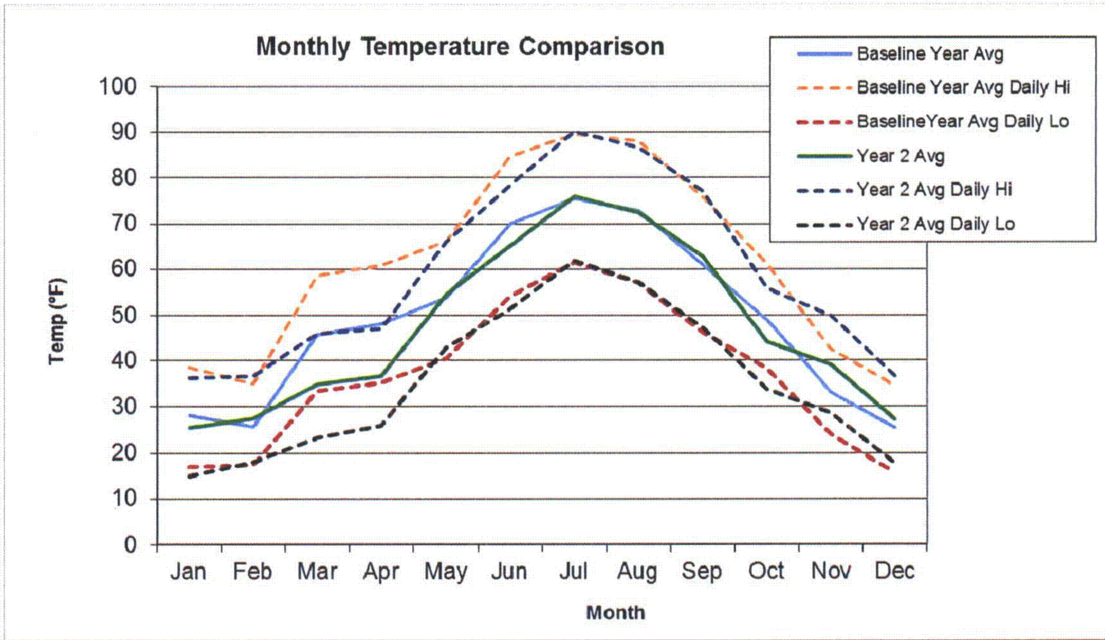


Figure ER3-1 Monthly Temperature Comparison, for the Jane Dough Unit.

1971-2000 are summarized in Table ER-4. During this 30-year period, average maximum precipitation occurs during the month of May, and average minimum precipitation occurs during the month of January (Curtis and Grimes 2004). In winter, mean annual snowfall totals are 45-53 inches (Curtis and Grimes 2004). The average number of days with snowfall totals of 1 inch or more is 16 to 26 days for the area, with the highest average monthly snowfall occurring from February to April (Martner 1986).

3.6.4 Wind

The entire state of Wyoming is windy and ranks 1st in the US with an annual average wind speed of 12.9 mph. During the winter there are frequent periods when the wind reaches 30 to 40 mph with gusts of 50 or 60 mph (Curtis and Grimes 2004). Detailed on-site information concerning wind speed and direction is presented below.

Table ER3-4 Average Precipitation Values.[1]

Month	Inches
January	0.54
February	0.61
March	0.95
April	1.71
May	2.55
June	1.95
July	1.35
August	0.72
September	0.86
October	1.13
November	0.69
December	0.70
Annual	13.76

1 Data from the Midwest, Wyoming Meteorological Station (MW1) (1971-2000) (Curtis and Grimes 2004).

3.6.4.1 Wind Speed

Based on 2 years of wind data collected hourly at the Nichols Ranch meteorological station, the average wind speed is 10.6 mph. The highest wind speed collected was 51.3 mph. The weakest winds occur in the mornings and the strongest winds generally occur in early to mid-afternoon. Figure ER3-2 provides a monthly comparison between the Baseline Year, Year 1 to Year 2 and a second year of data. Figure ER3-3 compares the wind roses for the two, 12-month monitoring periods for the baseline year and second year of data collected at the Nichols Ranch ISR Project area meteorological station. The wind roses demonstrate fairly consistent wind speed and direction from year to year.

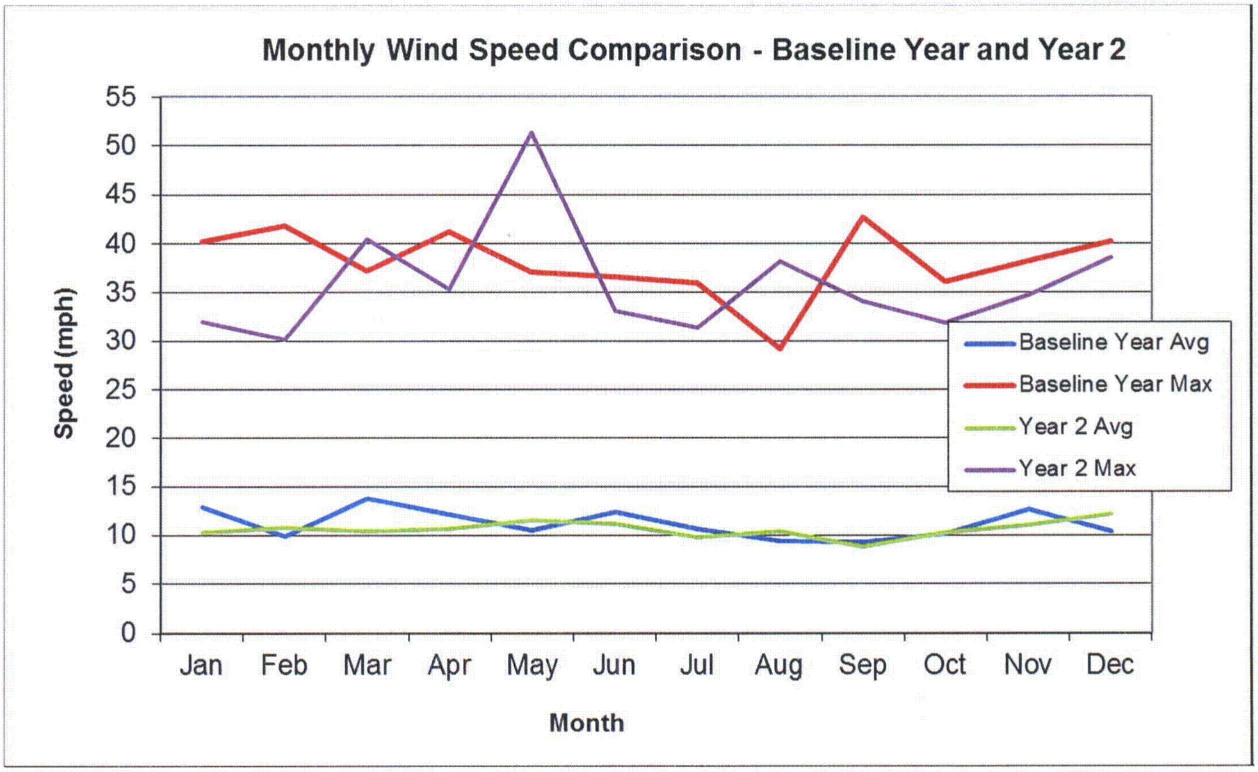
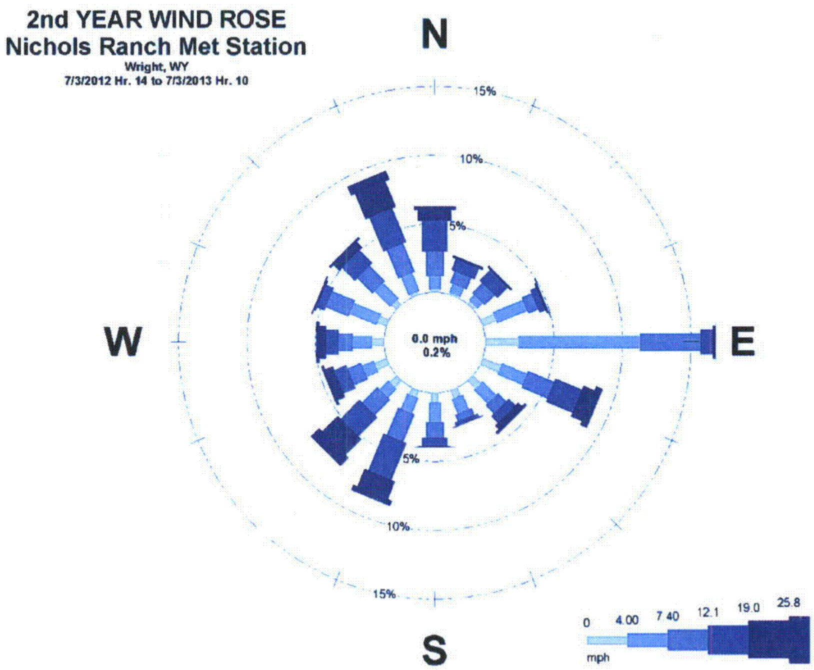


Figure ER3-2 Monthly Wind Speed Statistics, Baseline (Year 1) and Year 2 Comparison for the Jane Dough Unit.

3.6.4.2 Wind Speed Frequency

The MILDOS-AREA model was used to determine wind speed frequency wind distribution based on 2 years of collected data. The wind speeds were divided into six classifications ranging from mild (zero to three mph) to strong (>24 mph). A seventh classification is denoted as "calm," indicating wind speeds below the instrument threshold.

The percent of the time that winds occur in each of the seven wind speed categories can be represented as a wind speed frequency distribution. Figure ER3-4 compares the frequency of occurrence of each of the seven classifications during the Baseline Year and Year 2 at the Nichols Ranch meteorological station. The percent of the time the wind speed falls within each of the seven wind speed classes shown, is quite similar for the two monitoring periods.



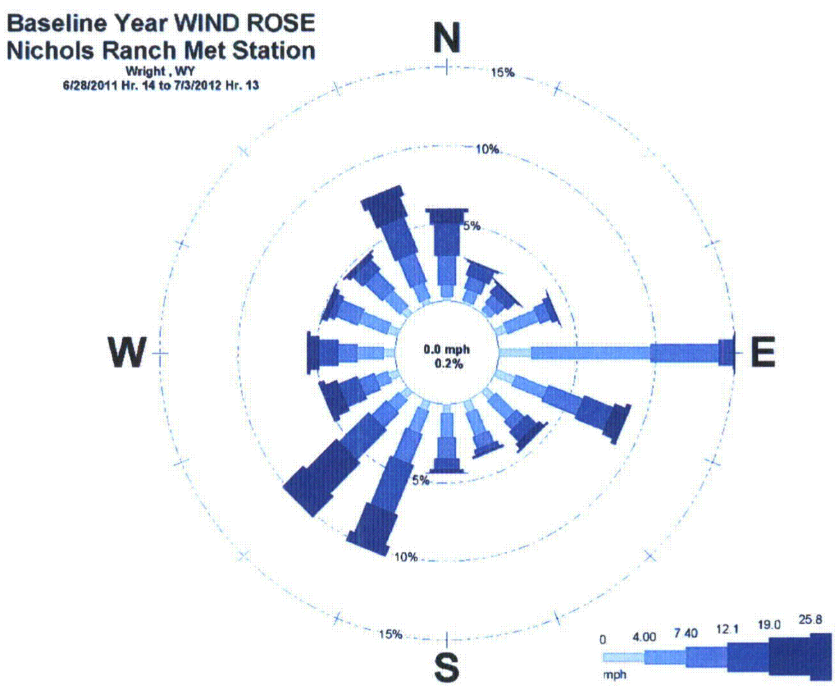


Figure ER3-3 Wind Rose Comparison, Baseline (Year 1) and Year 2 for the Jane Dough Unit.

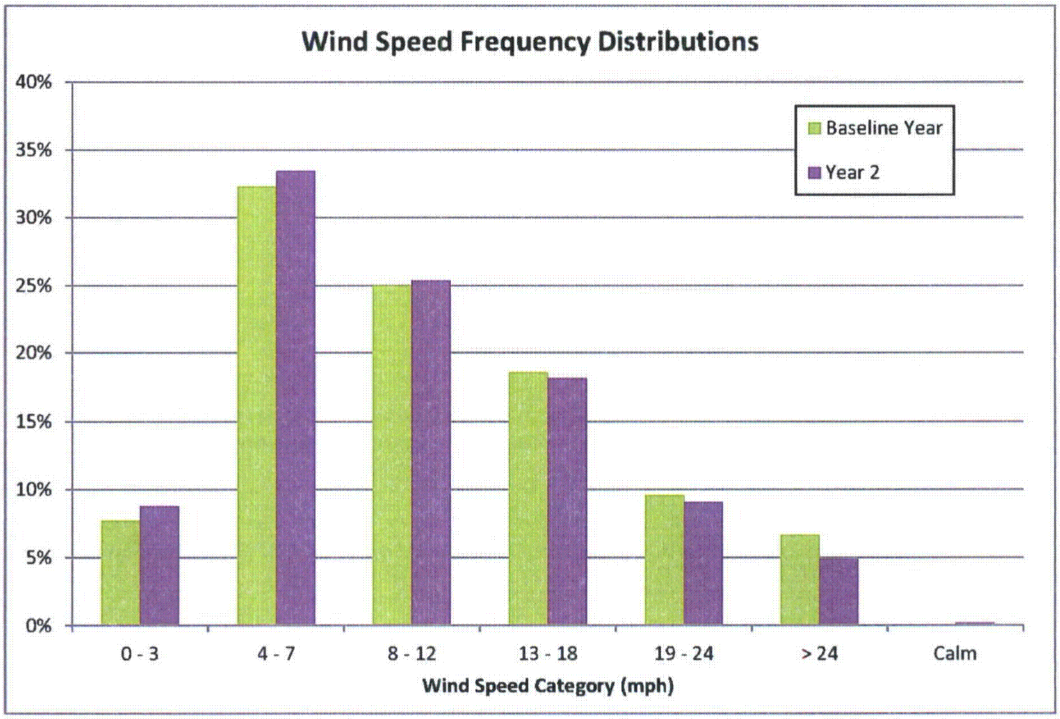


Figure ER3-4 Wind Speed Frequency Distributions Year 1 and Year 2 for the Jane Dough Unit.

3.6.4.3 Wind Direction

Predominant wind direction was from the predominately from east accounting for 16.8% of the possible winds (see Figures ER3-3 and ER3-4). Wind direction was similar from year to year.

3.6.4.4 Wind Direction Frequency

The MILDOS-AREA model was also used to determine wind direction frequency wind distribution based on 2 years of collected data at the Nichols Ranch meteorological station. Wind directions were divided into 16 categories corresponding to the compass directions illustrated in the wind roses (refer to Figure ER3-3). A 17th category is denoted as "calm," indicating wind speeds below the threshold to move the wind vane. The percent of the time that winds blow from each of the 17 directions can be represented as a wind direction frequency distribution. Figure ER3-5 shows that the percent of the time the wind direction falls within each of the 17 wind direction categories shown, is quite similar for the two monitoring periods.

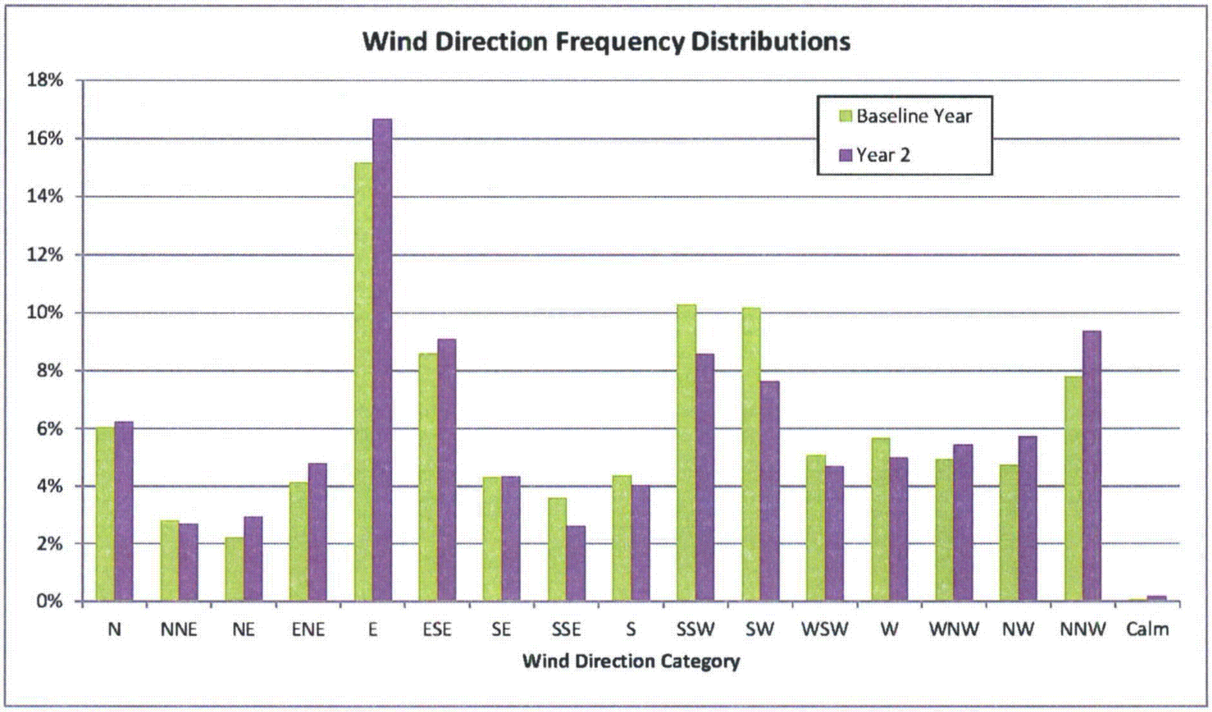


Figure ER3-5 Nichols Ranch Wind Direction Frequency Distributions Year 1 and Year 2.

3.6.5 Humidity

Wyoming's annual average relative humidity is quite low and is particularly low in the summer. In the project area, the mean annual relative humidity is between 52% and 60%. However, during the warmer part of the summer days, the humidity across the state can drop to about 25 to 30% and on a few occasions it would be as low as five to 10%. Late at night, when the temperature is lowest, the humidity would generally rise to 65 or 75%. This results in an average diurnal variation of about 40 to 45% during the summer, but in the winter the variation is much less (Curtis & Grimes 2004).

3.6.6 Evaporation

Wyoming's low humidity, abundant sunshine, and relentless winds contribute to a high rate of evaporation. Annually, statewide evaporation rates range from 30 to about 50 inches. In the

Jane Dough Unit evaporation is likely 40 to 45 inches annually. Evaporation in Wyoming varies much less on a yearly basis than precipitation. Even extreme variations in annual total evaporation are within 25 percent of the long term annual average (Curtis and Grimes 2004).

3.6.7 Severe Weather

Information on severe weather in the region of interest is not available; however, severe weather in Wyoming is relatively uncommon in part because of the Rocky Mountains' ability to separate and block prevailing air flows from the Gulf of Mexico, north-central North America, and the Pacific Ocean thus minimizing clashes between contrasting air masses that produce severe weather (Curtis and Grimes 2004). Thunderstorms and hailstorms are the most common severe weather events in the state and region and hailstorms are the most destructive type of events. Severe hail (size 0.75 inch or larger) events occur about 29 times a year across the state with the greatest frequency by far occurring over the extreme southeast part of the state. The annual frequency of thunderstorms range from about 30 days per year on its western border; to about 50 days per year in the extreme northeast and southeast corners of the state (Curtis and Grimes 2004).

Tornados are not a common occurrence in the area and "significant" tornados are much rarer. Tornado intensity is measured by the Fujita (F-Scale) and range from the weakest intensity storms (F0) to the strongest storms (F5). Significant tornadoes are considered to be F2 intensity winds, between 113 and 157 mph or stronger, or if a weaker tornado kills a person. Significant tornadoes occur in about four out of 100 tornadoes in Wyoming (Curtis and Grimes 2004).

3.6.8 Effects of Local Terrain

Approximately 6 mi east of the Jane Dough Unit is a series of buttes known as Pumpkin Buttes. These buttes rise approximately 1,200 feet above the proposed project area of the Jane Dough Unit. The proximity of the Pumpkin Buttes to the Jane Dough Unit cannot be ignored and likely creates a microclimate on the surrounding area. Considering that the prevailing winds in the area are from the east, the change in elevation is relatively minor, temperature and relative humidity in the region are quite low, topographically generated weather systems are expected to be nominal. However,

it is possible that the buttes do produce some microclimatic effects on the local precipitation pattern but these effects would be variable and diverse especially given the variable nature of summer precipitation events.

The along-slope wind systems, while certainly present, are expected to be insignificant since the daytime adabatic or upslope wind has just a few hundred meters to gather strength before reaching the apex of the buttes. Returning katabatic or down slope winds in the evening should also be minimal as winds in the area tend to decrease with nightfall. The potential for mountain-gap wind between North Butte and North Middle Butte exists but is expected to be negligible. First, the narrow dimensions of the buttes do not allow for a buildup of wind speed as would be expected in a true valley situation. Secondly, in general when air stratification is stable, the air flow tends to be from high to low pressure and wind could emerge through a gap as a "jet" known as mountain-gap wind. However, joint frequency distribution data shows stability class F winds, the most stable, to be quite light in the region. Therefore, while the buttes themselves are a striking visual characteristic of the landscape topographically speaking they are of limited magnitude.

3.6.9 Air Quality

The Jane Dough Unit is located in and adjacent to counties that are designated as attainment with EPA National Ambient Air Quality Standards (NAAQS) for all criteria pollutants (EPA 2010a). The nearest and only designated nonattainment area in Wyoming is the city of Sheridan, in Sheridan County (EPA 2010a). The city of Sheridan is approximately 88 miles northwest of the Jane Dough Unit. The terrain within the region where the proposed site is located, combined with windy conditions provides good conditions for dispersion of air pollutants (BLM 2003). The nearest residence to the Jane Dough Unit is Dry Fork Ranch, approximately 1 mile to the west. The nearest residence along the path of the predominant wind direction (refer to Figure ER3-3) is the Dry Folk Ranch located approximately 1.0 mile west of the Jane Dough Unit.

The EPA has established air quality standards to promote and sustain healthy living conditions. These standards, known as NAAQS, address six pollutants EPA refers to as criteria pollutants: carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), particulate matter (PM_{10} and $PM_{2.5}$),

ozone (O_3), and sulfur dioxide (SO_2). EPA revised the NAAQS standards after the preparation of the Generic Environmental Impact Statement (GEIS). This includes a new rolling 3-month average standard for lead at 0.15 $\mu g/m^3$ and a new 1-hour nitrogen dioxide standard at 100 parts per billion. EPA revisions to SO_2 and O_3 standards are under consideration but are not finalized (EPA 2010b). WDEQ adopted the EPA NAAQS. States may develop standards that are stricter than, or that supplement, the NAAQS. Wyoming has a more restrictive standard for sulfur dioxide (annual at 60 $\mu g/m^3$ and 24-hour at 260 $\mu g/m^3$) and supplemental standards for particulate matter (annual PM_{10} at 50 $\mu g/m^3$ and 24 hour $PM_{2.5}$ at 65 $\mu g/m^3$) (WDEQ 2008). The principal non-radiological emissions from activities at the Jane Dough Unit include diesel combustion engine emissions and fugitive road dust (particulate matter).

Particulate matter (PM) refers to particles found in the air. Some particles are large enough to be seen as dust, soot, or smoke, while others are too small to be visible. As noted previously, NAAQS limit the allowable concentration of PM particles to smaller than for PM_{10} and $PM_{2.5}$ $\mu g/m^3$. Emissions from highway and non-road construction vehicles comprise approximately 28 percent of total PM_{10} and $PM_{2.5}$ emissions. The largest source of PM includes fugitive dust from paved and unpaved roads, agricultural and forestry activities, wind erosion, wildfires, and managed burning. The WDEQ-Air Quality Division analyzes measurements from 26 stations located throughout Wyoming to ensure ambient air quality is maintained, in accordance with NAAQS. The results are synthesized into the Wyoming Ambient Air Monitoring Annual Network Plan (WDEQ 2009).

The baseline air quality conditions of the Jane Dough Unit were determined by evaluating data from four monitoring stations in the region to provide a reasonable representation of the air pollutant levels that could be expected to occur at the site. Monitoring data were reviewed for the Gillette, Campbell County South, Wright, and Antelope monitoring locations. Furthermore, the NRC GEIS reported that all areas within the Wyoming East Uranium Milling Region were classified as being in attainment for NAAQS (NRC 2009).

WDEQ monitors air quality and annually reports the results to EPA. Table 3-10 presents the air quality monitoring data for all of the monitoring stations within a 50 mile radius of the Jane Dough

Unit. These monitoring sites are located northeast, east, and southeast of the proposed project area in the general direction of the prevailing winds. The monitoring results for the 3 year period from 2006 through 2008 are consistent with the area's attainment status (WDEQ 2009; EPA 2010a). WDEQ uses the entire monitoring network to meet various objectives; therefore, all criteria pollutants are not monitored at each site and the data for monitoring sites in the vicinity of the Jane Dough Unit are limited.

The Prevention of Significant Deterioration (PSD) requirements identify maximum allowable increases in concentrations for particulate matter, SO_2, and NO_2 for areas designated as attainment. There are several different classes of PSD areas, with Class I areas having the most stringent requirements. Wind Cave National Park, the closest Class I area to the Jane Dough Unit is located about 115 miles to the east of the site. Cloud Peak Wilderness Area, the closest Class II area to the Jane Dough Unit, is located about 68 miles to the northwest of the site (NRC 2009).

3.7 NOISE

The A-weighted sound pressure level, or A-scale, is used extensively in the U.S. for the measurement of community and transportation noise; and is a measure of noise in A-weighted decibels (dBA) that is directly correlated with commonly heard sounds (Table ER3-5). Noise-sensitive receptors in and adjacent to the ISR Project area include residences, nesting raptors, and greater sage-grouse. No ambient noise measurements have been made in the Jane Dough Unit; however, noise levels are likely to be in the range reported for "farm in valley" sites by Wyle Laboratories (1971), where median noise levels ranged from 29 to 39 dBA, depending on the time of day. The NRC estimated existing ambient noise levels in the undeveloped rural areas if the Wyoming East Uranium Milling Region (in which the Jane Dough Unit would be located located) would be 22 to 38 dBA (NRC 2009). High winds, trucks, and traffic likely range from 50 to 60 dBA on occasion. Use of agricultural equipment, as well as oil and gas drilling and completion operations in the general area, likely result in temporary noise levels of 70 dBA to more than 100 dBA (NRC 2009).

Table ER3-5 Comparison of Measured Noise Levels with Commonly Heard Sounds.[1]

Source	dBA	Description
Normal breathing	10	Barely audible
Rustling leaves	20	
Soft whisper (at 16 ft)	30	Very quiet
Library	40	
Quiet office	50	Quiet
Normal conversation (at 3 ft)	60	
Busy traffic	70	
Noisy office with machines; factory	80	
Heavy truck (at 49 ft)	90	Constant exposure endangers hearing

[1] (Wyle Laboratories 1971).

3.8 HISTORIC, CULTURAL, AND PALEONTOLOGICAL RESOURCES

Reports containing information regarding historic, cultural, and paleontological resources for the Jane Dough Unit are discussed in detail in Appendix JD-D3 of the NRC Technical Report. Addendum JD-3A contains the cultural resource report for the Jane Dough Unit and Addendum 3B contains the results of a paleontological survey conducted for the Jane Dough Unit. All addendums are considered confidential and not for public disclosure under 10 CFR 2.390. Please refer to the affidavit regarding the withholding of this information from public disclosure.

3.8.1 Historic and Cultural Resources

3.8.1.1 Class I Literature Search for the Jane Dough Unit

A file search Wyoming State Historic Preservation Office (WSHPO) [File Search No. 25735] was conducted through the Cultural Records Office of the WSHPO for Sections 20, 21, 27, 28, 29, 30, 31, 32, 33, and 34, T43N, R76W, on May 14, 2010, and includes a description of archaeological and historical resources within the Jane Dough Unit and includes the full sections of land directly associated with this project. The Jane Dough Unit occurs within a majority of these legal descriptions. Once the list of sites is obtained from the WSHPO database, the sites within each section were plotted to determine if they occur within the physical boundaries of the Jane Dough

Unit. The file search for this area indicates that 10 projects have been conducted with 31 archaeological and historic sites located within the full sections listed above.

The 10 projects conducted within the full sections listed above were completed between 1984 and 2008 for a variety of energy development projects, including five CBNG plans of development (PODs), four oil/gas wellfield surveys, and one seismic project (Table JD-D3-1). The projects consist of nine (9) Class III inventories and one historic trail evaluation project. Of the nine inventory projects seven contain inventory areas that overlap within the current project area.

Table ER3-6 Cultural Resource Inventories Completed Within or near Uranerz's Jane Dough Unit.

Accession No. [1]	Project Name	Contractor [2]	Type [3]	Legal Location
84-540	77 Drill Holes and Block	TVA	B	Section 27, T43N, R76W
84-725	Taylor Unit No. 9	PAS	B	Section 33, T43N, R76W
99-1041	Dry Fork Block Survey	PAS	B	Sections 29, 30, 31, 32, and 33, T43N, R76W
99-1142	West Pumpkin Buttes Prospect	PAS	B	Section 34, T43N, R76W
4-2191	East Bullwhacker CBNG POD	SWCA	B	Sections 20, 29, 30, 31, and 32, T43N, R76W
4-2191-3	East Bullwhacker CBNG POD Trails Evaluation	ACR	B/L	Sections 30 and 31, T43N, R76W
6-615	Mojave 3-D Seismic Project	TRC	L	Section 31, T43N, R76W
6-1465	Dry Willow Phase 2 POD	Arcadis	B	Section 27, R43N, R76W
7-1669	Blade CBNG POD	ACR	B/L	Sections 20, 21, 28, and 29, T43N, R76W
8-425	Tex Draw Federal POD	WLS	B	Sections 20, 21, 27, 28, and 29, T43N, R76W
--	Jane Dough Unit ISR Project	TRC	B	Sections 20, 28, 29, and 32, T43N, R76W

1 -- = report has not been accessioned.
2 ACR = ACR Consultants, Inc.; Arcadis = Arcadis U.S. Inc.; PAS = Pronghorn Archaeological Services; SWCA = SWCA Environmental Consultants; TRC = TRC Environmental Corporation; TVA = Tennessee Valley Authority; WLS = Western Land Services.
3 B = block; B/L = combination block/linear; L = linear.

Based on comprehensive inventory area and project accession dates, four of these inventory projects (WSHPO Project Nos. 99-1041, 99-1142, 4-2191, and 8-425) were utilized to determine which portions of the current project area did not require additional Class III inventory. Approximately 2,660 acres of the 3,680-acre Jane Dough Unit had been previously inventoried in association with these four projects and are shown on Exhibit JD-D3-1 (presented in Appendix JD-D-3 of the NRC Technical Report) and discussed below.

The northern portion of the Jane Dough Unit, including the S1/2N1/2, NSE1/4, and S1/4ESE1/4 of Section 20, all of the project portions in Sections 21 and 27, the N1/2 of Section 28, and the E1/2NE1/4 of Section 29, T43N, R76W, was inventoried by Western Land Services as part of the Tex Draw Federal POD project. The inventory report for that project was accessioned by WSHPO in 2008 (Project No. 8-425). The E1/2SW1/4 and SW1/4SE1/4 of Section 20 in the northern portion of the Jane Dough Unit and all of southwestern portion of the project area in Sections 30 and 31 were inventoried by SWCA Environmental Consultants (SWCA) as part of the East Bullwhacker CBM POD. The report was accessioned by WSHPO in 2004 (Project No. 4-2191). The central portion of the Jane Dough Unit, including the W1/2NE1/4 and SE1/4 of Section 29, the S1/2 of Section 32, and all of the project area within Section 33, was inventoried by Pronghorn Archaeological Services (PAS) in 1999 as part of the Dry Fork Block Survey. The report was accessioned by WSHPO in 1999 (Project No. 99-1041). The portion of the project area in Section 34 in the southeastern portion of the Jane Dough Unit was inventoried by PAS in 1999 as part of the West Pumpkin Buttes Prospect. The report was accessioned by WSHPO in 1999 (Project No. 99-1142).

TRC evaluated the current Jane Dough Unit area and determined that a majority of the project area had been previously inventoried as described above. However, a total of 1,040 acres had not been inventoried. As a result, TRC inventoried the remaining uninventoried portion of the project area (portions of Sections 20, 28, 29, and 32, T43N, R76W) in 2010 and the report is presented in Addendum JD-D3-A and it has been added to Table ER3-6. Results of the 2010 inventory indicate that no newly identified historical or archaeological sites were found; however, one newly identified segment and three previously identified segments of the Deadwood Road were recorded.

This report will be reviewed by NRC and WDEQ-LQD and will be submitted to the WSHPO for review after it is accepted by the NRC.

Fourteen sites have been recorded within the Jane Dough Unit boundary covered by the file search and the inventory completed in 2010 by TRC. The 14 sites consist of nine prehistoric and five historic sites (Table ER3-7).

The results of the current and previously conducted Class III inventories indicate that 14 sites and two IRs are located within the project area for Uranerz's Jane Dough Unit (refer to Table ER3-7). The 14 sites consist of two sites that are eligible for listing on the National Register of Historic Places (NRHP) and 12 that are ineligible.

Table ER3-7. Recorded Sites Within or near the Jane Dough Unit.

Site No.	Time Period[1]	Site Type	NRHP Eligibility Status [2]	Legal Location
48CA1568/ 48JO2292	H	Deadwood Road	E/WSHPO	Sections 27, 28, 29, 30, 31, 33, and 34, T43N, R76W
48CA5393	P	Lithic scatter	NE/WSHPO	Section 20, T43N, R76W
48CA5394	H	Trash scatter	NE/WSHPO	Section 21, T43N, R76W
48CA5395	P	Lithic scatter	NE/WSHPO	Section 21, T43N, R76W
48CA5396	P	Lithic scatter	NE/WSHPO	Section 21, T43N, R76W
48CA5397	P	Lithic scatter	NE/WSHPO	Section 21, T43N, R76W
48CA5398	H	Oil/gas wellfield	NE/WSHPO	Section 21, T43N, R76W
48CA5399	P	Lithic scatter	NE/WSHPO	Section 21, T43N, R76W
48CA5400	P	Lithic scatter	NE/WSHPO	Section 21, T43N, R76W
48CA5401	P	Lithic scatter	NE/WSHPO	Section 21, T43N, R76W
48CA5412	P	Lithic scatter	NE/WSHPO	Section 28, T43N, R76W
48CA6583	H	Trash scatter	NE/WSHPO	Section 27, T43N, R76W
48JO134	H	Bozeman Trail	E/WSHPO	Sections 30 and 31, T43N, R76W
48JO3452	P	Lithic scatter	NE/WSHPO	Section 32, T43N, R76W

[1] H = historic; P = prehistoric.
[2] E = eligible; E/WSHPO = eligible with WSHPO concurrence; NE = not eligible; NE/WSHPO = not eligible with WSHPO concurrence; U/WSHPO = unevaluated with WSHPO concurrence.

3.8.2 Paleontological Resources

A paleontological survey was conducted of the Jane Dough Unit. The survey did not produce any vertebrate fossil bearing strata and no vertebrate fossils were discovered. However, some limited invertebrate fossils (e.g., clams and mollusks) were discovered; however, these resources were located on private lands and are not scientifically important.

The complete paleontological survey is attached as Addendum JD-D3-B in Appendix JD-D-3 of the NRC Technical Report.

3.9 VISUAL RESOURCES

The Jane Dough Unit is located in southwest portion of the Powder River Basin in northeast Wyoming (Knight 1994). The project area is unit located west and southwest of the North Middle Butte in the Pumpkin Butte area. The Jane Dough Unit is located approximately 6.0 mi west of South Butte Unit on the border between Johnson and Campbell counties. Topography in this area is relatively flat with gently rolling hills and low ridges that drain north toward Cottonwood Creek (an intermittent stream) that is located outside of the unit and the remaining portion of the Jane Dough Unit drains southwest toward Seventeenmile Creek which cuts through a small portion of the Jane Dough Unit. Elevations in the Nichols Ranch Unit range from 4,670 to 4,960 ft AMSL. Figure 3-8C (see map pocket in the NRC Technical Report) depicts the Jane Dough Unit drainages and elevations.

The Jane Dough Unit encompasses approximately 3,680 acres and surface ownership is completely privately-owned. The two closest residences are the Dry Fork Ranch and Rolling Pin Ranch. The Dry Fork Ranch is located approximately 1.0 mile to the west of the northwest corner of the Jane Dough Unit and the Rolling Pin Ranch is located is located approximately 1.0 mile east of the eastern boundary Jane Dough Unit (refer to Figure JD-D11-1 in Appendix JD-D11 of the NRC Technical Report).

Because the Jane Dough Unit is located entirely on private land in a remote location, the operations aesthetic impact is limited to only the landowner and those that have permission to be on the landowner's property. In addition, there are no visually sensitive areas within 4.0 miles of the Jane Dough Unit.

3.10 SOCIOECONOMICS (INCLUDING ENVIRONMENTAL JUSTICE)

The population within 50 mi of the Nichols Ranch ISR Project consists mainly of rural areas. The community of Gillette, Wyoming, is the closest major urban area to the mine site located approximately 46 mile away. Casper, Wyoming, is the next closet major urban area to the mine site located approximately 61 mile away. These two communities provide the major locations of public services such as schools, churches, medical care facilities, public parks, and commodities. Wright and Buffalo, Wyoming also provide public services near the mining site. Table ER3-8 lists the cities, and the estimated populations of all major towns within 50 mi of the project area.

Chapter 2.0 of the NRC Technical Report gives further detailed information, including figures and tables, regarding the areas surrounding the Jane Dough Unit.

Gillette, Wyoming is the county seat of Campbell County. The city has been experiencing major growth over the last few years. Coalbed methane, oil and gas development, and coal mining have played significant roles in expanding the city's population by almost 12% from April 2000 through July 2005. According to the Campbell County Economic Development Corporation, Campbell County Housing Needs Assessment of January 2005, Campbell County is projected to grow at a consistent pace between 7% and 11% for the next 15 years due to the expansion of the work force and natural population growth. With the influx of industry, Gillette also serves a regional center for oil and gas, mining, and CBNG support services.

Table ER3-8 Cities Within a 50-mile Radius of the Jane Dough Unit.

City	Population[1]	Distance From Permit Area (mi)	Direction
Gillette	28,729	46	Northeast
Buffalo[2]	4,888	57	Northwest
Kaycee	263	35	West
Midwest	404	25	Southwest
Edgerton	195	23	Southwest
Wright	1,807	22	East
Casper[2]	54,874	61	Southwest

[1] Source: U.S. Census Bureau Population Division (2010).
[2] Major Wyoming cities just beyond 50 mi.

Casper, Wyoming, is the County Seat of Natrona County and the second largest city in Wyoming. The city serves as the economic center of central Wyoming servicing a 150 mi radius that encompasses all or part of seven counties. Oil and gas, mining, and retail services are all found in the city. Casper also is home to the Casper Events Center which hosts many public events such as concerts, trade shows, and sporting events. The population of Casper is in an upward trend with the recent resurgence in oil and gas development and uranium mining. According to the U.S. Census Bureau, the estimated population in Casper has increased 4.0% from April 2000 to July 2005. The population of Casper is expected to continue to follow an upward trend with an average growth rate comparable to the state growth rate of 2.58%.

Several small communities exist in Johnson County, Wyoming. The county seat, Buffalo, is the largest town in Johnson County. Buffalo is located approximately 57 mi to the northwest of the project area and houses the Bureau of Land Management office that oversees all federal land in Northeast Wyoming. The population of Johnson County is expected to grow at a rate of 1.5% to 1.7% from 2005 to 2012 according the Johnson County Comprehensive Land Use Plan of 2005. Much of the population growth is expected to come from the development of coalbed methane in Johnson County.

Two ranches are found within five miles of the Jane Dough Unit. The closest inhabited dwellings are the Dry Fork and Rolling Pin Ranches. Each ranch is located approximately 1.0 mile west and east, respectively of the Jane Dough Unit. Currently three people reside at the Dry Fork Ranch and five people reside at the Rolling Pin Ranch. Five other ranches are located between 5 and 11 miles from the Jane Dough Unit. The name of the ranches and the number of inhabitants are listed in Table ER3-1. All together, the two ranches result in a total of eight people residing within 5.0 mi of the Jane Dough Unit. This results in an occupational density of 0.06 persons per square mile for the area within 5.0 mi of the project area.

Because of the absence of public lands in the Jane Dough Unit, the public does not have unrestricted access to the Jane Dough Unit. In addition, visitation to the Jane Dough Unit would be limited to Uranerz employees, vendors, contractors, regulatory agency personnel, coalbed methane and oil and gas operators, and prearranged public tours.

Figures 4-1 through 4-3 of the NRC Technical Report provides detailed information regarding the county profiles of Campbell, Johnson, and Natrona counties. Included in this information are data about demographics, county employment statistics, and landowners in the county.

The Jane Dough Units economic contribution to the state of Wyoming the counties surrounding the project would be through such avenues as the 4% severance tax rate applied by the state on the mining of the uranium, sales tax revenue generated by the money spent by Uranerz and its employees for goods and services in the surrounding counties, and the wages paid to Uranerz employees. The monies collected by the state and counties would go to support the funding of items such as state public schools, county infrastructure projects, and special county projects.

Regarding environmental justice, the estimated population of Campbell, Johnson, and Natrona counties in 2010 by the U.S. Census Bureau was approximately 122,800. Minority populations accounted for a small percentage, ~4.6%, of the total population with percentages of minorities being similar to or smaller than those of the rest of the state of Wyoming. The 2014 unemployment levels for the three counties averaged ~2.8% and in 2009 the average yearly earning was ~$42,000 per year in Johnson County, ~$50,000 per year in Natrona County, and ~$74,000 per year in Campbell County. The average county earning for the areas surrounding the Jane Dough Unit are above the 2013 poverty level of $23,550 for a four family household. Figures 4-1 through 4-3 of the NRC Technical Report (see map pockets) detail employment, population, and earnings data for the Campbell, Johnson, and Natrona counties, Wyoming.

3.11 PUBLIC AND OCCUPATIONAL HEALTH

3.11.1 Background Radiation

Because background radiation varies significantly across the U.S., it follows that population exposure varies. Factors determining the level of radiation include elevation and the natural concentration of radionuclides in the soils and rocks. Table ER3-9 shows several examples of how radiation dose rates from natural sources vary from place to place. The higher cosmic value (twice the U.S. average) shown for Denver, Colorado is a reflection of elevation, and the higher-than-average terrestrial level listed for the Rocky Mountains can be attributed to the elevated (in comparison to other areas in the U.S.) radioactive isotopes in soil and rock.

Table ER3-9 Natural Background Radiation Dose Rates (mrem/year).[1]

	Cosmic	Terrestrial	Total
East Coast	----	16	----
Rocky Mountains	----	40	----
Colorado Plateau	----	----	90 (Total Background)
Gulf Coast	----	----	23 (Total Background)
Central U.S.	----	----	46 (Total Background)
Denver, Colorado	50	----	----
Sea Level	26	----	----
U.S. Average	27	28	55
U.S. Average	----	----	300 (Natural Sources)
U.S. Average	----	----	360 (All Sources)

[1] Sources:
U.S. Department of Energy. Draft Environmental Impact statement: Management of Commercially Generated Radioactive Waste. Vol. 1. Washington, D.C. (1979).
National Research Council. Committee on the Biological Effects of Ionizing Radiation (BIER V). Washington, D.C. (1990).
Idaho State University. Radiation and Risk. Physics Department. Pocatello, Idaho. (2007).

Convention divides radiation sources into two categories; natural and artificial. Natural background radiation comes from cosmic, terrestrial and internal sources, while artificial radiation consists of contributions from medical procedures, occupational exposure, nuclear medicine, consumer products and very small amounts from the nuclear fuel cycle.

By far, natural sources of radiation account for the largest percentage of the average annual exposure to the population. Table ER3-10 shoes natural background sources account for 82% of the total exposure, and within this source category, radon accounts for 55% of the total. Of the artificial sources, medical X-rays are the frontrunner at 11%. Within the other category, occupational exposure (radiation workers) is less than 0.3%, and lowest contributions come from the nuclear fuel cycle.

Table ER3-10 Radiological Exposure from Various Sources in the United States.[1]

Natural Background	Source Categories of Radiation Exposure
Radon	55%
Cosmic	8%
Terrestrial	8%
Internal	11%
Total Natural	**82%**
Artificial	
Medical X-rays	11%
Nuclear Medicine	4%
Consumer Products	3%
Other	
Occupational Exposure	<0.3%
Nuclear Fuel Cycle	<0.03%
Fallout from Nuclear Weapons Testing	<0.03%
Miscellaneous	<0.03%
Total Artificial	**18.0%**

[1] Sources:
National Research Council. Committee on the Biological Effects of Ionizing Radiation (BIER V). Washington, D.C. 1990.

To provide additional perspective on how the public is exposed to radiation from various sources and activities, Table ER3-10 has been prepared. A review of the table readily illustrates that the highest doses come from medical procedures. Smoking is a major source of radiation dose. At 280 mrem, a person would receive nearly 78% of the total 360 mrem annual average from all sources. With respect to energy, it can be seen from the table that natural gas in the home imparts 9 mrem – this is 2.5% of the annual average from all sources. Dosage from nuclear power generation is very low at <0.1 mrem. Doses from modern ISR operations are also in the very low ranges.

As part of developing an application for a radioactive material license, NRC requires an applicant to conduct a radiological assessment. A model known as MILDOS is used to generate estimates of dose to the public. The dose rates are then compared the protective regulatory levels to

demonstrate that no member of the public would be exposed to radiation levels in excess of the standards. To avoid redundancy, details of the model run would not be discussed here. However, to illustrate minimal impact that the project would have on public health Table ER3-11 has been prepared from data obtained from the MILDOS model run. Values in the table represent the Time-Step 4, which is the period of maximum activity from a combination of production and restoration at the Jane Dough Unit.

Table ER3-11 Radiation Dose Comparisons.[1]

	Dose Rate (mrem)
Medical:	
CT- Head Scan	1,100
Lower GI	405
Upper GI	245
Spine X-Ray	130
Hip	83
Dental X-Ray	10
Chest X-Ray	8
Medical (average all radiological uses)	53
Activities:	
Smoking	~280
Air Travel (coast-to-coast round trip)	5
Materials:	
Drinking water (average per year)	5
Concrete (average per year)	3
Energy:	
Natural gas in home (cooking/heating)	9
Coal Burning Plant	0.2
Nuclear Power	<0.1
Annual Average from an ISR Operation (Whole Body)	**<1***
U.S. Annual Average from all sources	**360**

[1] Sources: Health Physics Society. McLean, Va. (2007).
National Academy of Sciences. Biological Effects of Ionizing Radiation. (1972).
University of Missouri. Nuclear Engineering. (2007).
*Uranerz MILDOS Modeling Results. November (2007).

Table ER3-12 lists seven of the nearest ranches to the Jane Dough Unit and four license boundary receptors. The boundary receptors were located in four different directions; north, south, east, and west. The ranches are located at varying distances and directions from the facilities. It was noted above that the values in the table represent the worst case scenario-that is, the period in the operation's life that has the highest expected impacts. The MILDOS model also used meteorological data collected at the on-site Nichols Ranch meteorological station (refer to Section 3.6 of this report). During this period, the maximum dose is projected to be 0.40 mrem at the Pumpkin Butte Ranch Receptor. When compared to the public dose limit of 100 mrem, the minimum impact is clearly evident. This dose is over a two hundred fifty times lower than the federal standard. Values for the other public receptors are even lower.

Table ER3-12 Projected Dose Rates to Hypothetical Receptors at the License Boundaries and to Public Receptors (Time-Step 4, Maximum Activity Period).

Receptor	Dose (mrem/yr)*
Public Receptors	
T-Chair (Rolling Pin) Ranch	0.20
Dry Fork Ranch	0.10
Christensen Ranch	0.30
Pfister Ranch	0.30
Pumpkin Butte Ranch	0.40
Van Buggenum Ranch	0.10
Ruby Ranch	0.10
License Boundary Receptors	
Jane Dough Unit North-central	0.50
Jane Dough Unit East-central	0.60
Jane Dough Unit South-central	0.30
Jane Dough Unit West-central	0.40
Public Dose Limit	**100**

*Total Effective Dose Equivalent (whole body).

3.11.2 Major Sources and Levels of Background Chemicals

The remote location of the proposed operation is characterized by sparse population settlements, and the predominant land uses are agriculture and energy exploration. The region does not have any industrial activities that constitute a major source of chemical generation. As described in Section 2.10 of the NRC Technical Report, chemicals associated with an ISR process include CO_2, HCL, H_2O_2, and NaOH. Emission rates for these chemicals are well below the threshold that would trigger a permit. With respect to fugitive dust, the same can be said; the levels are too low to warrant a permit. In conclusion, because emissions are all below permitting action levels, the concentrations are protective of the public.

3.11.3 Occupational Health

The nuclear fuel cycle industry is one of the most, if not the most, regulated industries in the U.S., and it is no wonder that all of the measures and comparisons given above show doses to the public from this source category are indeed very small. The same highly protective regulations given in 10 CFR 20, Standards for Protection Against Radiation, apply to workers in the uranium recovery industry. Specifically, 10 CFR 20.1201, Occupational Dose Limits, are the protective occupational health standards. An operator, such as Uranerz, must show compliance with these standards. Compliance is demonstrated through a number of checks and balances, which include: (1) measurements with numerous instruments during operations; (2) bioassays; (3) unannounced inspections by the Radiation Safety Officer (RSO); (4) annual independent audits: (5) preparation of Standard Operating Procedures (SOPs); (6) NRC inspections; (7) record-keeping and other mechanisms that provide assurance that worker exposure to radioactive materials is kept As Low As Is Reasonably Achievable (ALARA).

3.11.4 Regional Public Health Studies

After making a reasonable literature search for public health studies that may have been completed or are being completed for the project region, there are no studies of record. The absence of regional health studies for this sparsely populated area is not unexpected for two reasons: (1) for

reasons of statistical significance, epidemiological studies must involve a significant population and (2) the region at issue does not have any major sources of contaminants that are known to cause health problems.

3.12 WASTE MANAGEMENT

Liquid wastes generated at the Jane Dough Unit would be disposed of through the deep disposal wells located at the CPP in the Nichols Ranch Unit. These wastes include the production bleed stream; wash down water, and groundwater restoration water from groundwater sweeping and groundwater treatment activities. The Uranerz deep disposal wells have been permitted and approved through WDEQ. Deep disposal wells are completed and operated in accordance with all applicable permit requirements.

No sanitary waste facilities would be provided in the Jane Dough Unit. Restrooms and a lunch room would be provided at the CPP located in the Nichols Ranch Unit. Sanitary wastes from these facilities would be disposed of in approved septic systems. The septic system at the Nichols Ranch ISR Project has been approved by the State of Wyoming.

Solid wastes would be generated at the Jane Dough Unit and these wastes would include both contaminated and noncontaminated wastes. Contaminated wastes include rags, trash, packing material, worn or replaced parts from equipment, piping, and sediments removed from process pumps and vessels. 11e2 by-product with contamination levels requiring disposal at a licensed NRC disposal facility would be isolated in drums or other suitable containers prior to disposal offsite. Until the wastes are disposed of, they will be held in an area with a restricted boundary. Noncontaminated wastes would be disposed of at a state-approved landfill located near Casper in Natrona County, Wyoming.

4.0 ENVIRONMENTAL IMPACTS

The following chapter analyzes and describes the potential impacts for those resources discussed in Chapter 3.0, Description of the Affected Environment. The potential impact of each alternative (the no action alternative and proposed project) are analyzed for each resource.

4.1 LAND USE

4.1.1 Proposed Action

As required by NRC regulations, the wellfield within the Jane Dough Unit would be fenced off during construction and operation to prevent unauthorized entry. Implementation of the Proposed Action would eventually affect the availability for livestock grazing on approximately 101 acres within the entire Jane Dough Unit. As each area is developed, Production Area #1 would be fenced out first followed by Production Area #2. Livestock grazing on approximately 101 acres on private lands would be prevented over the life of the operation. The surface disturbance and loss of foraging opportunity for livestock would occur over a 9-year period as the two proposed production areas are developed, reclaimed, produced, restored, and decommissioned. Areas not needed for operations would undergo reclamation and soil stabilization within the year of the disturbance or the first planting season following wellfield construction.

During the life of the project, the areas would be fenced to prevent livestock entry and to enhance reclamation success and safeguard equipment. WDEQ-LQD Type III fences would be installed; to prevent livestock entry but would not prevent wildlife entry. Grasses and forbs comprise the landowner and WDEQ-LQD approved seed mix, and over the long term locally dominant shrub species would invade the disturbed areas. Approximately 101 acres would be unavailable for a majority of the LOP. Assuming an average stocking rate of 2 acres per animal unit month (AUM), the Proposed Action would result in a life of project reduction of approximately 50 AUMs.

Long-term fenced out areas would be unavailable for livestock grazing for approximately (9 years life of project plus 5 years for reclamation) or until ISR activities are completed, wellfield and

facilities have been abandoned, and all remaining disturbed areas have been reclaimed and approved for livestock grazing by WDEQ-LQD. Once successful reclamation is deemed successful, project-related fencing would be removed, forage production would return as permanent vegetation is reestablished, and livestock grazing would be allowed if and when authorized by WDEQ-LQD in accordance with the approved reclamation standards.

As discussed in Section 3.1, there are limited recreational opportunities within the Jane Dough Unit as there no developed recreational sites or facilities exist within the Jane Dough Unit. In addition, land lands with the project area are private and access to the project area is controlled by private landowners and they will continue to maintain control over access to the Jane Dough Unit. Therefore, the Proposed Action would have limited impacts on recreational opportunities.

The primary impact on mineral resources from the Proposed Action would be the removal of uranium from that portion of the Wasatch Formation occurring within the Jane Dough Unit. As a result, uranium from the exploited zones would not be available in the future.

As discussed in Section 3.0, leasable oil and gas resources have been developed in the project area as documented by the existence of 46 CBNG wells and three conventional oil and gas currently operating within the Jane Dough Unit (refer to Exhibits JD-D6-2 and JD-D6-3 in Appendix JD-D6). CBNG is typically produced at a depth of approximately 1,000 feet below the surface, which is approximately 300-500 feet deeper than the uranium mineralization found in the Jane Dough Unit and typical depths of conventional oil and gas wells-bearing strata in this area generally ranges from 10,000 to 12,400 feet below the surface which is approximately 3,400 to 19,900 feet deeper than the uranium mineralization. Therefore, there could be no conflict in areas of target mineralization between the Proposed Action and the existing CBNG and conventional oil and gas wells.

It is possible that some subsurface conflicts between other developing energy resources could occur. In accordance with NRC policy environmental safeguards would be implemented. These safe guards are as follows: if there are oil, gas, CBNG, or other production layers near the uranium ISR production zone, and if NRC determines that there could be potential for cross contamination

between the ISR production zone and other production layers based on environmental impact assessments, the NRC may require Uranerz to expand the groundwater monitoring well ring for detection of potential contamination between the ISR production zone and other mineral production layers (NRC 2011). However, the NRC determined that cross contamination between production zone and CBNG or conventional oil and gas production was unlikely in the Nichols Ranch ISR project area (NRC 2011). Uranerz has also indicated that, if excursions are detected, the monitoring well would be placed on excursion status and reported to the NRC. Corrective actions would be taken and the well would be placed on a more frequent monitoring schedule until there is no longer an excursion.

Since CBM activity is already occurring in the Jane Dough Unit, engineering safeguards would be put in place to preclude cross contamination. For example, both the CBNG and ISR processes are designed to work on a negative pressure basis. In other words, each process pulls product from the production zone into recovery wells for the specific process and materials from each process are not comingled. Therefore, the processes and materials from CBNG and ISR are kept separated. The prospective zones of interest (uranium as opposed to CBNG) are vertically separated by at least 400 ft. In addition, the respective regulatory processes (NRC and WDEQ-LQD for ISR uranium and WOGCC for CBNG development) require well casing to be cemented from the surface to the total depth, with the exception of the production or injection interval. Uranerz would take care while drilling occurs to avoid interference with other production zones. Uranerz could, if necessary, enhance the ISR monitoring requirements should the potential for cross contamination be determined to exist (NRC 2011). Thus, this additional monitoring would allow Uranerz to detect and document possible cross contamination.

It is also possible oil and gas exploration of deeper formations is likely in the future as evidenced by existing conventional oil and gas development in the general area. Uranerz would continue to coordinate with other developers to ensure uranium ISR operations and deeper development to not compromise the integrity of the uranium production zones. The prospective formations are generally 4,000-13,500 ft deep and are separated by hundreds of feet of shales (aquitards); thus, there would be no conflict between the Proposed Action and deep oil and gas exploration. As with

CBNG development, deep hydrocarbon wells are cased and cemented in accordance with BLM and WOGCC regulations to preclude cross contamination between formations.

4.1.2 No Action Alternative

The no action alternative would result in no land use impacts. There would be no project related land disturbances, and no impacts to existing grazing, recreation and mineral development. Selection of the No Action Alternative would not preclude other energy resources from being developed in the future.

4.2 TRANSPORTATION

4.2.1 Proposed Action

4.2.1.1 Introduction

The NRC completed analyses of accidents at ISR uranium extraction facilities that consider the likelihood of occurrence and/or consequence (NRC 2001; NRC 1980). These analyses demonstrate that consequences are minor in the presence of effective emergency procedures and properly trained personnel. The facility design, site features, and operating assumptions of the Jane Dough Unit are consistent with those of the existing NRC license. Therefore, independent accident analyses will not be conducted for the Jane Dough Unit. However, assessments are provided of applicable accident types and scenarios to individual site specific conditions. The primary difference to traffic as a result of the Proposed Action would be the continuation of traffic and associated risk for an additional 9 years beyond that which is already been approved by the NRC and WDEQ-LQD. Assessments are provided of applicable accident types and scenarios to include site specific conditions. More specifically, discussion is provided with respect to CBNG recovery, which is unique to the region.

Existing written operating procedures prepared by Uranerz for the Nichols Ranch ISR Project will be maintained and utilized to describe requirements for responses to postulated accidents and

mitigation of consequences for the Jane Dough Unit. Uranerz has written appropriate operating procedures for accidents related to radon releases from process streams, uranium spills from process upsets (e.g. pregnant lixiviant, loaded resin, thickener, or dryer), leaks in buried lixiviant piping, and chemical releases as they might affect radiological accidents.

4.2.1.2 Transportation Incidents

Materials transportation to and from the Jane Dough Unit can be classified into four categories:

1) Shipment of refined yellowcake from the Nichols Ranch CPP to a uranium conversion facility.
2) Shipment of loaded resin from the Nichols Ranch CPP to the Smith Ranch Central Processing Plant.
3) Shipment of process chemicals from suppliers to the Nichols Ranch Units.
4) Shipments of 11(e)2 by-product material to a NRC licensed facility for disposal.

One other transportation classification is the transporting of employees to and from the plant site.

4.2.1.3 Shipment of Refined Yellowcake

Refined yellowcake produced at the Nichols Ranch CPP would not differ from the refined yellowcake produced at conventional mills. The NRC evaluated transportation accidents associated with yellowcake shipments from conventional mills and published the results in a generic environmental impact statement, NUREG-0706, NRC, 1980. As previously discussed, no refined yellowcake will be shipped from the Jane Dough Unit. The following information on transportation accidents is based on the analysis on the earlier NRC study.

Refined yellowcake produced at the Nichols Ranch CPP would be packaged in 55-gallon steel drums. Yellowcake would be shipped approximately 1,200 mi to a uranium conversion facility. This conversion facility is the first manufacturing step in converting the yellowcake into reactor fuel. An average truck shipment contains approximately 40 drums, or up to 19 tons of yellowcake.

Based on the initially projected annual production rate of 800,000 pounds of yellowcake per year, approximately 21 shipments of 40 drums each would be required annually for the Nichols Ranch ISR Project. By increasing the annual production rate to 2.0 million pounds per year per the vacuum dryer designed throughput, approximately 53 shipments would be required annually. The development of the Jane Dough Unit would only extend the operating life of the Nichols Ranch CPP rather than increase the annual production rate.

According to NUREG-0706, published accident statistics predict the probability of a truck accident under three different scenarios: 1) on interstate highways in rural areas, 2) on interstate highways in urban areas, and 3) on two-lane roads typical of those in the vicinity of the proposed project. The overall average probability of a truck accident for the Nichols Ranch ISR Project based on the NUREG-0706 data is 2.2×10^{-6}/mi. This takes into account that most of the shipping of yellowcake would be on interstates in both rural and urban areas.

The truck accident statistics also include three categories of events: collisions, noncollisions, and other events. Collisions are considered to be between the trucks and other vehicles or any other object, whether moving or stationary. Noncollisions are accidents involving only the truck that result in accidents such as the truck leaving the road and rolling over. Other events include personal injuries that are suffered from someone on the truck, someone falling from or being thrown against the truck, cases of stolen trucks, and fires occurring on a standing truck. The probability of a truck being involved in any of the accidents types during a one year period is approximately 10 percent.

A generalized accident-risk evaluation conducted by the NRC classified accidents into eight categories, depending on the combined stresses of impact, puncture, crush, and fire. Using this classification scheme as a basis, conditional accident probability was developed for eight severity levels. Two radioactive material release models were then developed to calculate the amount of yellowcake that could be released based up what severity of accident occurs. Model I is hypothetical assuming a complete loss of yellowcake drum contents when an accident occurs. Model II is based on actual tests assuming a partial loss of yellowcake drum contents. The quantity of the release for Model I and Model II in the event of an accident is 17,000 pounds and

1,200 pounds respectively, (NUREG 0706, NRC, 1980). Most of the yellowcake that is released from the container would be directly deposited on the ground in the immediate vicinity of the accident location. Some fraction of the released material would be dispersed to the atmosphere. The following expression was utilized by the NRC to estimate the amount of released material dispersed to the atmosphere:

$$F = 0.001/4.6x10^{-4} (1-e^{-0.15ut}) u^{1.78}$$

Where:

F = the fractional airborne release

u = the wind speed at 50 ft expressed in m/s

t = the duration of the release (hours)

In this expression, the first term represents the initial "puff" that is immediately airborne when the yellowcake drum fails in an accident. Assuming a wind speed of 10 mph (5 m/s) and a release time of 24 hours, the environmental release fraction would be $9x10^{-3}$. Since the conversion facility is located in the eastern United States, a population density of 160 people per square mile was used to calculate the 50 year dose commitments to the lungs of the general public. The calculated 50-year dose commitments are 2 man-Sv (200 man-rem) and 0.14 man-Sv (14 man-rem) for Model I and Model II. The integrated dose estimate would be lower for the more sparsely populated areas.

Any accident that results during the shipment of yellowcake product could result in some yellowcake being spilled. In the unlikely event that such an accident does occur, all yellowcake and contaminated soil would be removed, processed through a uranium mill, or disposed of in a licensed NRC disposal facility. All areas that are disturbed by the accident would then be reclaimed in accordance to all applicable NRC and State regulations.

The risk of an accident involving the transporting of yellowcake resulting in a yellowcake spill would be kept to a minimum by the use of exclusive use shipments. If an accident were to occur, impact to the environment would be further reduced by following instruction outlined in the Uranerz Incident Response Guide. This guide would be included with every shipment of

yellowcake that leaves the Nichols Ranch CPP. The carrier would also be required to maintain accident response capability to specifically include spill response.

With the shipment of yellowcake product to a conversion facility located approximately 1,200 mi away, all risks associated with the transportation of the product cannot be eliminated. However, the potential impacts to the environment in the event of an accident can be minimized by having proper procedures in place to ensure that any yellowcake that is spilled is contained as soon as possible and the area affected by the spill is secured and cleaned up to avoid contact with unauthorized personnel.

4.2.1.4 Shipments of Loaded Resin

In 2013, Uranerz and Cameco Resources entered into an agreement in which Uranerz could transport uranium-loaded resin beads to Cameco Resources' Smith Ranch-Highland CPP, if needed. Should Uranerz not need to ship loaded resin, any transportation risk would be reduced. Once delivered to either CPP, the uranium would be processed into yellowcake. Cameco Resources' Smith Ranch-Highland CPP is located approximately 50 miles south of the Jane Dough Unit. Access to the Smith Ranch CPP would begin at the Nichols Ranch CPP on existing T-Chair Ranch and Iberlin Ranch roads to State Highway 387. Uranerz has a road use agreement with the surface owner for use of the T-Chair and Iberlin Ranch roads. Once on State Highway 387, traffic would turn south on Ross Road (County Road 31) to Cameco Resource's Smith Ranch-Highland CPP. Uranerz has road use agreements with the specific surface owners for use of nonpublic roads, and no separate approvals are required for use of public roads.

The uranium that is loaded onto the resin beads at the Nichols Ranch CPP would remain attached to the resin until it is removed by a strong brine solution at the Smith Ranch CPP. When the loaded resin is transferred to a truck, it is moved using barren lixiviant. The barren lixiviant can have uranium concentrations of approximately 1-3 mg/L U_3O_8. The loaded resin is transferred to specially designed tanker trailers that would hold approximately 500 ft^3 of loaded resin. Most of the barren lixiviant is removed prior to shipping to minimize that amount of water weight in the tanker trailer. Because of the size of the trucks hauling the resin being consistent with a standard

tractor-trailer combination, the trucks hauling the loaded resin should withstand the impact of most collisions.

If an accident were to occur with a loaded resin truck, a rupture to the tanker trailer carrying the loaded resin could happen. The ruptured tank could result in a portion of the loaded resin to be spilled on the ground. The uranium that is attached to the loaded resin would remain attached to the resin, but any residual barren lixiviant contained in the tank could spill to the ground carrying the resin a short distance from the accident scene. The environmental impact that would result would be minimal. The uranium on the resin would stay attached to the resin as would the uranium contained in any barren lixiviant that might spill. No airborne release of uranium would result from the spill. The spilled resin and lixiviant would typically collect in the low areas surrounding the accident scene trapping the resin for cleanup. The loaded resin and contaminated soil from the barren lixiviant would be removed and processed at a uranium mill or disposed of in a NRC licensed facility. The disturbed areas would then be reclaimed in accordance with all applicable NRC and State regulations.

4.2.1.5 Shipment of Process Chemicals

Truck shipments of process chemicals to the Nichols Ranch ISR Project site could result in local environmental impacts if the trucks are involved in an accident. Any spills would be removed with the affected area cleaned up and reclaimed. The process chemicals used at an ISR facility in truck load quantities are common to many industries and present no abnormal risk. Table ER4-1 lists the process chemicals that may be utilized at the Nichols Ranch ISR CPP and the Jane Dough Unit. Since most of the material would be recovered or could be removed, no significant long-term environmental impacts would result from an accident involving the process chemicals.

Uranerz may use anhydrous ammonia in the precipitation circuit at the Nichols Ranch CPP. A significant environmental impact could result if a truck carrying the anhydrous ammonia was

Table ER4-1 Bulk Chemicals Required at the Nichols Ranch CPP and Jane Dough Unit.

Shipped As Dry Bulk Solids		Shipped as Liquids or Gases	
Salt	NaCl	Hydrochloric Acid	HCL
Sodium Bicarbonate	$NaHCO_3$	Hydrogen Peroxide	H_2O_2
Sodium Carbonate	Na_2CO_3	Carbon Dioxide	CO_2
Sodium Hydroxide	NaOH	Oxygen	O_2
		Diesel	
		Gasoline	
		Bottled Gases	
		Ammonia	NH_3

involved in an accident. The ammonia "cloud" that could develop from a release during an accident could pose an environmental hazard if it were to occur in a populated area.

The anhydrous ammonia would be trucked to the Nichols Ranch CPP in bulk shipments of approximately 7,500 gallons. The frequency of shipments would be approximately 10-12 trucks per year. The trucks would originate from Casper and travel to the project site. The distance to be covered is approximately 85 road miles. Using the accident rate of $4.8x10^{-7}$ accidents/mile from the Generic Environmental Impact Statement for Uranium Mills, (NUREG-0706, NRC, 1980), the chance of a traffic accident involving these trucks is very low.

4.2.1.6 Shipment of 11e(2) By-product Material for Disposal

All 11e(2) by-products generated at the Nichols Ranch CPP and Jane Dough Unit would be transported to an off-site NRC licensed disposal facility. The risk involved in shipping the material to a disposal facility is inherently lower that the risk involved in shipping yellowcake to a conversion facility since the distance between the disposal facility and the Nichols Ranch ISR Project site is considerably less than the distance between the conversion facility and the Nichols Ranch ISR Project site.

In the event that an accident would occur while transporting 11e(2) by-product material, the impact to the environment would be minimal. Any waste that is spilled on the ground and any contaminated soil would be removed and sent to the disposal facility. Because the 11e(2) by-products could contain some uranium, an airborne release could occur, but would not be any greater than the amount of released determined in Section 4.2.1.3 using the Model I criteria.

The risk of an accident involving the transporting of 11e(2) byproduct material and resulting in a spill would be kept to a minimum by the use of proper packaging and exclusive use shipments. If an accident were to occur, impact to the environment would be further reduced by following instruction outlined in the Uranerz Incident Response Guide. This guide would be included with every shipment of 11e(2) byproduct material that leaves the Nichols Ranch CPP. The carrier would also be required to maintain accident response capability to specifically include spill response.

4.2.1.7 Transporting Employees To and From Project Site

Employees working at the Jane Dough will first be transported to the Nichols Ranch CPP and then they would travel to the Jane Dough Unit. The Jane Dough Unit is in a remote location in Wyoming. Employees that work at the Jane Dough Unit would more than likely have to commute to the project site from areas such as Gillette, Wright, or Casper, Wyoming. The distances involved could be from 22 miles away to as far as 61 miles away from the project site. Transportation to and from the project site would either be from personal vehicles or company provided transportation.

Potential risks to employees coming to and from the Jane Dough Unit (via the Nichols Ranch CPP) site include fatigue, animals, and adverse weather conditions. Fatigue and animal risks can be minimized by taking precautions such as resting and defensive driving, but adverse weather conditions can be more involved. If weather conditions exist such that roads leading into and out of the Jane Dough Unit are impassible or closed, then measures would be taken so that employees, contractors, vendors, and visitors would have a place to take shelter and be provided meals and a place to stay until the roads are passable.

The likelihood of an accident occurring while going to and from the Jane Dough Unit is estimated at $2.2x10^{-6}$/mi based on NUREG 0780 (NRC 1980). All travel would be on either two lane rural highways with some rural interstate travel depending if employees come from Casper. Work schedules would be developed with the goal of trying to minimize the amount of time that employees are traveling to and from the project site to help in reducing the risks of commuting to the project site.

4.2.2 No Action Alternative

Under the No Action Alternative, the Proposed Action would not be implemented and transportation impacts would continue at their current level. Traffic in the area would continue to be limited to the landowners, oil/gas and CBNG operators, and personnel associated with the existing Uranerz Nichols Ranch ISR project.

4.3 GEOLOGY AND SOIL RESOURCES

4.3.1 Proposed Action

ISR mining activities would not result in the removal of any rock matrix or structure. No subsidence would result at the site from the collapse of overlying rock strata in the mining zone which would happen in underground mining operations. No other geologic impacts are anticipated to occur with the ISR mining method.

Impacts to the soils of the area would be limited to approximately 101 acres during the life of the project. Soils would be disturbed in the area of the wellfields and any access roads that would be constructed. These disturbances would be temporary as any disturbance affected by the project would be restored and reclaimed after the project has reached the end of its life.

Soils that are impacted during the life of the project would be handled accordingly. All topsoil removed from construction activities would be preserved by adopting construction practices the

prevent erosion and loss of topsoil. Chapter 5.0 in the NRC Technical Report presents detailed methods that would be utilized when handling topsoil.

Additional impacts on soils could result from spills from processing equipment, leaks from pipeline breaks and ruptures, or transportation accidents resulting in yellowcake or ion exchange resin spills. If soil were contaminated by a spill, the soil would be removed and disposed of at a licensed NRC disposal facility. All decontamination procedures would be confirmed with radiation surveys, and would be required to meet NRC's regulations addressing radioactive materials in soils in areas released for unrestricted use.

4.3.2 No Action Alternative

Under the No Action Alternative, the mining activities described in the Proposed Action would not be undertaken on any lands within the Jane Dough Unit. No additional ground would be disturbed and no additional impacts to soils would take place beyond those that already exist.

4.4 WATER RESOURCE (INCLUDING WETLANDS)

4.4.1 Proposed Project

4.4.1.1 Surface Water Impacts

Surface water impacts that result from the Jane Dough Unit would be minimal and temporary. Implementation of appropriate mitigation measures (presented in Chapter 5.0) would reduce the intensity and duration of any impacts.

Key surface water features in the Jane Dough Unit is limited to one identified jurisdictional wetlands. The wetland is in such a location that it would not be disturbed by the mining activities. In the event that any disturbance would occur in a jurisdictional wetland, consultation with the Corp of Engineers would be initiated to establish mitigation and control plans. Appendix JD-D10 if the NRC Technical Report provides more information regarding wetlands.

The potential for erosion and potential movement of sediments into drainages may occur during construction and reclamation activities associated with processing facilities and wellfield. To minimize impacts to surface water resources from sedimentation and erosion, Uranerz will implement appropriate best management practices according to the WDEQ Mine Permit and Storm Water Pollution Prevention Plan. Re-seeding with landowner- and WDEQ-LQD-approved seed mixture would also occur upon completion of construction and decommissioning operations. Seeding of an area would take place during the appropriate growing seasons, either spring or fall, whichever comes first.

Surface water runoff should not be affected by the presence of any surface facilities including the wellfields and associated structures, access roads, and pipelines. In the event that surface runoff flows are impeded by any facilities, culverts and diversion ditches would be implemented to control the runoff and prevent excessive erosion. If the surface runoff is concentrated in an area, best management practices such as energy dissipaters would be used to slow the flow of the runoff so that erosion and sediment transport are minimized.

One wetland area exists on the Jane Dough Unit; however, this area would be avoided and not disturbed by ISR activities. Approximately 2.47 miles of Waters of the US occur within the Jane Dough Unit. The potential impact to Waters of the U.S. would be mitigated through the implementation of BMP for the Uranerz WYPDES storm water permit that would obtain from the WDEQ-WQD before operations commence. In addition, if required Uranerz would secure coverage under an individual permit or Nationwide Permit 12 or 44 from USACE and comply with all applicable requirements of the permit. Therefore, impacts to wetland resources would be minimal.

4.4.1.2 Ephemeral Drainages Impacts

There are only ephemeral channels with the Jane Dough Unit and impacts to ephemeral drainages may occur with some of the production activities such as wellfield operations or the construction of access roads. To avoid impacts to the drainages, existing roads within the project area would be utilized as much as possible. If an ephemeral drainage may be impacted by the roads or

wellfield operations, appropriate measures would be taken to minimize the impact to the ephemeral drainage including the implementation of appropriate best management practices. Uranerz will not block off any ephemeral drainages and will maintain surface water flow through all ephemeral drainages.

Access road construction would be minimized where possible by using existing roads within the project area. When new roads are needed, design and construction practices would incorporate such parameters as drainages, elevations contours, location with regard to weather conditions, and land rights to ensure the least amount of impact. If a new road has to cross an ephemeral drainage, efforts would be made to cross the drainage at right angles to minimize erosion with the appropriate sized culverts installed. In the event that a drainage has to be crossed, but cannot be crossed at a right angle or along elevation contours, appropriate measures for erosion control would be examined and implemented.

Wellfield construction activities would result in some short term or temporary impacts on erosion. The ongoing drilling, well development, pipeline construction, header house construction, lateral pipeline placement, and access road construction activities would incorporate best management practices based on the conditions where construction activities are taking place. Protection measures that may be used are: grading and contouring, placement of hay bales, culvert installation, sedimentation breaks, or placement of water contour bars.

In areas where steep grades are encountered during construction activities, seeding of the disturbed areas would take place along with the erosion protection measures mentioned above. Temporary and permanent seeding operations would take place at the first seasonal appropriate opportunity after the construction activity has been completed.

Wells that are constructed in any ephemeral drainage will use the appropriate erosion protection controls to minimize the impact to the drainage. Protection controls that could be used, but not limited to, are: grading and contouring, placement of hay bales, culvert installation, placement of water contour bars, and designated traffic routes. The drainage bottoms would be restricted to the work activities that are needed to construct and maintain the wells. If the wells are placed in a

location in the drainage where runoff has the potential to impact the well, measures would be taken to protect the well and wellhead. Barriers surrounding the well such as cement blocks, protective steel casing around the wellheads, or other measures to protect the wells from damage would be utilized.

4.4.1.3 Groundwater Impacts

During the uranium recovery process, the groundwater in the immediate project area would be impacted by the elevated concentration of certain constituents that are present in the groundwater in the ore zone. These impacts would be temporary as the groundwater would be eventually returned to pre-mining condition or class of use as defined by the WDEQ when the mining and groundwater restoration phase of the project is completed.

As discussed in Appendix JD-D6, groundwater would be removed from the ore zone aquifers during the life of the Jane Dough Unit from the wellfield bleed. The water that is removed from the ore zone aquifers would result in a net loss of water from the ore zone aquifer, but the water that is lost would be replaced over time by the recharging of the aquifer. Water that is removed from ore zone aquifers would be sent to a deep disposal well.

Jane Dough production will occur after the Nichols Ranch Unit production is over. Therefore production and restoration water balance usage will not increase with Jane Dough Unit but will only extend the same usage for a longer period of time. Uranerz will use a 1% bleed rate for the Jane Dough Unit.

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As discussed in Appendix JD-D6, groundwater would be removed from the ore zone aquifers during the life of the Jane Dough Unit from the wellfield bleed. The water that is removed from the ore zone aquifers would result in a net loss of water from the ore zone aquifer, but the water that is lost would be replaced over time by the recharging of the aquifer. Water that is removed from ore zone aquifers would be sent to a deep disposal well.

Jane Dough production will occur after the Nichols Ranch Unit production is over. Therefore production and restoration water balance usage will not increase with Jane Dough Unit but will only extend the same usage for a longer period of time. Uranerz will use a 1% bleed rate for the Jane Dough Unit.

The bleed rate from the ISR operation at Jane Dough Unit would cause a steady stress on the A Sand aquifer. For production of 3,500 gpm and a 1% bleed rate, the bleed rate would average 35 gpm. This stress for a four and one quarter year operation at Jane Dough Unit was simulated in a numerical model with the same aquifer properties used in the Nichols Ranch Unit simulations. This model also simulated the previous three years of the Nichols Ranch Unit operation to account for the cumulative stresses on the A Sand aquifer. NRC Addendum 3D presents the results of these drawdowns. These drawdowns were calculated from stresses from the two different wellfields at Jane Dough. Recovery wells were simulated at an equal rate where their total equaled the 3,500 gpm production rate while the injection rates were varied to balance the wellfield with an average bleed rate of 1%. These predictions show that 20 feet of the drawdown at the end of the Jane Dough mining would be nearly two miles outward from the wellfields. The 5.0 foot contour is projected to extend out approximately 6.0 miles to the north and two miles to the south from the Jane Dough Unit ISR Project area.

The flowing wells that are inside the 10 foot contours and produce the majority of its water from the A Sand are likely to cease flowing. Most of the flowing wells in the area only have a few PSI pressure when they are shut in. Brown 20-9 and Pats #1 flowing wells are completed in the A Sand and would very likely cease flowing during the ISR operation. In a 3.0-mile radius of the Jane Dough Unit, there are approximately 10 free flowing wells. Most of these flowing wells are not thought to be completed in the A Sand. If any of these wells are completed in the A Sand they

may be impacted by the drawdown associated with the Jane Dough Unit. Exhibit JD-D6-1 shows the approximate location of the wells in relation to the Jane Dough Unit. As stated in the Technical Report, Uranerz has confidential surface use agreements in place with the landowners detailing mitigation measures that Uranerz would implement if a free flowing well is impacted by the Nichols Ranch ISR Project.

4.4.2 No Action Alternative

Under the No Action Alternative, the Proposed Action would not be implemented. No additional ground would be disturbed, ISR operation would not be undertaken, and no additional impacts to surface water or groundwater resources would take place beyond those that already exist.

4.5 ECOLOGICAL RESOURCES

4.5.1 Proposed Action

4.5.1.1 Threatened, Endangered, Proposed, and Candidate Species

As discussed in Chapter 3.0, Section 3.5.2.2 and 3.5.3.2 of this document, only one threatened, endangered, proposed, or candidate plant or animal species, the greater sage-grouse (*Centrocercus urophasianus*), a candidate species, was documented as occurring in the Jane Dough Unit (refer to Appendix JD-D9).

As discussed in Appendix JD-D9, the Proposed Action is not located in a core population area (CPA) and would therefore not impact any greater sage-grouse CPAs. The closest CPA is located approximately 9.4 miles northwest of the Jane Dough Unit. In addition, the WGFD has not identified any winter concentration or connectivity areas within or near the Jane Dough Unit. Development activities are restricted in CPA, winter concentration areas, and connectivity areas; however, none of these restrictions applies to the Jane Dough Unit.

However, one occupied greater sage-grouse lek (38-Cottonwood Creek 1) occurs within the Jane Dough Unit (0.25 miles inside the southeast boundary of the Jane Dough Unit), and three

additional occupied greater sage-grouse leks occur within 2.0 miles of the Jane Dough Unit: lek 38-Cottonwood Creek 1 Satellite, lek 38-Cottonwood Creek 2, and lek 38-Cottonwood Creek 3 (refer to Figure JD-D9-3 in Appendix JD-D9 of the Technical Report). All of these leks have been monitored annually since 2005 using the WGFD-approved survey methodology. Lek 38-Cottonwood Creek 1 was active from 2005-2009; lek 38-Cottonwood Creek 1 Satellite was active in 2006 and 2007; lek 38-Cottonwood Creek 2 was active in 2005-2010; and lek 38-Cottonwood Creek 3 was active in 2005-2007 and had one male and one female in 2010 (refer to Table JD-D9-2 in Appendix JD-D9). Very little activity has been noted at any of these leks after 2010; however, one female was recorded at 38-Cottonwood Creek 3 in 2012 (refer to Table JD-D9-2 in Appendix JD-D9). Based on this data, the WGFD classifies all four of these leks as occupied. An occupied lek is defined as any lek that has been active during at least one strutting season within the past 10 years.

Based on the location of the proposed wellfields and know leks, the Proposed Action would have no physical impacts to greater sage-grouse leks. The closest portion of the Jane Dough Unit wellfield is approximately 0.75 mi away from Cottonwood Creek 1 lek (Figure JD-D9-3 of Appendix JD-D9 of the NRC Technical Report). In addition, the Wyoming Governor's Executive Order 2011-5, identifies areas outside of CPA and within 0.25 mile of any occupied leks as no surface occupancy areas; meaning that no development can be permitted through any state agency to occur in these areas. Uranerz would not conduct any activities within the 0.25 mile no surface occupancy area around Cottonwood Creek 1 lek.

It is also possible that noise from construction activities could impact nesting and brood rearing activities of greater sage-grouse and they might avoid using nesting and brood rearing habitat near any occupied lek (Knick and Connelly 2011).

Based on the location of the proposed wellfields and this lek, the Jane Dough Unit will have no direct physical impacts on any greater sage-grouse leks. The closest portion of the Jane Dough Unit wellfield is approximately 0.75 mile away from Cottonwood Creek 1 lek. In addition, the Wyoming Governor's Executive Order 2011-5, identifies areas outside of CPA but within 0.25 mile of any occupied leks as no surface occupancy areas; meaning that no development can

be permitted through any state agency to occur in these areas. Therefore, Uranerz will not conduct any ground-disturbing activities within the 0.25 mile no surface occupancy area around any occupied lek.

It is also possible that construction activities could impact nesting and brood rearing activities of greater sage-grouse and they might avoid using nesting and brood rearing habitat near any occupied lek. Therefore, to address the potential disturbance near occupied greater sage-grouse leks, Executive Order 2011-5 indicates that "a two (2) mile seasonal buffer should be applied to occupied leks." To comply with this portion of the Executive Order, Uranerz will:

1. monitor attendance at this lek annually during the lekking season (April 1 through May 7);
2. not conduct any surface-disturbing activities (e.g., topsoil removal) within 2 miles of any occupied lek from March 15 through June 30; and
3. if an area is physically disturbed (i.e., stripped of topsoil) prior to March 15, Uranerz will be able to continue all non-surface disturbing activities (e.g., construction, drilling, well completion, pipeline installation, etc.) within 2 miles of any occupied lek between March 15 and June 30. During the seasonal buffer period, Uranerz will limit non-surface disturbing activities to daylight hours and will minimize noise to the extent possible.
4. Once uranium extraction facilities have been installed, Uranerz will be able to conduct year-round routine and emergency maintenance and service on all facilities within the Jane Dough Unit.

To reduce raptor predation on greater sage-grouse, the construction of overhead power lines, permanent high-profiled structures such as storage tanks, and other perch sites would not be constructed within 0.25 mi of any active lek. In addition, some greater sage-grouse could be lost due to vehicle collisions. Therefore, Uranerz will advise project personnel of appropriate speed limits for specific access roads, that they are not allowed to haze or harass the animals, and that they should minimize any direct disturbance to all wildlife whenever possible.

Some greater sage-grouse could be lost due to vehicle collisions. Therefore, Uranerz would advise project personnel of appropriate speed limits for specific access roads, that they are not allowed to

haze or harass the animals, and that they should minimize any direct disturbance to all wildlife whenever possible.

4.5.1.2 Wildlife

4.5.1.2.1 Big Game

The entire project area lies within winter/yearlong pronghorn antelope and mule deer range of the Pumpkin Buttes Herd Units (WGFD 2011a and WGFD 2011b). Direct impacts to big game as a result of project activities will include the disturbance of a portion of winter/yearlong range, loss of forage, increased potential for poaching, vehicular collision accidents, and the displacement of big game into surrounding areas. An estimated 101 acres will be incrementally disturbed during the life of the operation at the Jane Dough Unit. As a result of these habitat disturbances, the winter/yearlong range carrying capacity for big game will be reduced during the life of the Jane Dough Unit and for approximately 1-3 years following mining until vegetative growth on the revegetated areas becomes productive enough to support big game. Only approximately 50-60 acres will be disturbed for approximately 2 years and these areas will be withdrawn from use as wildlife habitat at any given time. Therefore, the Jane Dough Unit is not expected to have any adverse impacts on pronghorn antelope or mule deer. Uranerz will also perform interim reclamation operations that will minimize displacement of big game species.

No significant increase in the potential for vehicle collision with big game is expected because of the short distances and low speeds allowed on the project access roads. Levels of vehicular traffic associated with mine development and use of the roads are not expected to increase above current levels.

The number of employees and the nature and intensity of mining activities will be comparable to those already taking place near this site, and no increase in the potential for poaching and general harassment of big game is anticipated.

The number of employees and the nature and intensity of mining activities would be comparable to those already taking place on this site, and no increase in the potential for poaching and general harassment of big game is anticipated. Mitigation plans such as speed limits and fencing would aid in the reduction of big game conflicts associated with the Jane Dough Unit.

4.5.1.2.2 Upland Game Birds, Shorebirds, and Waterfowl

The only upland game bird in the Jane Dough Unit is the greater sage-grouse and it is discussed above. Limited habitat for shorebirds and waterfowl occur in the project area due to the fact that aquatic habitats on the project area are generally seasonal in nature and higher-quality waterfowl habitat is located outside the project area. Therefore, the Jane Dough Unit is not expected to have any adverse impacts on waterfowl or shorebirds.

4.5.1.2.3 Mammalian Predators, Lagomorphs, and Small Mammals

The use of the project area by mammalian predators would be temporarily reduced due to mining activities at the Jane Dough Unit. In addition, occasional outbreaks of Tularemia may have an effect on the prey base (i.e., rabbits) for mammalian predators, which may have already resulted in a shift of predators to other areas to seek prey. Therefore, the Jane Dough Unit is not expected to have any adverse long-term impacts on mammalian predators.

Rabbits were abundant within the project area and wildlife study area. Direct impacts to lagomorphs as a result of the project may include vehicular collision accidents, loss of habitat, increased motorized access by the public leading to legal and illegal harvest; and the displacement of lagomorphs into surrounding areas due to human activity and project-related noise. It also appears that natural and cyclical outbreaks of Tularemia can result in noticeable decrease in the number of rabbits in the area. Since lagomorphs are relatively abundant in the project area, and the fact that they show an affinity to disturbed areas with existing facilities such as culverts and well pads, the Jane Dough Unit is expected to have a negligible short-term adverse impacts on lagomorph populations and no adverse long-term impacts are likely to occur.

Because suitable habitat exists throughout the project area, some small mammals may be displaced mining-related activities over the life of the operation. Whenever possible, Uranerz would take steps to minimize disturbance to known small mammal habitat such as black-tailed prairie dog towns; however, some disturbance will be unavoidable. Because of the limited amount of disturbance (101 acres over the life of the operation), the Jane Dough Unit would have negligible short-term and long-term impacts on small mammal populations in the immediate project area.

4.5.1.2.4 Raptors and Nongame/Migratory Birds

In 2013, 79 raptor nests were located within the Jane Dough wildlife study area, of which two golden eagle nests were determined to be active. Based on the project area boundary, these trees with nests would be removed during project activities. The principal impact to these nests from project activities and associated increased human access is potential disturbance during nesting, which could result in nest abandonment and decreased reproductive success. Potential conflicts between active nest sites and project-related activities would be mitigated by annual raptor monitoring and mitigation plans as presented in the Mine Plan.

The temporary disturbance of approximately 101 acres of raptor prey species' habitat is unlikely to result in a reduction in the raptor population in the area because only 50-60 acres would be disturbed during construction for approximately 2 years. This reduction is expected to be short-term and negligible. Therefore, the Jane Dough Unit is not expected to have any adverse long-term impacts on raptor populations.

The short-term disturbance of approximately 101 acres of habitat would likely result in some temporary reduction in the carrying capacity for nongame/migratory birds within the project area. Birds may be displaced by the mining activities and the temporary disturbance of wildlife habitat; however, the amount of habitat lost would be minimal in relation to the amount of comparable habitats that are available in the general area. Therefore, the Jane Dough Unit is not expected to have any adverse long-term impact on any passerine bird populations.

4.5.1.2.5 Reptiles and Amphibians

No reptiles or amphibians were documented in the Jane Dough Unit; however, it is possible that some individuals could be found in the project area. The mining activities and temporary disturbance may result in some reduction in the population levels of reptile and amphibian species in the area; however, these impacts are expected to be short-term and negligible. Therefore, the Jane Dough Unit is not expected to have any adverse long-term impacts on any reptiles or amphibian populations.

4.5.1.3 Vegetation Impacts

Approximately 101 acres or less of land would be disturbed by the proposed Jane Dough Unit. The impacts to vegetation will be short term as most disturbances are associated with the development of the wellfields, access roads, and pipelines that would be immediately reclaimed and reseeded. Additionally, the small amount of vegetation that may be affected by the proposed project would occur over the life of the project with only 50-60 acres of land over approximately a 2 year period of construction. With a large amount of land available outside of the disturbed areas, the effect to the vegetation is minimal.

One impact that could result to the vegetation is the introduction of non-native species or weeds associated with the activity of the Jane Dough Unit. One noxious weed species, Canada thistle, is found in the proposed project area. Mitigation measures such as keeping vehicles that come into the Nichols Ranch Project washed and possible spraying of weeds may be used to aid in reducing the spread of these species.

4.5.2 No Action Alternative

Under the No Action Alternative, the Proposed Action would not be implemented. No additional surface would be disturbed and no additional impacts to wildlife resources including threatened, endangered, proposed, or candidate species would take place beyond those that already exist. Land

would continue to be used for pastureland and mineral extraction activities. CBNG and conventional oil and gas operations in the Jane Dough Unit would continue.

4.6 AIR QUALITY RESOURCES

4.6.1 Proposed Action

The air quality impacts of the proposed project in the local and regional areas are minimal. The main impact to the air quality would be from fugitive dust that is generated from the construction of facilities, construction, and operation of the wellfields and the increase in traffic from the operation of the proposed project. Fugitive dust releases are estimated to be the same during the construction of the Jane Dough Unit as they are during the operation of the proposed project since the amount of vehicle traffic is expected to be the same. Detailed calculations of the amount of estimated fugitive dust that would be released by the project are presented in Appendix JD-D4 of the NRC Technical Report). The estimated release of fugitive dust from the proposed project is under the allowable 250 tons per year increment for prevention of significant deterioration of air quality.

The potential for fugitive dust emissions from wind erosion would be minimized by promptly reclaiming disturbed soil and establishing vegetative cover on soil stockpiles. Most of the work associated with wellfield installation would take place with stationary equipment hence any additional fugitive dust releases resulting from vehicular traffic in the wellfield would be small because of low traffic volume.

Air quality in the wellfields could be affected by radon gas. It is possible that radon gas could be released as result of operations in the wildlife. This gas can be present in the processing solutions and could escape into the atmosphere in several locations. In order to escape, the dissolved radon gas would first have to be vented in the wellfield from either individual well vents or from the header house.

The radiological effects of radon or any radiological emission upon the local and surrounding area was completed using the NRC MILDOS model for predicting radiological doses. The results of

the MILDOS modeling are described in Chapter 7.0, Section 7.3 of the NRC Technical Report. The estimated releases from the Jane Dough Unit are small fractions of the allowable does limit for the general public.

4.6.2 No Action Alternative

Under the No Action Alternative, the Proposed Action would not be implemented. No additional surface would be disturbed and no additional air quality impacts would take place beyond those that already exist.

4.7 NOISE

4.7.1 Proposed Action

Noise related to development of the Jane Dough Unit would primarily be associated with drilling and operation of the wells, including the use of heavy equipment necessary to scrape and level the ground surface for drilling, travel, etc. The NRC and WDEQ (2008) estimated that noise impacts from construction, operations, and aquifer restoration generally would be "small to moderate," and that noise impacts from decommissioning generally would be "small."

Figure ER4-4 presents the noise levels generated by various kinds of heavy equipment, including that used at the proposed project. These noise levels generally range from 70 to 95 dBA at 50 ft. Noise levels decrease at approximately 6 dBA with each doubling of distance, so a dBA of 95 at 50 ft would be reduced to approximately 55 dBA at 1.0 mi--the distance from the Jane Dough Unit boundary to the nearest residence (i.e., T-Chair Ranch). Referring to Table ER3-1, this would be an increase in noise levels from "very quiet" to "normal conversation." In the same way, a dBA of 75 at 50 ft would be reduced to approximately 40 dBA at 1.0 mi--a level very similar to the ambient noise level in the area. Noise levels would not be constant, but would occur only when equipment was operating. Noise levels would be highest during construction, after which they would decrease for the operating phase when noise would be generated primarily by trucks and the processing facility itself. Traffic would be approximately eight pickup trucks per day and six tractor-trailer trucks per week during all phases of the project-a small to moderate increase in traffic.

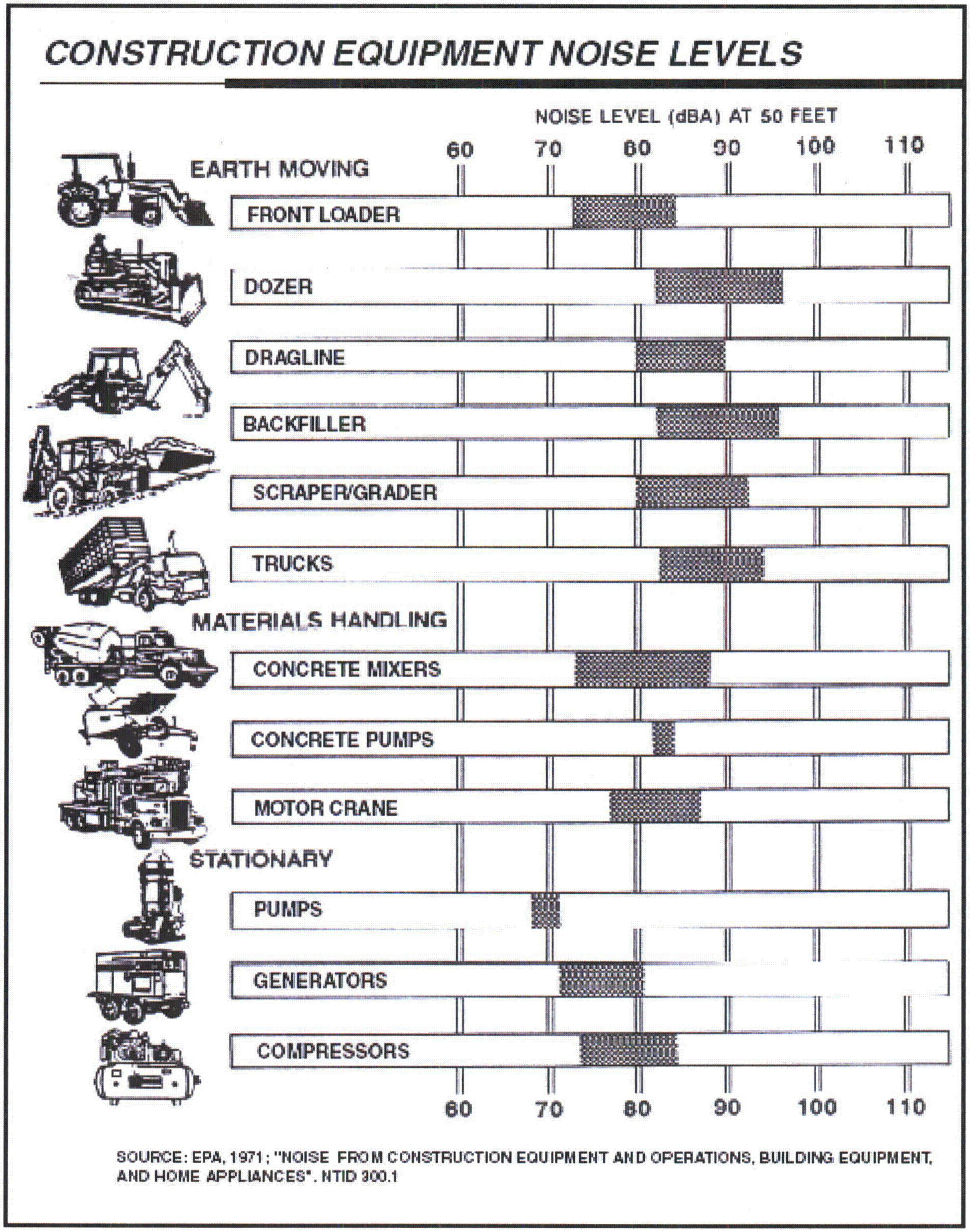

Figure ER3-6 Construction Equipment Noise Levels.

4.7.2 No Action Alternative

Under the No Action Alternative, the Jane Dough Unit would not be developed and noise levels would remain at the level that currently exists.

4.8 HISTORIC, CULTURAL, AND PALEONTOLOGICAL RESOURCE IMPACTS

4.8.1 Proposed Action

4.8.1.1 Historic and Cultural Resources

The results of the current and previously conducted Class III inventories indicate that 14 sites and two IRs are located within the project area for Uranerz's Jane Dough Unit (Table ER4-2). The 14 sites consist of six sites that are eligible for listing on the NRHP and 12 that are ineligible. There will be no effect to the 12 ineligible sites and the two IRs because of their NRHP eligibility, and no further work is recommended for those cultural resources. A discussion of the project effects and management recommendations for the two NRHP-eligible sites is provided below.

Two segments of the NRHP-eligible Bozeman Trail (Site 48JO134-Segments 65 and 66) and four segments of the NRHP-eligible Deadwood Road (Site 48CA1568-Segment 31 and Site 48JO2292-Segments 14, 15, and 16) were revisited or recorded within the project area in 2010. One of the two Bozeman Trail segments (Site 48JO134-Segment 65) and three of the four segments of the Deadwood Road (Site 48CA1568-Segment 31 and Site 48JO2292-Segments 14 and 15) are recommended as noncontributing segments. There would be no adverse effect to these segments because of their NRHP eligibility, and no further work is recommended.

The remaining segments of the Deadwood Road (48JO2292-Segment 16) and the Bozeman Trail (48JO134-Segment 66) are both recommended as contributing to their sites' overall eligibilities. While the two segments are both located outside the proposed wellfield, they could be potentially disturbed by other project-related activities. However, the project would have no adverse physical

Table ER4-2 Summary of Project Effects and Management Recommendations for Sites Within the Jane Dough Unit.

Site No.	Site Type	Current NRHP Eligibility Recommendation	Project Effects and Management Recommendations
Eligible Sites			
48JO134-Segment 65	Bozeman Trail-Segment 65	Eligible-Noncontributing	No adverse effect
48JO134-Segment 66	Bozeman Trail-Segment 66	Eligible-Contributing	No adverse effect with physical avoidance; no adverse visual effects
48JO2292-Segment 14[1]	Deadwood Road-Segment 14	Eligible-Noncontributing	No adverse effect
48JO2292-Segment 15[1]	Deadwood Road-Segment 15	Eligible-Noncontributing	No adverse effect
48JO2292-Segment 16[1]	Deadwood Road-Segment 16	Eligible-Contributing	No adverse effect with physical avoidance; no adverse visual effects
48CA1568-Segment 31[1]	Deadwood Road-Segment 31	Eligible-Noncontributing	No adverse effect
Not Eligible Sites			
48CA5393	Lithic scatter	Not eligible	No effect
48CA5394	Trash scatter	Not eligible	No effect
48CA5395	Lithic scatter	Not eligible	No effect
48CA5396	Lithic scatter	Not eligible	No effect
48CA5397	Lithic scatter	Not eligible	No effect
48CA5398	Oil/gas well field	Not eligible	No effect
48CA5399	Lithic scatter	Not eligible	No effect
48CA5400	Lithic scatter	Not eligible	No effect
48CA5401	Lithic scatter	Not eligible	No effect
48CA5412	Lithic scatter	Not eligible	No effect
48CA6583	Trash scatter	Not eligible	No effect
48JO3452	Lithic scatter	Not eligible	No effect
Isolated Resources			
IR-1	Lithic scatter	Not eligible	No effect
IR-2	Biface	Not eligible	No effect

[1] Site 48CA1568 and 48JO2292 (Deadwood Road) are treated as one historic site.

effect on either segment because Uranerz will avoid direct ground-disturbing activities to the segments. Furthermore, there would be no adverse visual effects to either segment because the integrity of the setting has been significantly compromised and no longer contributes to either segment's overall eligibility status.

In addition, Uranerz activities would not significantly impact the viewshed of any NRHP-eligible sites (e.g., Bozeman Trail and Deadwood Road segments) located outside the Jane Dough Unit project area because the proposed disturbances are consistent with the existing widespread visual disturbances associated with ongoing CBNG and conventional oil and gas development and ISR development on the surrounding landscape.

Uranerz would not conduct any ground-disturbing work within the boundaries of Sites 48JO134-Segment 66 or 48JO2292-Segment 16. In addition, Uranerz would not conduct any ground-disturbing work in areas that have not been previously inventoried and cleared for cultural resources.

Uranerz would instruct all employees, contractors, subcontractors, and any additional parties involved in the project not to search for, retrieve, deface, or impact archaeological materials (e.g., arrowhead hunting), and that it is a violation of the federal *Archaeological Resources Protection Act* (16 U.S.C. 470aa-mm) to do so on federal land.

If previously unknown cultural resources are discovered at the site, Uranerz would immediately stop the ground-disturbing activities in the area of the discovery and would immediately notify the NRC, WDEQ/LQD, and WSHPO. Uranerz would have any discovered cultural materials evaluated for NRHP eligibility by a professional meeting the Secretary of Interior's Standard for Archaeology and History. Documentation of the discovery and evaluation would be promptly provided to the NRC. The NRC would then consult with the WSHPO on the determination of eligibility and adverse effect. If WSHPO determines that there is an adverse effect to a historic property, NRC would follow the procedure to resolve the adverse effect as described above. Work may continue in other areas of the site; however, work in the area of discovery may not resume until such time as any additional actions are completed or deemed unnecessary. Assuming the discovery is located on private property the cultural resource(s) would remain under the ownership of the specific private landowner. Applicable federal, state, or local laws would apply to the discovered cultural resources.

If human remains or associated funerary objects as defined in the NAGPRA are encountered on private land, work would immediately stop in the vicinity of the discovery, the area would be secured, and Uranerz would immediately contact local law enforcement and the county coroner per Wyoming Statute (W.S.) 7-4-104. If the remains are not associated with a crime, then Uranerz would contact the NRC, WDEQ-LQD, and WSHPO and the landowner to further consult on the treatment of the remains. Uranerz would assure compliance with applicable federal, state, and local regulations relating to burial discoveries through inadvertent construction-related disturbance of graves.

4.8.1.2 Paleontological Resources

A paleontological survey was conducted for the Jane Dough Unit. The survey did not produce any vertebrate fossil bearing strata and no vertebrate fossils were discovered. However, some limited invertebrate fossils (e.g., clams and mollusks) were discovered, these resources were located on private lands and are not scientifically important. The results of the survey indicate that the Jane Dough Unit will not have any impact to significant fossil remains because of the geology and poor exposures of fossil bearing sediments.

4.8.2 No Action Alternative

Under the No Action Alternative, the Proposed Action would not be implemented. No additional ground would be disturbed and no additional impacts to the existing historic, cultural, or paleontological resources would take place beyond those that already exist.

4.9 VISUAL RESOURCES

4.9.1 Proposed Action

Because the Jane Dough Unit is located entirely on private land in a remote location, the operations aesthetic impact is limited to only the landowners and those that have permission to be on the landowner's property.

CBNG and conventional oil and gas well are present in the Jane Dough Unit and surrounding area. There are no sensitive visual resources within 4.0 miles of the Jane Dough Unit and the visually sensitive Pumpkin Buttes area is more than 4.0 miles away. Therefore, the Jane Dough Unit would have no visual impacts on the surrounding area.

4.9.2 No Action Alternative

Under the No Action Alternative, the Proposed Action would not be implemented. No additional ground would be disturbed and no additional impacts to visual resources would take place beyond those that already exist.

4.10 SOCIOECONOMICS (INCLUDING ENVIRONMENTAL JUSTICE)

4.10.1 Proposed Action

The socioeconomic impacts/benefits of the Jane Dough Unit would be a continuation of those seen as a result of the Nichols Ranch ISR project as development of the Jane Dough Unit would be an extension of approximately 9 years during the life of the Jane Dough Unit. The continued impacts/benefits would be seen by the communities in the surrounding area of the project. Businesses in towns such as Gillette, Wright, and Casper would continue to see some additional income from purchase of goods and services by Uranerz and its employees. Currently, Uranerz does not anticipate that additional employees would be required to run the Jane Dough Unit. The approximate 45-55 current jobs at the Nichols Ranch Unit would continue to work in the Nichols Ranch ISR project area and then transition to the Jane Dough Unit starting in approximately 2016 continuing to the end of the project in about 2024.

The continued employment of the approximate 45-55 people would not have an impact to the current health and social services and educational services in the communities surrounding the Jane Dough Unit and would not add to any change in housing in the region.

The proposed project would continue to generate revenue for the State of Wyoming, Johnson and Campbell counties, and the communities surrounding the project area through the collection of state severance taxes, property taxes, and sale taxes. This continued collection of taxes would go to the funding of schools, local city and county projects, and special county projects such as improved water/sewer lines, community centers, and county road maintenance.

Regarding environmental justice, the estimated population of Campbell, Johnson, and Natrona counties in 2010 by the U.S. Census Bureau was approximately 122,800. Minority populations accounted for a small percentage, ~4.6%, of the total population with percentages of minorities being similar to or smaller than those of the rest of the state of Wyoming. The 2014 unemployment levels for the three counties averaged ~2.8% and in 2009 the average yearly earning was ~$42,000 per year in Johnson County, ~$50,000 per year in Natrona County, and ~$74,000 per year in Campbell County. The average county earning for the areas surrounding the Jane Dough Unit are above the 2013 poverty level of $23,550 for a four family household. Figures 4-1 through 4-3 (see map pockets in the NRC Technical Report) detail employment, population, and earnings data for the Campbell, Johnson, and Natrona counties, Wyoming.

Based on the data above, no concentrations of people living below the poverty level or no concentrated minority populations are located near the Jane Dough Unit; therefore, no adverse environmental impacts would result to minority populations or those living below the poverty level.

4.10.2 No Action Alternative

Under the No Action Alternative, the Proposed Action would not be implemented. No additional impacts to socioeconomic resources (including environmental justice) due to not mining of the Jane Dough Unit would take place beyond those that already exist or have been identified.

4.11 PUBLIC AND OCCUPATIONAL HEALTH

4.11.1 Proposed Action

The values in Table ER4-3 show the maximum dose rates (based on MILDOS modeling) to seven public receptors near the Jane Dough Units. The highest dose is projected to be 0.40 mrem at the Pumpkin Butte Ranch Receptor. When compared to the public dose limit of 100 mrem specified in 10 CFR 20, the minimum impact is clearly evident; the maximum dose is 250 times lower than the protective standard. Values for the other public receptors are even lower. Another important measure is the 10 rem effective dose, a level well in excess of the maximum predicted 0.40 mrem value shown in the table below. According to the Health Physics Society, "Radiogenic health effects (primarily cancer) are observed in humans only at doses in-excess of 10 rem delivered at high dose rates. Below this dose, estimation of adverse health effects is speculative." In addition to the seven nearby public receptors discussed here, the radiological assessment completed by Uranerz included population bases that extended out to 80 km and in 16 compass directions from the proposed process facilities. The model results showed that no member of the public would receive a dose in excess of the standards. To summarize, the proposed operations would not have a significant radiological impact on public health.

From a nonradiological perspective, chemicals associated with an ISR operation include CO_2, HCL, H_2O_2, and NaOH. Emission rates for these chemicals are well below the threshold that would trigger a requirement for a permit. With respect to fugitive dust, the same can be said; the levels are too low to warrant a permit. In conclusion, because emissions are all below permitting action levels, the concentrations are considered to be highly protective of the public.

The nuclear fuel cycle industry is one of the most, if not the most, regulated industry in the U.S., and it is no wonder that all of the measures and comparisons discussed in other sections of the NRC license application demonstrate that impacts to the public from this source category are indeed very small. The same highly protective regulations given in 10 CFR 20, Standards for Protection Against Radiation, apply to workers in the uranium recovery industry. Specifically, 10 CFR 20.1201, Occupational Dose Limits, are the protective occupational health standards.

Table ER4-3 Projected Dose Rates to Public Receptors (Time-Step 4, Maximum Activity Period).

Receptor	Dose (mrem/yr)*
Public Receptors	
T-Chair (Rolling Pin) Ranch	0.20
Dry Fork Ranch	0.10
Christensen Ranch	0.30
Pfister Ranch	0.30
Pumpkin Butte Ranch	0.40
Van Buggenum Ranch	0.10
Ruby Ranch	0.10
License Boundary Receptors	
Jane Dough Unit North-central	0.50
Jane Dough Unit East-central	0.60
Jane Dough Unit South-central	0.30
Jane Dough Unit West-central	0.40
Public Dose Limit	**100**

*Total Effective Dose Equivalent (whole body).

An operator, such as Uranerz, must show compliance with these standards. Compliance is demonstrated through a number of checks and balances which include: (1) measurements with numerous instruments during operations; (2) bioassays; (3) unannounced inspections by the Radiation Safety Officer (RSO); (4) annual independent audits; (5) preparation of Standard Operating Procedures (SOPs); (6) worker exposures measured with thermoluminescent dosimeter badges; (7) NRC inspections; and (8) record-keeping and other mechanisms that provide assurance that worker exposure to radioactive materials is kept As Low As Is Reasonably Achievable (ALARA). In summary, the close oversight listed provides a high level of assurance that occupational health is well protected and there would be no significant impacts as a result of implementation of the Proposed Action.

4.11.2 No Action Alternative

Under the No Action Alternative, the Proposed Action would not be implemented. No additional impacts to public health or occupational health risks would take place beyond those that already exist or have been identified (specifically the Nichols Ranch ISR project).

4.12 WASTE MANAGEMENT

4.12.1 Proposed Project

Three types of waste will be generated with the proposed project; liquid, solid, and sanitary. All liquid wastes generated as a result of the Jane Dough Unit at the Nichols Ranch CPP will be disposed of through deep disposal wells located in the Nichols Ranch Unit. These liquid wastes normally consist of wellfield bleed streams, plant wash down water, groundwater restoration water from groundwater sweeping and groundwater treatment, and any other plant liquid effluent. The deep disposal wells have been permitted through the WDEQ and will be operated according to permit requirements. The deep disposal wells would be designed to handle a maximum flow rate of ~150 gallons per minute or as allowed by WDEQ permit.

Solid wastes generated at the proposed project include both contaminated and noncontaminated wastes. Contaminated wastes include rags, trash, packing material, worn or replacement parts from equipment, piping, and sediments removed from process pumps and vessels. Radioactive solid wastes with contamination levels requiring disposal at a licensed NRC disposal facility would be isolated in drums or other suitable containers prior to disposal offsite. Until wastes are disposed of they would be held in an area with a restricted boundary. Any noncontaminated wastes would be disposed of at a landfill located near Gillette in Campbell County, Wyoming. Other solid contaminated wastes such as wellfield piping would either be reused in a different production area, or flattened, surveyed, and shipped to a licensed NRC disposal site.

No restrooms, change houses, or lunchrooms would be installed in the Jane Dough Unit. However, sanitary wastes from the restrooms, change houses and/or lunchrooms used at the Nichols Ranch

ISR CPP would be disposed of in approved septic systems. The septic systems at the Nichols Ranch ISR CPP would be approved and maintained in accordance with WDEQ regulations.

4.12.3 No Action Alternative

Under the No Action Alternative, the Proposed Action would not be implemented. No additional impacts to the environmental from wastes would take place beyond those that already exist or have been identified (specifically at the Nichols Ranch ISR project).

5.0 MITIGATION MEASURES

5.1 INTRODUCTION

The mitigation measure that are planned for the Jane Dough Unit are intended to reduce or avoid adverse environmental impacts and to return the surface and subsurface of the Jane Dough Unit to conditions compatible with the pre-mining uses. All groundwater that is affected by the Jane Dough Unit would be restored to a condition of use equal to or exceeding that which existed prior to project construction. All disturbed land would be reclaimed and restored to the pre-mining condition of livestock grazing and wildlife habitat.

5.2 GROUNDWATER RESTORATION

Groundwater restoration is an important part of an ISR operation. The time it takes to restore the groundwater is primarily linked to the capacity of the deep waste disposal well. If the capacity of a deep waste disposal well is such that the time involved for groundwater restoration is unacceptable, then measures such as installing another deep disposal well would be implemented to decrease the restoration time.

5.2.1 Water Quality Criteria

The primary goal of the groundwater restoration efforts would be to return the groundwater quality of the mined ore zone, on a production area average, to the pre-mining baseline water quality condition that has been defined by the baseline water quality sampling program. During the groundwater restoration, all parameters on an average basis would be returned to baseline or as close to average baseline values as is reasonably achievable. If the average baseline values of some of the parameters are unachievable using the best practical technology (BPT), Uranerz would then use a secondary goal of returning the groundwater to the WDEQ class of use designation. This would return the groundwater to a quality consistent with the use of the water prior to the ISR extraction.

The use categories of the groundwater are those established by the WDEQ. Pre-mining baseline water quality data, groundwater use category, available technology, and economics would be criteria used in attaining the final level of water quality during restoration.

5.2.2 Restoration Criteria

Groundwater restoration criteria in a production area would be based on the baseline water quality data collected for each production area. The baseline water quality data would include data collected from wells completed in the ore zone and perimeter monitoring ring wells. Baseline water quality parameters would be used, on a parameter by parameter basis, to monitor restoration activities in returning the affected groundwater back to pre-mining quality as reasonably as possible.

Specific restoration values would be established prior to mining in each production area by computing specific restoration values for specific parameters. The restoration values would be the mean plus two standard deviations of the pre-mining water quality for each parameter listed in Table 5-1 of the NRC Technical Report. These restoration target values would not change unless the operational monitoring program indicates that baseline water quality has changed in a production area because of accelerated movement of groundwater, and that such change justifies re-determination of the baseline water quality. If this were to occur, resampling of monitor wells would be conducted along with the WDEQ and NRC reviewing and approving the change to restoration values.

The success of the restoration would be determined after the completion of the stability monitoring period (see Section 5.1.1.4). If no significant increasing trends in restoration values are identified, restoration would be deemed complete. A summary report requesting approval would be submitted along with the appropriate water quality data to the regulatory agencies. When approval is received from the regulatory agencies, final decommissioning of the wellfield would commence.

5.2.3 Groundwater Restoration Methods

For ISR operations, a common commercial groundwater restoration program consists of two stages, the restoration stage and the stability monitoring stage. The restoration stage typically consists of three phases such as groundwater sweep, groundwater transfer, and groundwater treatment. The stability monitoring stage includes a six month or longer time period in which the groundwater is monitored for successful restoration by monitoring the restoration targets for consistency.

The three phases used in groundwater restoration are designed to efficiently and effectively restore the groundwater so that groundwater loss is kept to a minimum and restoration equipment is optimized. Monitoring of the quality of groundwater would occur in selected wells as needed during restoration to determine the efficiency of the operations and to determine if additional or alternate techniques are necessary. Online production wells would be sampled for certain parameters, such as uranium and conductivity, to determine restoration progress on a pattern-by-pattern basis.

The sequence of the restoration methods used would be determined based on operating conditions and waste water system capacity. Depending on the progress of restoration, it is possible that not all phases of the restoration stage would be utilized. Uranerz would determine the need for certain restoration steps based on the progress of restoration and the monitoring of restoration values.

During groundwater restoration, a reductant may be added to lower the oxidation potential of the ore zone. Either a sulfide or sulfite compound may be added to the injection stream in concentrations sufficient to reduce the mobilized species. The use of reductants is beneficial because several of the metals typically found in the ore zone groundwater become solubilized during the recovery process. These metals can then form stable insoluble compounds that are usually in the form of sulfides. Dissolved metal compounds that are precipitated by such reductants include those of molybdenum, selenium, uranium, and vanadium.

Once restoration activities have returned the average concentration of restoration parameters to acceptable levels, the WDEQ and NRC would be contacted for agreement that restoration has been achieved in the production area. After this, the stability monitoring stage would begin. This phase of restoration consists of monitoring the water quality in the restored production area for six months after the successful completion of the restoration stage. When the stability monitoring stage is completed, Uranerz would make a request to the WDEQ and NRC that the production area be deemed restored.

5.2.3.1 Groundwater Transfer

During the groundwater transfer phase, water may be transferred between a production area beginning restoration operations and a production area beginning mining operations. Also, a groundwater transfer may occur within the same production area, if one section of the production area is in a more advanced state of restoration than another.

Pre-mining baseline quality water from the production area beginning mining may be pumped and injected into the production area in restoration. The higher Total Dissolved Solids (TDS) water from the production area in restoration would be recovered and injected into the production area beginning mining. The direct transfer of water would act to lower the TDS in the production area being restored by displacing affected groundwater with pre-mining baseline quality water.

The goal of the groundwater transfer is to blend the water in the two production areas until they become similar in conductivity. The water recovered from the restoration production area may 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.

For the groundwater transfer to occur between production areas, a newly constructed production area must be ready to begin mining. Because of this condition, a groundwater transfer can occur at any time during the restoration process, if needed. If a production area is not available to accept transferred water, then groundwater sweep would be utilized as the first phase of restoration.

The advantage of using the groundwater transfer technique is that it reduces the amount of water that must ultimately be sent to the deep disposal well during restoration activities.

5.2.3.2 Groundwater Sweep

During the groundwater sweep stage, the groundwater from a production area beginning restoration is pumped from the production area to the processing plant though all production wells without any re-injection. By doing this, native groundwater is drawn into the production area to flush contaminants from the mining zone thus "sweeping" the mining aquifer. The cleaner baseline water has lower ion concentrations that act to strip off the cation that have attached to the clays during mining. The water produced during groundwater sweep is usually then sent to the processing plant for treatment and removal of any uranium that could be in the production area water. Ra-226 and dissolved solids are also removed. After the treatment, the swept water is disposed of in an approved manner such as injection into a deep disposal well.

The rate of groundwater sweep would be dependent upon the capacity of the deep disposal wells and the ability of the production area to sustain the rate of withdrawal. A hydraulic barrier may be employed during this stage if there is an adjacent operation production area to prevent drawing groundwater from the operational production area to the production area undergoing restoration.

5.2.3.3 Groundwater Treatment

Either following or in conjunction with the groundwater sweep, water would be pumped from the mining zone to treatment equipment at the surface. Ion exchange and reverse osmosis (RO) treatment equipment would then be utilized during this phase of restoration.

Groundwater recovered from the restoration production area may be passed through the ion exchange system prior to RO. The groundwater would either be sent to waste disposal system or it would be re-injected into the production area. The ion exchange columns exchange the majority of the contained soluble uranium for chloride or sulfate. Additionally, prior to or following ion

exchange treatment, the groundwater may be passed through a de-carbonation unit to remove residual carbon dioxide that remains in the groundwater after mining.

At any time during treatment, an amount of reductant sufficient to reduce any oxidized minerals may be metered into the restoration production area injection stream. The concentration and amount of reductant injected into the restoration production area is determined by how the ore zone groundwater reacts with the reductant. The goal of reductant addition is to decrease the concentrations of oxidation-reduction sensitive elements through reduction of these elements.

All or some portion of the restoration recovery water can be sent to the RO unit. The use of an RO unit 1) reduces the total dissolved solids in the groundwater being restored, 2) reduces the quantity of water that must be removed from the aquifer to achieve restoration limits, 3) concentrates the dissolved contaminates in a smaller volume of brine to facilitate waste disposal, and 4) enhances the exchange of ions from the formation due to the large difference in ion concentration. The RO passes a high percentage of the water through the membranes, leaving 60 to 90 percent of the dissolved salts in the brine water or concentrate. The clean water, called permeate, would be either re-injected, or stored for use in the mining process, or sent to the waste water disposal well. The permeate may also be de-carbonated prior to re-injection into the wellfield. The brine water that is rejected contains the majority of the dissolved salts in the affected groundwater and is sent to the disposal system. Make-up water, which may come from either water produced from a production area that is in a more advanced state of restoration, or water being exchanged with a new production area, water being pumped from a different aquifer, or the purge of an operating production area, or a combination of these sources, may be added prior to the RO or production area injection stream to control the amount of "bleed" in the restoration area.

If needed, the reductant (either biological or chemical) added to the injection stream during this stage would scavenge any oxygen and reduce the oxidation-reduction potential of the aquifer. During mining operations, certain trace elements are oxidized. By adding the reductant, the oxidation-reduction potential of the aquifer is lowered thereby decreasing the solubility of these elements. Regardless of the reductant used, a comprehensive safety plan regarding reductant use would be implemented.

If necessary, sodium hydroxide may be used during the groundwater treatment phase to return the groundwater to baseline pH levels. This would assist in immobilizing certain parameters such as trace metals.

The number of pore volumes treated and re-injected during the groundwater treatment phase would depend on the efficiency of returning the production area back to pre-mining baseline water quality conditions. This relies on the efficiency of the RO in removing contaminates from the restoration production area groundwater and the success of the reductant, if used, in lowering the uranium and trace element concentrations.

5.2.3.4 Restoration Monitoring

During restoration, lixiviant injection is discontinued while improving the quality of the groundwater back to restoration standards. Because of this, the possibility of an excursion is greatly reduced. The monitor ring wells, overlying aquifer wells, and underling aquifer wells sampling frequencies would be changed from once every two weeks to once every 60 days during restoration. The wells are analyzed for the excursion parameters chloride, total alkalinity and conductivity. Water levels are also obtained at these wells prior to sampling.

In the event that unforeseen conditions (such as snowstorms, flooding, and equipment malfunction) occur, the WDEQ would be contacted if any of the wells cannot be monitored within 65 days of the last sampling event.

5.2.4 Restoration Stability Monitoring Stage

Once a production area has been designated as restored by the WDEQ, a six month stability period begins to ensure that the restoration goal of returning the production area groundwater to baseline water quality or pre-mining class of use category is maintained. The following restoration stability monitoring program would be in place during the stability period:

1. The monitor ring wells are sampled once every two months and analyzed for the UCL (upper control limits) parameters: chloride, total alkalinity and conductivity; and
2. At the beginning, middle, and end of the stability period, the production wells would be sampled and analyzed for the parameters in Table 5-1.

In the event that unforeseen conditions (such as snowstorms, flooding, and equipment malfunction) occur, the WDEQ would be contacted if any of the monitor or production wells cannot be monitored within 65 days of the last sampling event.

5.2.5 Well Abandonment

When the groundwater has been adequately restored and determined stable by the regulatory agencies, surface reclamation, and well abandonment would begin. All production, injection, monitor wells, and drill holes would be abandoned in accordance with WS-35-11-404 and Chapter VIII of the WDEQ Rules and Regulations to prevent adverse impacts to groundwater quality or quantity, and to ensure the safety of people, livestock, wildlife, and machinery in the area.

Wells would be abandoned using the following procedure:

1. All pumps and piping would be removed from wells, when practicable.
2. All wells are plugged from total depth to within 5 ft of the collar with a well abandonment plugging gel formulated for well abandonment and mixed in the recommended proportion of 10 to 20 lbs per barrel of water, to yield an abandonment fluid with a 10 minute gel strength of at least 20 lbs/100 sq ft and a filtrate volume not to exceed 13.5 cc.
3. The casing is cut off at least two feet below the ground surface. Abandonment fluid is used to fill the void to the top of the cut-off casing.
4. Cement or a plastic plug would be placed at the top of the abandoned well casing. The area is backfilled, smoothed, leveled, and reseeded to blend with the natural terrain.

Any deviation from the above procedure would be approved in advanced by the NRC and WDEQ.

5.3 SURFACE RECLAMATION AND DECOMMISSIONING

5.3.1 Introduction

At the completion of mining of the Nichols Ranch ISR Project, all lands disturbed by the mining project would be restored to their pre-mining land use of livestock grazing and wildlife habitat. Any buildings or structures would be decontaminated to regulatory standards, and either demolished and trucked to a disposal facility or turned over to the landowner if desired. Baseline soils, vegetation, and radiological data would be used as guide in evaluating the final reclamation. A final decommissioning plan would be sent to the NRC for review and approval at least 12 months prior to the planned decommissioning of a wellfield or project area.

5.3.2 Surface Disturbance

Because of the nature of ISR mining, minimal surface disturbance would be associated with the Jane Dough Unit. Surface disturbance would consist of construction activities associated with the construction of the wellfields including well drilling, pipeline installations, and road construction. Disturbances associated with the wellfield impact a relatively small area and have short term impacts.

Surface disturbances associated with the construction of the central processing plant, satellite plants, and wellfield header houses would be for the life of those activities. Topsoil would be stripped from these areas prior to the construction of the facilities. Disturbances associated with the wellfield drilling and pipeline installation are limited and reclaimed as soon as possible after completion of these items. Access roads to and from the wellfield are also limited with minimum surface disturbance.

5.3.3 Topsoil Handling and Replacement

Topsoil would be salvaged from any building sites, permanent storage areas, main access roads, and chemical storage areas prior to construction in accordance with WDEQ requirements. To accomplish this, typical earth moving equipment such as rubber tired scrapers and front end loaders

would be utilized. Topsoil salvage operations for the wellfield would be limited to the removal of topsoil at header house locations. Wellfield access roads topsoil removal would be in accordance with the landowner's road construction practices. These practices are outlined in the letter attached in Addendum 5A. Altogether, an estimated 101 acres of topsoil would be salvaged, stockpiled, and reapplied during the life of the Jane Dough Unit.

Topsoil that is salvaged during construction activities would be stored in designated topsoil stockpiles. These stockpiles would be located so as to minimize topsoil losses from wind erosion. Topsoil stockpiles would also not be located in any drainage channels or other locations that could lead to a loss of material. Berms would be constructed around the base of the stockpiles along with the seeding of the stockpiles with a mixture of western wheatgrass and thickspike wheatgrass at a seeding rate of 7 pounds pure live seed per acre per wheatgrass species to reduce the risk of sediment runoff. Additionally, all topsoil stockpiles would be identified with highly visible signs labeled "Topsoil" in accordance with WDEQ requirements.

During excavations of mud pits associated with well construction, exploration drilling, and delineation drilling activities, topsoil is separated from the subsoil with a backhoe. The topsoil is first removed and then placed at a separate location. The subsoil is then removed and deposited next to the mud pit. When the use of the mud pit is complete (usually within 30 days of initial excavation), the subsoil is then redeposited in the mud pit followed by the replacing of the topsoil. Pipeline ditch construction utilizing a backhoe will follow a similar path with the topsoil stored separately from the subsoil with the topsoil deposited on the subsoil after the pipeline ditch has been backfilled. Trenching equipment may be used for trenching a nominally 6-inch, and no more than 12-inch, wide trench line. Topsoil will not be salvaged unless specifically required or requested in the surface owner agreement. Following installation, the trench is backfilled with the excavated material. These methods of topsoil salvaging have proven to be adequate as demonstrated by the successful revegetation and reclamation at prior and existing ISR operations.

5.3.4 Vegetation Reclamation Practices

All revegetation practices would be conducted in accordance with the WDEQ regulations and the methods outlined in the mining permit. Topsoil stockpiles, along with as many as practical

disturbed areas of the wellfield, would be seeded with vegetation throughout the mining operation to reduce wind and water erosion. Final revegetation of the mine area would consist of seeding the area with the permanent reclamation seed mix (Table ER6-1). This mixture was developed through discussions with the landowner and approved by the WDEQ. A seeding rate of 15 pounds of pure live seed per acre would be used when using a rangeland drill. On areas where it is not practicable to use a drill, the seed would be broadcast at a rate of 30 pounds pure live seed per acre.

The success of the final revegetation would be determined by measuring the revegetation in meeting prior mining land use conditions and reclamation success standards as compared to the "Extended Reference Area" outlined in WDEQ Guideline No. 2. The Extended Reference Area allows for a statistical comparison of the reclaimed area with an adjacent undisturbed area of the same or nearly the same vegetation type. The area that the Extended Reference Area has to encompass; needs to be at least one half the size of the reclaimed area that is being assessed, or at least no smaller than 25 acres in size.

In choosing the Extended Reference Area, the WDEQ would be consulted. This would ensure that the Extended Reference Area adequately represents the reclaimed area being assessed. The success of the final revegetation and final bond release would be determined by the WDEQ.

Table ER6-1 Permanent Reclamation Seed Mixture.

Species	Percent of Mix	Pounds PLS/acre
Western Wheatgrass	16.7	3.10
Pubescent Wheatgrass Luna	16.7	3.10
Bozoisky Russian Wildrye	16.7	3.10
Intermediate Wheatgrass Rush	16.7	3.10
Slender Wheatgrass Pryor	16.7	3.10
Alfalfa/Inocculated Falcata	16.7	3.10
Total	100	18.6

5.3.5 Road Reclamation

The wellfield access roads would allow vehicular traffic to move from the plants to the wellfields and from one wellfield to another wellfield. The construction design for the wellfield access roads is present in Addendum 5A. At the time of decommissioning, the land owner would decide which wellfield access roads would remain and which roads would be reclaimed.

If wellfield access roads are to be reclaimed, the first step in reclaiming the wellfield access roads would be to pick up and remove the scoria/gravel so that the road bed is back to the approximate original grade. Next, the road bed would be either disced or ripped. The disturbed area would then be mulched and seeded with the permanent seed mixture.

5.3.6 Site Decontamination and Decommissioning

5.3.6.1 Wellfield

Following the successful conclusion of the aquifer restoration stability period in a particular production area, the wellfield piping, well heads and associated equipment would be removed and, if serviceable, taken to a new production area for continued service. Wellfield equipment that is no longer usable would be gamma surveyed and placed in either a contaminated or noncontaminated bone yard located near the central processing plant for subsequent removal from the site. If the final production area is being reclaimed, the nonsalvageable contaminated piping, well heads, and associated equipment would be trucked from the site to an approved NRC disposal facility.

5.3.6.2 Plant Dismantling

After groundwater restoration is complete in the final production area, decommissioning of the Nichols Ranch Unit CPP would commence. The Nichols Ranch CPP may continue to be used after completion of mining to process materials from other satellite units. All process equipment associated with the plants would be dismantled and either sold to another NRC licensed facility or

decontaminated in accordance with NRC Regulatory Guide 1.86 "Termination of Operating Licenses for Nuclear Reactors" and "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source or Special Nuclear Material." Any material that cannot be decontaminated to an acceptable level would be disposed of at an approved NRC facility. After decontamination, materials that would not be reused or that do not have any resale value, like building foundations would be removed and disposed of at an off-site facility. Additional detailed information is presented in the Reclamation Plan of Technical Report for the Nichols Ranch Unit and will not be repeated here.

The Nichols Ranch Unit plant site would be contoured to blend in with the natural terrain after all buildings have been removed. Gamma surveying would then be completed to verify that gamma radiation levels are within acceptable limits. Topsoil replacement and reseeding of the area would then take place.

5.3.7 Final Contouring

Because of the nature of solution mining, very little, if any, construction activities would take place which would require any major contouring during reclamation. Any surface disturbances that do occur would be contoured to blend in with the natural terrain. No final contour map has been included since no significant changes in the topography would result from the proposed mining operation.

5.3.8 Financial Assurance

Uranerz would maintain surety instruments to cover the costs of reclamation for the Jane Dough Unit. The surety instruments would cover the costs of groundwater restoration, decommissioning, dismantling, and disposal of all facilities including buildings and the wellfield, and the reclamation and revegetation of all affected mining areas. Additionally, the NRC and WDEQ require an updated Annual Surety Estimate Revision to be submitted each year to adjust the surety instrument amount to reflect existing operations and those planned for construction or operation in the

following year. Uranerz would revise any surety instrument amount to reflect any changes to the Annual Surety Estimate Revision after its review and approval by the NRC and WDEQ.

Once the WDEQ, NRC, and Uranerz have agreed to the estimated reclamation and restoration costs, a reclamation performance bond, irrevocable letter of credit, or other acceptable surety instrument would be submitted to the WDEQ with a copy to the NRC.

5.3 CULTURAL RESOURCE MITIGATION

Uranerz would comply with the following cultural resource mitigation measures.

1. Uranerz would not conduct any ground disturbing work in areas that have not been previously inventoried and cleared for cultural resources.
2. Uranerz would protect all cultural properties that have been determined eligible to the National Register of Historic Places within the permit area from ground disturbing activities until appropriate cultural resource mitigation measures can be implemented as part of an approved mining and reclamation plan unless modified by mutual agreement in consultation with the WSHPO and other regulatory agencies.
3. If cultural resources are discovered during operations, Uranerz would immediately stop ground disturbing activities in the area of the discovery and would immediately notify the NRC, WDEQ, the WSHPO, and any other appropriate regulatory agency.

5.4 WILDLIFE MITIGATION

Uranerz would comply with the following wildlife mitigation measures.

1. Uranerz would not conduct any ground disturbing activities within 0.25 miles of any occupied greater sage-grouse lek.
2. Uranerz will annually monitor attendance at all leks during the lekking season (April 1 through May 7).
3. Uranerz will not conduct any surface-disturbing activities (e.g., topsoil removal) within 2.0 miles of any occupied lek from March 15 through June 30.

4. If an area is physically disturbed (i.e., stripped of topsoil) prior to March 15, Uranerz will be able to continue all non-surface disturbing activities (e.g., construction, drilling, well completion, pipeline installation, etc.) within 2 miles of any occupied lek between March 15 and June 30.
5. During the seasonal buffer period, Uranerz will limit non-surface disturbing activities to daylight hours and will minimize noise to the extent possible.
6. Once uranium extraction facilities have been installed, Uranerz will be able to conduct year-round routine and emergency maintenance and service on all facilities within the Jane Dough Unit.
7. To reduce raptor predation on greater sage-grouse, the construction of overhead power lines, permanent high-profiled structures such as storage tanks, and other perch sites would not be constructed within 0.25 mi of any active lek.
8. Some greater sage-grouse could be lost due to vehicle collisions. Therefore, Uranerz will advise project personnel of appropriate speed limits for specific access roads, that they are not allowed to haze or harass the animals, and that they should minimize any direct disturbance to all wildlife whenever possible.

These mitigation measures have been reviewed and concurred with by the Wyoming Game and Fish Department (refer to Figure ER5-1).

5.5 WATER PROTECTION MEASURES

To minimize potential impacts to groundwater resources, Uranerz would comply with all appropriate well completion standards specified by NRC, WDEQ/LQD, and the Wyoming State Engineer's Office

To minimize potential impacts to surface water resources, Uranerz would develop and implement a SWPP Plan for the newly affected areas. Uranerz's current Wyoming Pollutant Discharge Elimination System (WYPDES) permit and SWPP Plan for the Nichols Ranch Unit would be expanded to include the Jane Dough Unit. This permit would be maintained pursuant to the *Federal Water Pollution Control Act* (Public Law 101-380) (also known as the *Clean Water Act*), the *Wyoming Environmental Quality Act*, Wyoming Statutes 35-11-101 through 35-11-1802, and

WYOMING GAME AND FISH DEPARTMENT

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April 29, 2014

WER 12776
Uranerz Energy Coporation
Letter of Compliance
Governor's Sage Grouse Executive Order 2011-5
Jane Dough Unit of the
Nichols Ranch In–situ Recovery Uranium Project
Johnson and Campbell Counties

Dawn Kolkman
Permitting Manager
Uranerz Energy Coporation
1701 East E Street
PO Box 50850
Casper WY, 82605

Dear Ms. Kolkman:

The staff of the Wyoming Game and Fish Department (WGFD) has reviewed the Governor's Sage Grouse Executive Order 2011-5, Letter of Compliance concerning the Jane Dough Unit of the Nichols Ranch In–situ Recovery Uranium project for Uranerz Energy Coporation. We offer the following comments for your consideration.

The project is located within two miles of the Cottonwood Creek 1 lek. Uranerz has agreed to and understands the following:

- There will be no surface occupancy within .25 miles of the lek.
- Monitor attendance at Cottonwood Creek 1 lek. This should be done in coordination with the WGFD Sheridan Regional Office (Erika Peckham, 307-670-8164)
- They will not conduct any surface-disturbing activities (e.g., topsoil removal) within 2 miles of any occupied lek from March 15 through June 30.
- If an area is physically disturbed prior to March 15, Uranerz will be able to continue all non-surface disturbing activities (e.g., construction, drilling, well completion, pipeline installation, etc.) within 2 miles of any occupied lek between March 15 and June 30. During the seasonal buffer period, Uranerz will limit non-surface disturbing activities to daylight hours and will minimize noise to the extent possible.
- Once uranium extraction facilities have been installed all production and maintenance activities will be allowed within the Jane Dough Unit. However, and best management

Figure ER5-1 Letter from Wyoming Game and Fish Department.

Dawn Kolkman
April 29, 2014
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practices that benefit sage-grouse should be applied as applicable (speed reduction, noise reduction, etc).

Thank you for the opportunity to comment. If you have any questions or concerns, please contact Mary Flanderka, Habitat Protection Coordinator, 307-777-4587.

Sincerely,

Mark Konishi
~~Deputy~~ Director

MK/mf/gb

cc: USFWS
Erika Peckham, WGFD – Sheridan Region,

Figure ER5-1 Letter from Wyoming Game and Fish Department (Continued).

the WDEQ-WQD Rules and Regulations Chapters 2 and 18. The SWPP Plan is designed to prevent and reduce the release of storm water-related pollution such as sediment and runoff from other exposed materials. The SWPP Plan would include erosion control measures to prevent and limit storm water pollution and procedures for periodic inspections of storm water pollution prevention devices and practices. Uranerz would install and maintain all appropriate runoff and erosion control measures as described in the SWPP Plan such as water bars, berms, and interceptor ditches. Since the Jane Dough Unit would not have any office facilities, copies of the SWPP Plan and inspection reports would be on file in the Nichols Ranch CPP.

To minimize potential impacts to surface and groundwater resources, Uranerz and its contractors would manage, store, handle, and dispose of all petroleum products and wastes in compliance with all appropriate federal and state regulations. In addition, Uranerz would train its personnel to properly handle, transport, and dispose of all petroleum products and hazardous materials and waste to avoid and reduce the potential occurrence of spills, leaks or releases. Uranerz would also develop and implement an emergency response plan to address potential spills, leaks, or releases of such materials. Uranerz would also mitigate potential spills, leaks, or releases of petroleum products and wastes by conducting routine maintenance and inspections on all appropriate vehicles and equipment to catch and fix problems early.

In the event of a spill, leak, or release of petroleum products and wastes (i.e., non-wellfield production fluid), Uranerz would clean up and dispose of the spill, leak, or release in accordance with state and federal regulations. All spills of petroleum products or hazardous chemicals in excess of the allowable quantity as determined by WDEQ-WQD would be reported to WDEQ-WQD and EPA. Spills, leaks, or releases of wellfield production fluids would be reported to the NRC and WDEQ-LQD in accordance with applicable regulations.

Uranerz 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 of in accordance with applicable federal and state regulations.

Any hazardous waste, such as organic solvents, paints, waste oil and paint thinners, empty chemical containers, tank sediments/sludges, chemical waste, and spent batteries, would be disposed of in accordance with a management program that the facility would develop to meet applicable local, federal, and state regulatory requirements for the disposal of nonradioactive hazardous waste.

During construction, portable self-contained chemical toilets would be provided for human waste disposal. As required, the holding tanks for the chemical tanks would be pumped out and their contents disposed of at an approved sewage facility in accordance with applicable rules and regulations. Upon completion of construction operations, sanitary wastes from restrooms would be disposed of in an on-site septic system that would be constructed and operated by Uranerz. The septic system would be located at the Nichols Ranch ISR CPP. The septic system would be designed in order to accommodate the estimated maximum of 35 permanent employees. Prior to construction of this facility, Uranerz would obtain a permit to construct the septic system from WDEQ-WQD.

5.6 SOLID WASTE DISPOSAL

Upon completion of construction activities, all debris and other waste materials not placed in the dumpsters or trash cages would be cleaned up, removed from the construction area, and disposed of in an approved landfill. No potentially harmful materials or substances would be left on location, and all solid waste would be disposed at an appropriate solid waste disposal facility. All facilities that would be used by Uranerz would be properly permitted through the appropriate state/local regulatory authority.

All radioactive wastes would be handled and disposed at a properly permitted and licensed waste disposal facility in accordance with applicable federal and state regulations.

6.0 ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

6.1 RADIOLOGICAL MONITORING

This section describes the results of baseline radiological measurement and monitoring conducted in support of the Jane Dough Unit. The radiological measurement and monitoring programs to be implemented during operation of the Jane Dough Unit are described in the license application NRC Technical Report at Section 5.7.7.

6.1.1 Surface Soil, Subsurface Soils and Sediment

6.1.1.1 Purpose and Procedure

An extensive soil and sediment sampling program was completed for the Jane Dough Unit. The purpose of the effort was to develop a representative radiological baseline for surface and subsurface soils and sediments.

Prior to conducting a field reconnaissance and collecting the samples, a map was prepared on a large-scale U.S. Geological Survey topographic base showing the license boundary, plant site location and ore zone footprint (in as much as it was known at the time). Because of their importance in an assessment such as this, the location of cultural features (residences, ranches, water wells, water impoundments, roads, etc.) with respect to the future process facility, production areas and license boundary were considered in the sampling design.

After completing the base map described above, a field reconnaissance was conducted to visually inspect the project area. All of the features just noted were considered in terms of their respective locations to the license boundary. Following the reconnaissance, a sample site map was prepared. Coordinates for each sample site were included with the map.

In determining the number, type (surface, subsurface and sediment) and areal distribution of sampling locations, pertinent NRC documents were used, along with judgment based on many

years of experience developing pre-operational and operational environmental monitoring programs for ISR operations. The primary documents included: (1) NRC Regulatory Guide 4.14, "Radiological Effluent and Environmental Monitoring at Uranium Mills," USNRC, April 25, 1980; (2) NUREG-1569, Standard Review Plan for In Situ Leach Uranium Extraction License Applications," Final Report, USNRC, June 2003; and (3) NUREG-1748 "Environmental Review Guidance for Licensing Actions Associated with NMISS Programs," Final Report, USNRC, August 2003.

Regulatory Guide 4.14 is the document that outlines the specifics of a pre-operational radiological monitoring program. Table 1 in the guide, for example, lists the suggested number, type, location, and frequency of samples. Because of the age of the guide, and because it primarily addresses conventional mills, Uranerz employed a modified baseline sampling program designed for a modern ISR facility. From a standpoint of physical disturbance and radiological alteration, it is widely recognized that a modern-day ISR operation has minimal impact on surface and subsurface soils.

There are three major reasons why the impacts are insignificant: (1) the recovery technique does not require the removal of overburden nor does it require the physical removal of the ore zone; (2) it is a wet process up to the stage of drying and packaging; and (3) modern dryers and packaging systems do not have significant particulate discharges. Thus in the absence of significant particulate sources, radiological impacts on soils and sediments through aerial dispersal and subsequent deposition are not associated with modern ISR operations.

Experience shows that potential radiological impacts are almost exclusively associated with accidental spills from pipe leaks or ruptures that occur off of the process facility pad (i.e., within the wellfields and between the wellfields and the process facility). Spills occurring on the process pad are fully contained by the curbed volume of the pad and its sump system. It should be noted that an accidental spill from a pipe break in a wellfield does not necessarily result in a major impact on soils or sediments. Engineering controls and a management program based on the principles of ALARA provide a high degree of assurance that impacts would be minimal. To illustrate, a pipeline break would cause a loss in pressure and this would be quickly detected by the monitoring

system. In addition to engineering controls, employees who are in the wellfields on a daily basis are trained to observe routinely the condition pipelines and wellheads. Leaks or breaks would be reported immediately. In the event of a break, the wetted area would be surveyed, sampled, and recorded on a spill map. Soils with significantly elevated levels of uranium and radium-226 would be removed and disposed at a licensed site.

Knowing that potential impacts are attributed to pipeline ruptures and leaks, the pre-operational sampling program was designed to thoroughly characterize radiological baseline conditions in the areas most likely to experience potential impacts. A review of Exhibit JD-D11-1, Jane Dough Unit-Soil, and Sediment Sample Location Map in the attached Appendix JD-D11 clearly shows that the focus of the baseline characterization was on the wellfield areas and the intermittent/ephemeral streams passing through the license area. A close examination of the map shows that sediment samples were collected from upstream and downstream locations in all of the streambeds. In addition to thoroughly sampling the wellfields and water courses, the radiological baseline was supplemented by including samples from areas within the license area (see sample sites labeled LAS on the map), the process facility location and the Rn-222/Gamma monitoring stations. Again, using Regulatory Guide 4.14 for general guidance, all soils and sediments were analyzed for Ra-226 and a large percentage of the total number of samples included analyses for U, Pb-210 and Th-230. In brief, the extensive coverage of the sampling effort provides a representative radiological baseline against which operational activities can be measured.

6.1.1.2 Sampling Methodology

The sample site map and coordinates described above, guided field personnel to the sample site locations. Surface and subsurface soils were collected with a 3-inch diameter bucket auger. Surface soils were collected from surface to a depth of 6-inches, and subsurface soils were collected in 12-inch increments to a total depth of 36 inches. The depth increments generally follow Regulatory Guide 4.14.

To avoid cross-contamination, the sampler and other tools were cleaned after each use using paper towels and de-ionized water. Samples were placed in 1-gallon plastic freezer bags and stored in

ice chests prior to delivery to the laboratory. While collecting the soil samples, gamma measurements were taken using a Ludlum Model 19 μR Survey Meter. While holding the meter at waist level, the area at and proximate to the sample point was surveyed for approximately two minutes. Gamma levels were recorded along with the GPS coordinates for each site.

The procedure for collecting sediment samples varied slightly from the soil sampling methodology. Instead of a single incremental sample, several samples were taken around each site to form a composite sample. As with the soil samples, sediments were placed in 1-gallon plastic freezer bags and placed in ice chests prior to delivery to the laboratory. Gamma measurements were taken following the protocol just described.

6.1.1.3 Results for the Jane Dough Unit

Table ER6-2, Surface Soil Radiological Baseline: Jane Dough Unit provides a summary of the analyses for each sample point as well as some basic statistical measures (minimum, maximum, average, and standard deviation).

The average background values are typical for surface soils in the U.S., averaging less than 1 pCi/g for Ra-226, Pb-210 and Th-230. According to (NCRP Report No.78), the average value of Ra-226 reported in surface soil is 1 pCi/g. The average Ra-226 background at the Jane Dough Unit is a little lower but similar to a mean of 1.1 pCi/g background reported in a survey covering 33 states. Not surprising, the background at the Jane Dough Unit and in the 33-state survey are similar to the natural values reported in sandstone (0.71 pCi/g), shale (1.1 pCi/g) and igneous rock (1.3 pCi/g). Similarly, the uranium values at the Jane Dough Unit comport with typical natural background soils, which average approximately 2 pCi/g or 3 ppm (du Preez 1989; NCRP 1984a). Although the single 2.4 pCi/g Ra-226 sample reported at sample site SS-12 is somewhat above the average found at the site, it is not outside the natural range of background Ra-226 in soils. However, it could also be an outlier or a reflection of uranium exploration activity. Although the 2+ mg/kg uranium values at sample sites JD-6, JD-7 and SS-11 are above the average at the site, these levels are in line with the 3 ppm average for U.S. soils. One additional comparison, Table ER6-3 shows that the values reported for the Jane Dough Unit are also in agreement with

Table ER6-2 Radiological Background in Surface and Subsurface Soil - Jane Dough Unit.

Sample Site	Depth (Inches)	Uranium (mg/kg*)	Pb-210 (pCi/g)	Precision Plus/Minus	Ra-226 (pCi/g)	Precision Plus/Minus	Th-230 (pCi/g)	Precision Plus/Minus
JD-1	0-6	1.16	1.0	0.1	0.8	0.06	0.5	0.2
JD-2	0-6	1.14	0.6	0.1	0.7	0.06	0.6	0.2
JD-3	0-6	1.80	0.7	0.1	0.7	0.05	0.6	0.2
JD-4	0-6	0.69	0.4	0.1	0.4	0.04	0.4	0.2
JD-5	0-6	0.75	0.3	0.1	0.4	0.04	0.4	0.2
JD-6	0-6	2.42	0.5	0.1	1.1	0.07	0.6	0.2
JD-7	0-6	2.32	1.3	0.1	0.9	0.06	0.8	0.3
LAS-1	0-6	1.80	0.6	0.1	0.9	0.06	0.8	0.3
LAS-2	0-6				1.0	0.06		
LAS-3	0-6				0.9	0.06		
LAS-4	0-6	1.40	0.6	0.1	1.0	0.06	0.7	0.2
LAS-5	0-6				1.0	0.07		
LAS-6	0-6				0.4	0.04		
LAS-7	0-6				0.6	0.05		
LAS-8	0-6				0.9	0.06		
LAS-9	0-6				0.9	0.06		
LAS-10	0-6				0.6	0.05		
LAS-11	0-6	1.06	1.0	0.1	0.6	0.05		
LAS-12	0-6				0.8	0.06		
LAS-13	0-6	1.39	1.0	0.1	0.7	0.05	0.7	0.2
LAS-14	0-6				0.4	0.04		
SS-1	0-6	1.25	0.7	0.1	0.9	0.06	0.9	0.3
SS-2	0-6				1.1	0.07		
SS-3	0-6				0.9	0.06		
SS-4	0-6				0.8	0.06		
SS-5	0-6	1.04	1.2	0.1	0.6	0.05	0.5	0.2
SS-6	0-6				0.8	0.06		
SS-7	0-6				0.7	0.05		
SS-8	0-6				0.5	0.04		
SS-9	0-6				0.6	0.05		
SS-10	0-6				0.8	0.05		
SS-11	0-6	2.17	1.2	0.1	0.8	0.05	0.7	0.2
SS-12	0-6				2.4	0.09		
SS-13	0-6				0.3	0.03		
SS-14	0-6				0.5	0.05		
SS-15	0-6				1.5	0.08		
SS-16	0-6				0.9	0.06		
SS-17	0-6	0.88	1.2	0.1	0.6	0.04	0.6	0.2
SS-18	0-6				0.8	0.05		
SS-19	0-6				0.6	0.05		
SS-20	0-6	1.16	0.8	0.1	0.7	0.05		
SS-21	0-6				0.8	0.06		
SS-22	0-6				0.9	0.06		
SS-23	0-6				0.7	0.06		
SS-24	0-6				0.9	0.06		
SS-25	0-6				0.6	0.05		
SS-26	0-6				0.8	0.06		
SS-27	0-6				0.4	0.04		
SS-28	0-6				0.5	0.04		

Table ER6-2 (Cont.)

Sample Site	Depth (Inches)	Uranium (mg/kg*)	Pb-210 (pCi/g)	Precision Plus/Minus	Ra-226 (pCi/g)	Precision Plus/Minus	Th-230 (pCi/g)	Precision Plus/Minus
SS-29	0-6				0.9	0.07		
SS-30	0-6				0.6	0.05		
SS-31	0-6	1.65	0.5	0.1	0.8	0.06	0.5	0.2
SS-32	0-6				1.1	0.09		
SS-33	0-6				0.7	0.05		
SS-34	0-6				0.6	0.05		
SS-35	0-6				0.6	0.06		
SS-36	0-6				1.0	0.06		
SS-37	0-6				0.6	0.05		
SS-38	0-6				0.8	0.05		
SS-39	0-6				0.7	0.05		
SS-40	0-6	1.17	1.2	0.1	0.7	0.05	0.4	0.2
SS-41	0-6				0.7	0.05		
SB-1**	0-6	1.18	0.3	0.1	0.6	0.05	0.8	0.3
	6-12	0.96	0.2	0.1	0.5	0.04	0.4	0.2
	12-24	0.78	0.2	0.1	0.4	0.04	0.3	0.1
	24-36	0.65	0.2	0.1	0.4	0.04	0.3	0.2
SB-2**	0-6				0.6	0.05		
	6-12				0.6	0.05		
	12-24				0.6	0.05		
	24-36				0.6	0.05		
SB-3**	0-6				0.7	0.05		
	6-12				0.6	0.05		
	12-24				0.6	0.05		
	24-36				0.7	0.05		
SB-4**	0-6	1.34	1.0	0.1	0.6	0.05	0.5	0.2
	6-12	1.30	0.4	0.1	1.1	0.07	0.5	0.2
	12-24	1.28	0.4	0.1	0.6	0.05	0.3	0.1
	24-36	1.13	0.5	0.1	0.6	0.04	0.5	0.2
SB-5**	0-6	1.09	0.5	0.1	0.8	0.05	0.7	0.2
	6-12	1.17	0.6	0.1	0.9	0.06	0.8	0.3
	12-24	1.29	0.8	0.1	0.9	0.06	0.6	0.2
	24-36	2.15	0.8	0.1	1.0	0.06	0.9	0.3
SB-6**	0-6				0.8	0.06		
	6-12				0.9	0.06		
	12-24				0.8	0.05		
	24-36				0.8	0.06		
SB-7**	0-6				0.7	0.05		
	6-12				0.5	0.05		
	12-24				0.6	0.06		
	24-36				0.6	0.05		
SB-8**	0-6				0.6	0.05		
	6-12				0.8	0.06		
	12-24				0.3	0.03		
	24-36				0.3	0.03		
SB-9**	0-6				0.6	0.05		
	6-12				0.5	0.05		
	12-24				0.5	0.05		
	24-36				0.6	0.05		

Table ER6-2 (Cont.)

Sample Site	Depth (Inches)	Uranium (mg/kg*)	Pb-210 (pCi/g)	Precision Plus/Minus	Ra-226 (pCi/g)	Precision Plus/Minus	Th-230 (pCi/g)	Precision Plus/Minus
SB-10**	0-6	1.20	0.4	0.1	0.7	0.05	0.5	0.2
	6-12	1.40	0.3	0.1	0.5	0.05	0.3	0.2
	12-24	1.63	0.4	0.1	0.2	0.03	0.4	0.2
	24-36	2.18	0.5	0.1	0.3	0.04	0.3	0.2
SB-11**	0-6				0.8	0.06		
	6-12				0.8	0.06		
	12-24				0.7	0.05		
	24-36				0.7	0.06		
SB-12**	0-6				0.8	0.05		
	6-12				0.8	0.05		
	12-24				0.7	0.05		
	24-36				0.7	0.05		
SB-13**	0-6	1.35	0.6	0.1	0.8	0.06	0.6	0.2
	6-12	1.65	0.5	0.1	0.7	0.05	0.6	0.2
	12-24	2.19	0.5	0.1	0.7	0.05	0.8	0.2
	24-36	4.01	0.9	0.1	0.9	0.06	0.7	0.2
Surface Soil:								
Minimum		**0.69**	**0.3**		**0.3**		**0.4**	
Maximum		**2.42**	**1.3**		**2.4**		**0.9**	
Average		**1.37**	**0.8**		**0.8**		**0.6**	
Standard Deviation		**0.46**	**0.3**		**0.3**		**0.1**	
Subsurface Soil:								
Minimum		**0.65**	**0.2**		**0.2**		**0.3**	
Maximum		**4.01**	**0.9**		**1.1**		**0.9**	
Average 6-12		**1.30**	**0.4**		**0.7**		**0.5**	
Average 12-24		**1.43**	**0.5**		**0.6**		**0.5**	
Average 24-36		**2.02**	**0.6**		**0.6**		**0.6**	

*Reporting Limit: 0.02 mg/kg-dry.
**SB-1-SB-13 are the 0-6 inch surface soil portions collected at the subsurface soil sample sites.
+/-: Plus/Minus Precision.
See Exhibit JD-D11-2 in Appendix JD-D11 for sample site locations.

Table ER6-3 Average Radiological Background Values.

	Radiological Background: Average Values			
Mine	**Uranium**	**Pb-210**	**Ra-226**	**Th-230**
Unit	(mg/kg)	(pCi/g)	(pCi/g)	(pCi/g)
Jane Dough Unit	1.37	0.8	0.8	0.6
Hank Unit	1.73	0.4	1.0	0.6
Nichols Ranch Unit	1.69	0.7	0.9	0.6

values previously reported for the Nichols Ranch and Hank Units. The averages presented in the summary table are based on 156 surface soil samples that were collected throughout the project area. Because the averages in all three unit areas are consistent, and because they compare favorably with averages reported in the literature for surface soils, it can be concluded that the soils are representative of natural background conditions.

Subsurface soil was sampled at 13 different locations. Two samples were collected from each of the smaller wellfield areas but the sample number was increased to five for the much larger, sinuously shaped wellfield in the west-central part of the Jane Dough Unit. Samples were collected from subsurface intervals of 6-12 inches, 12-24 inches and 24-36 inches. All samples were analyzed for Ra-226 and, although Regulatory Guide 4.14 recommends analyzing a single set for U, Pb-210 and Th-230, five sets (SB-1, SB-4, SB-5, SB-10 and SB-13) were analyzed for the additional constituents. The sampling approach was designed to obtain Ra-226 values throughout all of the wellfields and a full set of analyses from each of the five wellfield areas.

The results of the sampling effort are summarized in Table ER6-4, and Table ER6-5 provides a comparison of the values by depth and site location. The subsurface average uranium values of 1.30 mg/kg and 1.43 mg/kg in the 6-12 and 12-24 inch intervals, respectively, are consistent with the 1.37 mg/kg average reported for the 0-6 inch average in surface soil at the site. However, the 24 to 36 inch interval has an average value of 2.02 mg/kg. This elevated average can be traced to the contribution of a single high value of 4.01 mg/kg at sample site SB-13. As can be seen from Table ER6-3, and Table ER6-4, all other values are much lower and in line with the numerous other values reported across the site. Although it is possible that the 4.01 value is real, it is more likely an outlier. Assuming it is an outlier, it should not be counted in the average. If it is not used in calculating the average, the new average would be 1.53 mg/kg for the subsurface interval of 24-36 inches, and this is more consistent with the averages from the other intervals.

With respect to the other radionuclides, all of the averages are tightly grouped and consistent with typical background. As shown in Table ER6-5, the average values (pCi/g) have the following ranges: Pb-210 (0.4 to 0.6); Ra-226 (0.6 to 0.7); and Th-230 (0.5 to 0.5). In summary, with the exception of what appears to be an outlier discussed above, all of the values are consistent and within the range of background expected in U.S. soils.

Table ER6-4 Subsurface Soils: Radiological Baseline, Jane Dough Unit.

Sample Site	Depth (Inches)	Uranium (mg/kg*)	Pb-210 (pCi/g)	Precision Plus/Minus	Ra-226 (pCi/g)	Precision Plus/Minus	Th-230 (pCi/g)	Precision Plus/Minus
SB-1*	0-6	1.18	0.3	0.1	0.6	0.05	0.8	0.3
	6-12	0.96	0.2	0.1	0.5	0.04	0.4	0.2
	12-24	0.78	0.2	0.1	0.4	0.04	0.3	0.1
	24-36	0.65	0.2	0.1	0.4	0.04	0.3	0.2
SB-2*	0-6				0.6	0.05		
	6-12				0.6	0.05		
	12-24				0.6	0.05		
	24-36				0.6	0.05		
SB-3*	0-6				0.7	0.05		
	6-12				0.6	0.05		
	12-24				0.6	0.05		
	24-36				0.7	0.05		
SB-4*	0-6	1.34	1.0	0.1	0.6	0.05	0.5	0.2
	6-12	1.30	0.4	0.1	1.1	0.07	0.5	0.2
	12-24	1.28	0.4	0.1	0.6	0.05	0.3	0.1
	24-36	1.13	0.5	0.1	0.6	0.04	0.5	0.2
SB-5*	0-6	1.09	0.5	0.1	0.8	0.05	0.7	0.2
	6-12	1.17	0.6	0.1	0.9	0.06	0.8	0.3
	12-24	1.29	0.8	0.1	0.9	0.06	0.6	0.2
	24-36	2.15	0.8	0.1	1.0	0.06	0.9	0.3
SB-6**	0-6				0.8	0.06		
	6-12				0.9	0.06		
	12-24				0.8	0.05		
	24-36				0.8	0.06		
SB-7*	0-6				0.7	0.05		
	6-12				0.5	0.05		
	12-24				0.6	0.06		
	24-36				0.6	0.05		
SB-8*	0-6				0.6	0.05		
	6-12				0.8	0.06		
	12-24				0.3	0.03		
	24-36				0.3	0.03		
SB-9*	0-6				0.6	0.05		
	6-12				0.5	0.05		
	12-24				0.5	0.05		
	24-36				0.6	0.05		
SB-10*	0-6	1.20	0.4	0.1	0.7	0.05	0.5	0.2
	6-12	1.40	0.3	0.1	0.5	0.05	0.3	0.2
	12-24	1.63	0.4	0.1	0.2	0.03	0.4	0.2
	24-36	2.18	0.5	0.1	0.3	0.04	0.3	0.2
SB-11*	0-6				0.8	0.06		
	6-12				0.8	0.06		
	12-24				0.7	0.05		
	24-36				0.7	0.06		
SB-12*	0-6				0.8	0.05		
	6-12				0.8	0.05		
	12-24				0.7	0.05		
	24-36				0	0.05		
SB-13*	0-6	1.35	0.6	0.1	0.8	0.06	0.6	0.2
	6-12	1.65	0.5	0.1	0.7	0.05	0.6	0.2
	12-24	2.19	0.5	0.1	0.7	0.05	0.8	0.2
	24-36	4.01	0.9	0.1	0.9	0.06	0.7	0.2

*Reporting Limit: 0.02 mg/kg dry.
+/- Precision
See Exhibit JD-D11-2 in Appendix JD-D11 in Appendix JD-D11 of the NRC Technical Report for sample site locations.

Table ER6-5 Subsurface Soil Radiological Baseline Comparison by Depth and Sample Site Jane Dough Unit.

Sample Site	Uranium 6 to 12″ (mg/kg)	Uranium 12 to 24″ (mg/kg)	Uranium 24 to 36″ (mg/kg)	Pb-210 6 to 12″ (pCi/g)	Pb-210 12 to 24″ (pCi/g)	Pb-210 24 to 36″ (pCi/g)
SB-1	0.96	0.78	0.65	0.2	0.2	0.2
SB-4	1.30	1.28	1.13	0.4	0.4	0.5
SB-5	1.17	1.29	2.15	0.6	0.8	0.8
SB-10	1.40	1.63	2.18	0.3	0.4	0.5
SB-13	1.62	2.19	4.01	0.5	0.5	0.9
Avg.	**1.30**	**1.43**	**2.02**	**0.4**	**0.5**	**0.6**

Sample Site	Ra-226 6 to 12″ (pCi/g)	Ra-226 12 to 24″ (pCi/g)	Ra-226 24 to 36″ (pCi/g)	Th-230 6 to 12″ (pCi/g)	Th-230 12 to 24″ (pCi/g)	Th-230 24 to 36″ (pCi/g)
SB-1	0.5	0.4	0.4	0.4	0.3	0.3
SB-2	0.6	0.6	0.6	0.5	0.3	0.5
SB-3	0.6	0.6	0.7	0.8	0.6	0.9
SB-4	1.1	0.6	0.6	0.3	0.4	0.3
SB-5	0.9	0.9	1.0	0.6	0.8	0.7
SB-6	0.9	0.8	0.8			
SB-7	0.5	0.6	0.6			
SB-8	0.8	0.3	0.3			
SB-9	0.5	0.5	0.6			
SB-10	0.5	0.2	0.3			
SB-11	0.8	0.7	0.7			
SB-12	0.8	0.7	0.7			
SB-13	0.7	0.7	0.9			
Avg.	**0.7**	**0.6**	**0.6**	**0.5**	**0.5**	**0.5**

See Exhibit JD-D11-2 in Appendix JD-D11 of the NRC Technical Report for sample site locations.

Baseline radionuclides in sediments at the Jane Dough Unit are generally similar to those measured at the Nichols Ranch and Hank Units. A comparison of the averages at the three sites is provided in Table ER6-6. With regard to uranium, the averages are closely matched but the slightly higher average at Jane Dough was influenced by two anomalous values recorded at sample sites SD-11 and SD-16. As shown on Table ER6-7, these two sites have values of 8.93 mg/kg and 9.21 mg/kg, respectively. Although the Hank Unit did not have any values approaching 9 mg/kg, it had four values greater than 3 mg/kg, compared to the single 3+ value at Jane Dough. Because of this, the two averages are not far apart. Similarly, although the Nichols Ranch Unit did not have any values approaching 9 mg/kg, it had a value over 4 mg/kg and a 2.73 mg/kg value. Also because there are

Table ER6-6 Average Sediment Background Radiological Values.

Average Values In Sediments				
	Uranium	**Pb-210**	**Ra-226**	**Th-230**
Sample Location	(mg/kg)	(pCi/g)	(pCi/g)	(pCi/g)
Jane Dough Unit	2.60	1.6	0.8	0.6
Hank Unit	2.38	1.0	1.2	0.6
Nichols Ranch	2.34	1.3	9.6	0.6

many fewer sample points at the Nichols Unit compared to the Jane Dough Unit (10 vs. 19), the average at the Nichols Ranch Unit is more strongly influenced by higher values.

With respect to Pb-210, the background average exceeds the averages at the Hank and Nichols Units. The reason for this can be attributed to the number of samples (5 in total) that have values greater than 2 mg/kg. By comparison, the Hank and Nichols sites each had only one value greater than 2 mg/kg. It is difficult to say why the frequency of Pb-210 above 2 mg/kg is greater at the Jane Dough than the Hank and Nichols Units. All three sites share a common history of land use, which includes exploration and development of shallow coal bed methane and the exploration of uranium.

Table ER6-7 Radiological Baseline in Sediments: Jane Dough Unit.

Sample	Uranium	Pb-210	Ra-226	Th-230
Site	(mg/kg)	(pCi/g)	(pCi/g)	(pCi/g)
SD-1	1.37	1.4 +/-0.1	0.9 +/-0.06	0.4 +/-0.2
SD-2	1.84	0.8 +/-0.1	0.7 +/-0.05	0.7 +/-0.2
SD-3	1.57	1.7 +/-0.1	0.8 +/-0.06	0.5 +/-0.2
SD-4	2.15	2.4 +/-0.2	0.9 +/-0.06	0.7 +/-0.2
SD-5	1.94	2.1 +/-0.2	1.0 +/-0.06	0.6 +/-0.2
SD-6	1.51	1.5 +/-0.1	0.7 +/-0.05	0.6 +/-0.2
SD-7	1.62	2.4 +/-0.2	0.8 +/-0.05	0.9 +/-0.3
SD-8	1.92	0.7 +/-0.1	0.6 +/-0.05	0.5 +/-0.2
SD-9	2.77	1.3 +/-0.1	0.6 +/-0.04	0.7 +/-0.2
SD-10	3.40	1.1 +/-0.2	0.7 +/-0.05	0.6 +/-0.2
SD-11	8.93	2.0 +/-0.2	0.7 +/-0.05	0.4 +/-0.2
SD-12	1.20	0.7 +/-0.1	0.5 +/-0.04	0.7 +/-0.2
SD-13	1.76	1.3 +/-0.1	0.9 +/-0.06	0.4 +/-0.2
SD-14	1.38	1.6 +/-0.1	1.0 +/-0.07	0.5 +/-0.2
SD-15	2.10	0.8 +/-0.1	1.1 +/-0.07	0.6 +/-0.2
SD-16	9.21	1.8 +/-0.2	0.8 +/-0.05	0.5 +/-0.2
SD-17	1.58	2.8 +/-0.2	0.7 +/-0.05	0.5 +/-0.2
SD-18	1.49	1.3 +/-0.1	0.7 +/-0.05	0.5 +/-0.2
SD-19	1.69	2.4 +/-0.1	1.0 +/-0.07	0.8 +/-0.3
Minimum	1.20	0.7	0.5	0.4
Maximum	9.21	2.8	1.1	0.9
Average	**2.60**	**1.6**	**0.8**	**0.6**
Stdev	2.34	0.6	0.2	0.1
Hank Unit	**2.38**	**1.0**	**1.2**	**0.6**
Nichols Ranch	**2.34**	**1.3**	**9.6**	**0.6**

*Reporting Limit: 0.02 mg/kg-dry.
See Exhibit JD-D11-2 for sample site locations.

Referring again to Table ER6-2, it can be seen that Ra-226 values at the Jane Dough Unit are very much in line with values typically reported in the Nichols Ranch and Hank Unit. The values are for the most part at or below 1 pCi/g. The average of 0.8 pCi/g for the Jane Dough Unit is just below the 1.2 pCi/g value measured at the Hank Unit. As reported in the original license application, approximately 40% of the Ra-226 values at the Nichols Ranch Unit were in excess of typical background and therefore a comparison cannot be made with the Jane Dough. Lastly, there is little to say with regard to the values for Th-230 other than they are normal baseline values for Jane Dough, Nichols Ranch and Hank Units are all the same (0.6 pCi/g).

6.1.2 Baseline Gamma Survey

6.1.2.1 Purpose and Procedure

Baselines serve as a backdrop against which operational impacts can be measured. Baselines also serve as targets for reclamation goals, which in turn are eventually used for license termination and site release to unrestricted use. The procedure for establishing gamma background at the Jane Dough Unit followed the procedure used in the gammas surveys at the Nichols Ranch and Hank Units.

The survey that was performed for the project site differs in pattern from the survey described in Regulatory Guide 4.14. The layout of the pattern given in the guide is based on a conventional mine and mill, which have significant particulate source terms. Because of the vast difference between ISR and conventional mining and milling, a modified procedure was used to measure baseline gamma levels in the areas where operational activities will occur. Additionally, the survey design took into account the fact that the Jane Dough Unit will not have a central or satellite processing facility and fact that the processing facility at the Nichols Ranch Unit will be limited to resin loading.

Referring back to the discussion in the soils section, it was noted that potential impacts on soils and sediments from ISR operations are attributed to accidental spills from pipeline breaks or leaks. This aspect of potential impact served as a major guide in the baseline sampling pattern for soils, sediments and gamma. In addition to the large number of gamma readings taken throughout the proposed wellfield areas at the Jane Dough Unit, readings were also taken at the sediment sampling locations in the drainages passing through the proposed license area; the air monitoring sites; the nearest residences; and the vegetation sampling sites. Exhibit JD-D11-2 in Appendix JD-D11 of the NRC Technical Report shows the gamma sample sites.

6.1.2.2 Survey Methodology

A Ludlum Model 12S μR Survey Meter was the instrument used to collect data during the gamma survey. The calibration date on the meter for the September 2011 survey was September 2, 2011.

As described in the soils section of the application, a sample site map was developed prior to conducting the survey. Using GPS and the previously-developed sample site map, the survey team traveled to each sample point. Gamma measurements were recorded by holding the meter at waist level and slowly passing it over each sample point and over the area proximate to the sample location. Readings at each site were taken for 2 minutes.

6.1.2.3 Jane Dough Unit Results

Table ER6-8 provides a summary of the gamma measurements. A review of the table shows a range of 4 μR/hr (13 to 17 μR/hr) for the surface soil locations and the same 4 μR/hr range (14 to 18 μR/hr) for the sediment sample sites. The high end range for the surface soil locations is represented only a single reading of 17 μR/hr at LAS-13. Similarly, only two sediment sample locations support the 18 μR/hr top range value. Most of the values are within 14 to 16 μR/hr, and the averages for the surface soil sites and the sediment locations are 15 and 16 μR/hr, respectively. The averages at the Jane Dough Unit are a little higher but similar to the 13 μR/hr average measured at the Nichols Ranch and Hank Units. The highest values of 16, 17 and 18 μR/hr at the Jane Dough Unit were compared to the soil sample sites with the highest uranium, Pb-210, Ra-226 and Th-230 values reported in the soils at those locations to see if a positive correlation could be established. Not surprising, there was no consistent positive correlation between the slightly elevated gamma readings and the slightly elevated radionuclides in the soils.

In the previous baseline analysis for the Nichols Ranch Unit, a positive correlation for a few sites could be made but in those few examples, the level of Ra-226 was much more elevated than the levels at the Jane Dough Unit.

Gamma measurements taken with a general survey meter cannot establish a high degree of correspondence with the actual presence of Ra-226 in soil. An instrument of much higher resolving power (such as a 2x2 sodium iodide Ludlum Model 44-10) would be needed for this purpose. However, a standard survey meter such as a Ludlum Model 12S can be used in baseline surveys and as a first-level screening device to detect areas of elevated gamma levels (usually 2.5 to 3 times background).

Table ER6-8 Gamma Survey Results: Jane Dough Unit.

Sample Site	Gamma (μR/hr)	Sample Site	Gamma (μR/hr)	Sample Site	Gamma (μR/hr)	Sample Site	Gamma (μR/hr)
Random 1*	14	LAS-8	15	SS-10	16	SS-26	15
Random 2*	16	LAS-9	15	SS-11	15	SS-27	16
JD-1	14	LAS-10	13	SS-12	16	SS-28	14
JD-2	14	LAS-11	16	SS-13	14	SS-29	13
JD-3	16	LAS-12	14	SS-14	15	SS-30	15
JD-4	13	LAS-13	17	SS-15	15	SS-31	13
JD-5	13	LAS-14	14	SS-16	16	SS-32	14
JD-6**	15	SS-1	14	SS-17	14	SS-33	15
JD-7**	15	SS-2	14	SS-18	14	SS-34	15
LAS-1	15	SS-3	15	SS-19	14	SS-35	16
LAS-2	16	SS-4	15	SS-20	13	SS-36	16
LAS-3	16	SS-5	15	SS-21	14	SS-37	14
LAS-4	14	SS-6	16	SS-22	15	SS-38	15
LAS-5	15	SS-7	15	SS-23	14	SS-39	16
LAS-6	14	SS-8	14	SS-24	15	SS-40	15
LAS-7	14	SS-9	14	SS-25	15	SS-41	15
SB-1	15	SD-1	15	SD-14	16	--	--
SB-2	15	SD-2	14	SD-15	14	--	--
SB-3	15	SD-3	15	SD-16	14	--	--
SB-4	15	SD-4	17	SD-17	18	--	--
SB-5	15	SD-5	15	SD-18	15	--	--
SB-6	15	SD-6	16	SD-19	16	--	--
SB-7	14	SD-7	18	--	--	--	--
SB-8	15	SD-8	15	--	--	--	--
SB-9	16	SD-9	17	--	--	--	--
SB-10	14	SD-10	17	--	--	--	--
SB-11	15	SD-11	16	--	--	--	--
SB-12	16	SD-12	15	--	--	--	--
SB-13	16	SD-13	17	--	--	--	--
Average						**15**	**16**
Minimum						**13**	**14**
Maximum						**17**	**18**

Notes:

*Random 1 and 2 are additional vegetation sample sites.
**Nearest residences.
JD-1 through 7: gamma exposure rate/air/vegetation sample sites.
SS: Surface Soil Site
SB: Subsurface Soil Site
SD: Sediment Sample Site
LAS: License Area Sample Site
See Exhibit JD-D11-2 in Appendix JD-D11 in the NRC Technical Report for sample site locations.

In summary, the density of the survey and its consistent values provide reasonable assurance that a representative baseline was established. Additional evidence supporting the representativeness of survey are the values from the Nichols Ranch and Hank Units.

6.1.3 Baseline Radon-222 and Direct Gamma Exposure Rates

6.1.3.1 Purpose and Procedure

As described in previous discussions on soil, sediment and gamma baselines, although ISR operations do not generate significant levels of particulates, they do have Rn-222 emissions, which include radon daughter products with varying half-lives. For this reason, ambient baseline Rn-222 levels should be established. In establishing the baseline, the monitoring procedure outlined in Regulatory Guide 4.14 was followed, and it involved deploying Rn-222 detectors and gamma dosimeters at suggested locations.

6.1.3.2 Survey Methodology

Landauer Extra Sensitive Outdoor Rn-222 Detectors and X-9 Gamma Dosimeters were deployed at seven monitoring sites (JD-1 through JD-7). Detectors were placed at the two nearest residence locations (JD-6NR-2 and JD-7NR-1) and the remaining five were located as shown on Exhibit JD-D11-2. The five detectors were located at or near the following locations: (1) the proposed license boundary; (2) a control site (upwind and removed from operational activities); and (3) in the prevailing downwind direction.

6.1.3.3 Results for Jane Dough Unit

Monitoring extended over a full year beginning with the third quarter of 2010 and ending in the second quarter of 2011. The results of the baseline year are summarized in Table ER6-9. A review of the table shows that the third quarter had the highest average (0.9 pCi/l) and the first quarter had the lowest average (0.3 pCi/l). It is also interesting to note that five of the seven sites had readings greater than 1.0 pCi/l during the third quarter while all of the sites had values well below 1.0 pCi/l

Table ER6-9 Baseline Radon-222 at the Jane Dough Unit Air Monitoring Stations.

	Third Quarter 2010 (pCi/l)	Fourth Quarter 2010 (pCi/l)	First Quarter 2010 (pCi/l)	Second Quarter 2010 (pCi/l)	Average by Site (pCi/l)
JD-1	1.0 +/- 0.09	0.6+/-0.05	0.3 +/-0.04	0.6 +/-0.05	**0.6**
JD-2	1.2 +/-0.10	0.5+/-0.05	0.3 +/-0.04	0.7 +/-0.06	**0.7**
JD-3	0.7 +/-0.07	0.6+/-0.06	0.3 +/-0.04	0.6 +/-0.05	**0.6**
JD-4	0.6 +/-0.07	0.7+/-0.06	0.5 +/-0.05	0.4 +/-0.04	**0.6**
JD-5	1.0 +/-0.09	0.6+/-0.05	0.4 +/-0.04	0.6 +/-0.05	**0.7**
JD-6/NR-2*	1.1 +/-0.09	0.6+/-0.06	0.3 +/-0.04	0.7 +/-0.06	**0.7**
JD-7/NR-1*	1.1 +-/0.10	0.8+/-0.07	0.3 +/-0.04	0.5 +/-0.05	**0.7**
Average	**1.0**	**0.6**	**0.3**	**0.6**	

Notes: *Nearest residence upwind and downwind.
U.S. average outdoor Rn-222 level: 0.4 pCi/l (U.S. EPA).
See Exhibit JD-D11-2 in Appendix JD-D11 in the NRC Technical Report for sample site location.

throughout the remaining three quarters. A similar result was recorded at the Nichols Ranch and Hank Units when baseline surveys were conducted. To illustrate that point, the third quarter average for all five monitoring locations at the Hank Unit was 1.9 pCi/l and the first quarter average was 0.6 pCi/l. The profile was repeated again at the Nichols Ranch Unit. The third quarter average was 1.4 pCi/l and the first quarter had the lowest average of 0.8 pCi/l.

Although the second quarter average at the Nichols site was slightly higher than the third quarter (1.6 pCi/l vs.1.4 pCi/l), a sample location in the second quarter had a single high value of 2.3 pCi/l which raised the average. Because the 2.3 pCi/l number was the only value that exceeded all others at the time, it may likely have been an outlier. If the value had been more consistent with the values of 0.6 pCi/l and 1.4 pCi/l that were measured at that location during other quarters, the third quarter average would have been the highest as it was at the Hank and Jane Dough Units. The apparent trend of higher values occurring in the third quarter and the lowest values in the first quarter could likely be the result of weather conditions. The first quarter is quite cold with snow cover and the third quarter is much warmer and dry. The colder winter months with snow cover tends to suppress radon exhalation rates while the warmer and drier conditions of summer would increase the exhalation rate. This explanation is further supported by the fact that highest and

lowest values are not found at a single site; instead, the highest and lowest values vary with the time of year.

Table ER6-9 also shows the annualized average for all locations combined as being 0.6 pCi/l. This average is lower than the averages of 1.0 pCi/l and 1.2 pCi/l recorded at the Hank and Nichols Ranch Units, respectively. The range of the averages at all three units are consistent with values found in the U.S. Background radon varies considerable in the U.S. due to factors such as soil and rock types and the presence of naturally occurring uranium. The 0.6 pCi/l average measured at the Jane Dough Unit is consistent with but slightly above the U.S. average outdoor Rn-222 level of 0.4 pCi/l (U.S. EPA).

6.1.3.4 Background Gamma Exposure Rate

Background gamma exposure rates from the one year monitoring program are summarized in Table ER6-10. The quarterly averages comprising all seven sites range from 11.3 mrem to 45.8 mrem. When compared to previous baseline surveys at the Ranch Nichols Ranch and Hank units, the quarterly range average was 34.4 mrem to 55.0 mrem (Hank) and 35.0 mrem to 47.9 mrem (Nichols Ranch). An additional comparison can be made to values from an even earlier baseline that was developed for the nearby North Butte project. The quarterly averages from North Butte ranged from 32.3 mrem to 39.7 mrem.

Table ER6-10 Baseline Gamma Exposure Rate at the Jane Dough Unit Air Monitoring Stations.

	Third Quarter 2010 (mrems)	**Fourth Quarter 2010** (mrems)	**First Quarter 2011** (mrems)	**Second Quarter 2011** (mrems)	**Average by Site** (mrems)
JD-1	34.7	45.0	44.5	11.0	33.8
JD-2	38.8	45.1	38.0	11.3	33.0
JD-3	33.9	46.9	34.0	10.9	31.4
JD-4	30.8	42.7	34.7	11.8	30.0
JD-5	35.0	45.9	33.0	11.5	31.4
JD-6/NR-2*	37.4	49.4	38.4	10.9	34.0
JD-7/NR-1*	36.2	45.7	38.0	11.5	32.9
Average	**35.3**	**45.8**	**37.2**	**11.3**	**32.4**
Nichols	**39.6**	**35.0**	**47.5**	**47.9**	**42.5**
Hank	**41.5**	**34.4**	**55.0**	**50.5**	**45.4**

Notes: *Nearest residence upwind and downwind.
Minimum detectable dose equivalent: 0.10 mrem, See Exhibit JD-D11-2 in Appendix D11 of the NRC Technical Report for sample site locations.

Although there is a good level of consistency between the 3rd, 4th, and 1st quarters of data from the Jane Dough Unit, the 2nd quarter is significantly below (approximately 72% lower) the 39.4 mrem average of the other three quarters combined. Also, the spread between the 11.3 mrem recorded during the second quarter at Jane Dough compared to the values from Hank and Nichols (50.5 mrem and 47.9 mrem, respectively) exceeds 35 mrems. Because the second quarter values at Jane Dough appear to be exceeding low, the averages shown on Table ER6-10 are approximately 7 mrems too low. The ~7 mrem estimate was derived by comparing the average for all of the Jane Dough values from three quarters (39.7 mrem) and comparing this value to the 32.4 mrem average that includes the second quarter data. The 39.7 mrem value is much more consistent with the 42.5 to 45.4 mrem average recorded for Nichols Ranch and the Hank Units.

Apart from the comparisons just noted, the average values recorded the three project sites of approximately 40 to 45 mrem can be put into a better perspective when compared to the following:

- Average dose to the U.S. Public from natural sources: 300 mrem.
- Background radiation (total) in the Colorado Plateau: 75 to 140 mrem.
- Terrestrial background (Rock Mountains): 40 mrem.
- Average dose to the public from all sources: 360 mrem

As the comparison shows, the average background at the project site is very similar to terrestrial background (Rock Mountains) of 40 mrem.

6.1.4 Flora and Fauna

6.1.4.1 Purpose and Procedure

According to Section 2.1.4 in Regulatory Guide 4.14, vegetation, food and fish samples should be collected if, in individual licensing cases, a significant pathway to man is identified. As discussed previously in this report, pathways for significant radiological contaminants to enter the environment from current-day ISR operations have been nearly eliminated. ISR operations do not have fluid discharges nor do they generate significant particulate emissions. The main avenue for radiological constituents to enter the environment is limited to the emission of Rn-222.

Because emissions are restricted to nearly-particulate-free Rn-222, significant buildup of radionuclides in soil, vegetation and other media is not likely to occur. The minimal accumulation of radionuclides is supported by MILDOS modeling results, and is borne out in operational monitoring data that had been collected at various ISR facilities over the past 30 years.

The baseline sampling program for the Jane Dough Unit closely followed the approach used in the license application for the Nichols Ranch and Hank Units. It will be recalled that the program was modified from the guidance given in Regulatory Guide 4.14. Departure from the guide is discussed in the Methods Section below. While developing the pre-operational baseline studies, it was understood through experience and the evolution of ISR, that pathways to flora and fauna are not significant.

Even though potential impacts from ISR operations on flora, fauna and the food chain have been shown to be insignificant, good baseline characterizations continue to be an important and necessary part of a license application. Baseline values can be compared to values during actual operations to validate the minimal to no-impact of the project.

Baselines also provide an important background against which post-operational closeout surveys can be compared for demonstrating that release criteria have been met. Lastly, baseline values are used when corrective actions are initiated to address an accidental spill.

Following is a description of the baseline sampling program that was performed at the Jane Dough Unit.

6.1.4.2 Methods

According to the field reconnaissance, no permanent surface water exists at or immediately adjacent to the site. Given the absence of water, fish are absent. The site was surveyed for the presence a crop-growing areas and none were found. Agricultural activities appear to be limited to cattle grazing. Although the guide suggests sacrificing livestock to obtain samples, it is Uranerz's opinion that this is not necessary for modern ISR operations. Lacking a pathway for a source term of sufficient strength, grazing animals are not exposed in a meaningful way. In addition, since operational monitoring will include routine sampling of vegetation, food crops (if they are grown in the area) and grazing/forage foods, a mechanism will be in place to monitor this pathway to local fauna.

Based on the existing land use, samples were collected from wildlife browsing/grazing areas (Random-1 and Random-2 sites); the nearest residences (JD-6 and JD-7); and at the Rn-222/gamma/air monitoring sites (JD-1 through JD-5). Exhibit JD-D11-2 in Appendix JD-11 of the NRC Technical Report shows the sample site locations. Samples were collected on September 29, 2011 and delivered to the laboratory on September 30, 2011. While collecting the samples, care was taken to clip the vegetation approximately one inch above the ground to avoid mixing with surface soil. All samples were analyzed for Uranium, Ra-226, Pb-210 and Th-230.

6.1.4.3 Results for the Jane Dough Unit

Table ER6-11 provides a summary of the laboratory analyses. Although there is the usual variation, the values are within normal background ranges. To illustrate the consistency in the background values, a comparison was made with the baseline previously established for the Nichols Ranch and Hank Units. As can be seen from the Table ER6-12, the averages for all three sites are in close agreement. A single, somewhat higher Ra-226 value of 3.7E-04 μCi/kg, which was collected at sample site R-1 Dry Fork Ranch while developing the Nichols Ranch Unit baseline explains the higher average Ra-226 level in the table.

Table ER6-11 Radiological Baseline Values in Vegetation: Jane Dough Unit.

Sample Site	Ra-226 (μCi/kg)	Pb-210 (μCi/kg)	Th-230 (μCi/kg)	Uranium (μCi/kg)
JD-1	4.3E-06 +/- 8.9E-07	2.1E-04 +/- 4.7E-06	2.1E-06 +/- 3.0E-06	2.7E-05 +/- 3.7E-07*
JD-2	1.1E-05 +/- 1.6E-06	5.8E-04 +/- 8.7E-06	7.4E-06 +/- 4.7E-06	5.5E-05 +/- 2.0E-07*
JD-3	2.4E-05 +/- 2.5E-06	7.4E-04 +/- 1.0E-05	2.5E-05 +/- 8.9E-06	5.8E-05 +/- 2.0E-07*
JD-4	8.4E-06 +/- 1.6E-06	4.1E-04 +/- 8.4E-06	5.5E-06** +/- 4.7E-06	5.9E-05 +/- 2.0E-07*
JD-5	1.0E-05 +/- 1.6E-06	2.1E-04 +/- 6.7E-06	6.6E-06 +/- 4.5E-06	3.4E-05 +/- 2.0E-07*
JD-6	6.9E-06 +/- 1.4E-06	2.4E-04 +/- 7.4E-06	9.4E-06 +/- 6.0E-06	1.2E-05 +/- 2.0E-07*
JD-7	5.5E-06 +/- 1.5E-06	1.9E-04 +/- 8.3E-06	9.1E-06 +/- 6.8E-06	5.5E-05 +/- 2.0E-07*
Random-1	1.2E-05 +/- 2.0E-06	9.5E-04 +/- 1.3E-05	3.8E-05 +/- 8.8E-06	8.2E-05 +/- 2.0E-07*-
Random-2	1.9E-05 +/- 2.3E-06	6.1E-04 +/- 1.0E-05	2.4E-05 +/- 6.6E-06	9.7E-05 +/- 2.0E-07*
Average	**1.0**	**0.6**	**0.3**	**0.6**

*Reporting limit.
See Exhibit JD-D11-2 of Appendix JD-11 of the NRC Technical Report for sample site locations.

Table ER6-12 Comparison of Average Baseline Values: Jane Dough, Nichols Ranch and Hank Units.

Average Values In Sediments				
	Ra-226	**Pb-210**	**Th-230**	**Uranium**
Sample Location	(µCi/kg)	(µCi/kg)	(µCi/kg)	(µCi/kg)
Jane Dough Unit	1.1E-05	4.6E-04	1.5E-05	5.3E-05
Nichols Ranch	1.9E-04	5.4E-04	4.1E-05	1.2E-04
Hank Unit	7.0E-05	3.9E-04	1.6E-05	3.2E-05

6.1.5 Radon Flux

Regulatory Guide 4.14 indicates that radon flux measurements should be conducted at eight locations within 1.5 km of the site. Because there will be no tailings impoundments or evaporation ponds at the Jane Dough Unit, radon flux is not an applicable radiological parameter for baseline characterization.

6.1.6 Quality Assurance

The quality of data generated for the baseline radiological measurements and monitoring was managed throughout the effort. In general, each collection and analysis were controlled and monitored.

6.1.6.1 Collection

Representativeness was assured by sampling as planned based on applicable regulatory guidance and expectations, review of prior local and/or regional sampling efforts, expected radiological patterns or conditions, and adherence to written instruction for sampling or monitoring.

The instrument used to measure exposure rate had a current annual calibration.

6.1.6.2 Analysis

There were no problems with the analyses and all associated quality control data satisfied laboratory requirements.

6.1.6.3 Results

The completeness of a data set was evaluated by comparison of valid data to the amount of data expected to be obtained. The completeness criteria included use of proper analytical methods, review of quality control data, and approval of laboratory reports. Review of chain's-of-custody and final laboratory reports confirmed that the proper analytical methods were used during analysis of samples. Any case of unaccepted or uncertain data is otherwise described previously with presentation of the results. Each data set was approved by the laboratory.

The comparability of the data sets was also evaluated. Several conditions allow that subsequent data sets can be compared to the data collected during baseline radiological measurements and monitoring. These are:

- The plans for measurements and monitoring provided for collection of representative samples;
- Sample constituents measured in each sample were reported in the correct units;
- Data quality was confirmed by the laboratory; and
- Results are consistent with results of previous comparable efforts and expected conditions.

6.2 PHYSIOCHEMICAL GROUNDWATER MONITORING

This section describes the results of baseline regional groundwater quality monitoring conducted in support of the Jane Dough Unit. The section also addresses the groundwater monitoring program that would be developed based on information obtained from pre-mining baseline geologic and hydrologic information, wellfield testing, and wellfield groundwater baseline sampling.

6.2.1 Groundwater Monitoring

6.2.1.1 Regional Groundwater Monitoring

Regional baseline water quality sampling for the Jane Dough Unit was conducted for a one year time period with regional water wells sampled once a quarter and analyzed for parameters found

in Table ER6-13. These parameters are those that are required by the WDEQ in determining baseline groundwater quality. The results of the regional baseline water quality sampling are detailed in Addendum D6B of the attached Appendix JD-D6 of the NRC Technical Report. Additionally, Section 2.7 of the NRC Technical Report summarizes the groundwater quality information obtained during baseline groundwater sampling.

6.2.1.2 Pre-Operational Wellfield Assessment

The groundwater monitoring program for the Jane Dough Unit would begin with pre-operation wellfield testing. These tests are conducted utilizing the baseline geologic and hydrologic information that was collected and assembled for Jane Dough Unit. Appendix JD-D5 and JD-D6 this application contains the baseline geologic and hydrologic information.

By using the detailed geologic and hydrologic information, monitoring zones can be defined, geologic and hydrologic parameters quantified, wellfields planned, hydrologic monitoring programs developed, and baseline water quality sufficiently determined. This information would then be utilized for prevention and/or detecting excursions of lixiviant outside of the wellfield or into the underlying or overlying aquifers.

6.2.1.3 Monitor Well Spacing

The density and spacing of monitor wells for the Nichols Ranch Unit and the Hank Unit is determined during the geologic and hydrologic assessment of a proposed wellfield. Monitor wells would be installed in the ore zone at a density of one monitoring well per four acres in the proposed wellfield. These wells would be used to obtain baseline water quality data for the proposed wellfield to determine groundwater Restoration Target Values (RTV's).

Horizontal monitor wells would also be installed on the edge of the wellfield in the same zone as the ore zone. This "ring" of wells would be used to obtain baseline water quality data in the area were determined using a groundwater flow model and estimated hydrologic properties for the proposed wellfield. This distance also takes into consideration that if an excursion were to occur, processing fluids could be controlled within 60 days as required by the WDEQ.

outside of the wellfield and to ensure that recovery solutions do not migrate outside of the ore zones. UCL's would be determined for these wells from the baseline water quality data that are collected. The distance between these wells and the wellfield is approximately 500 ft. The distance from horizontal monitor well to horizontal monitor well is also 500 ft. These distances Vertical monitor wells would also be installed in the overlying and underlying aquifers at a density of one underlying and one overlying well per every four acres of wellfield. These wells would be used to collect baseline water data that would be used to determine UCL's for the overlying and underlying aquifers. If the immediate overlying or underlying aquifers in the wellfield are non-existent, or the confining unit (aquitard) is thin (less than five feet in thickness) within the proposed wellfield or section of the wellfield, then monitor well spacing and density would be determined in consultation with the regulatory agencies. In the case of the wellfield

Table ER6-13 Groundwater Baseline Water Quality Parameters and Analytical Methods.

Parameter*	**Analytical Method**
Alkalinity	EPA 310.1/310.2
Aluminum	EPA 200.7
Ammonia Nitrogen as N	EPA 350.1
Nitrate + Nitrite as N	EPA 353.2
Barium	EPA 200.7
Bicarbonate	EPA 310.1/310.2
Boron	EPA 212.3/200.7
Carbonate	EPA 310.1/310.2
Fluoride	EPA 340.1/340.2/340.3
Sulfate	EPA 375.1/375.2
Total Dissolved Solids (TDS) @ 180°F	EPA 160.1/SM2540C
Dissolved Arsenic	EPA 206.3/200.9/200.8
Dissolved Cadmium	EPA 200.9/200.7/200.8
Dissolved Calcium	EPA 200.7/215.1/215.2
Dissolved Chloride	EPA 300.0
Dissolved Chromium	EPA 200.9/200.7/200.8
Total and Dissolved Iron	EPA 236.1/200.9/200.7/200.8
Dissolved Magnesium	EPA 200.7/242.1
Dissolved Manganese	EPA 200.9/200.7/200.8/243.1/243.2
Dissolved Molybdenum	EPA 200.7/200.8
Dissolved Potassium	EPA 200.7/258.1
Dissolved Selenium	EPA 270.3/200.9/200.8
Dissolved Sodium	EPA 200.7/273.1
Dissolved Zinc	EPA 200.9/200.7/200.8
Radium-226 (pCi/L)	DOE RP450/EPA 903.1/SM7500-R-AD
Radium-228 (pCi/L)	SM7500-R-AD
Gross Alpha (pCi/L)	DOE RP710/CHEM-TA-GP B1/EPA 900
Gross Beta (pCi/L)	DOE RP710/CHEM-TA-GP B1/EPA 900
Uranium	DOE MM 800/EPA 200.8
Vanadium	EPA 286.1/286.2/200.7/200.8
Zinc	EPA 200.7
Gross alpha	EPA 900.0
Gross Beta	EPA 900.0

* All parameters measured in mg/L unless otherwise denoted.

6.2.1.4 Production Area Pump Test

When a proposed wellfield has been found to be feasible to be mined using the ISR method, the wellfield becomes a production area. A Production Area Pump Test is then developed to determine information about the hydrologic characteristics of the production area and the underlying and overlying aquifers within the production area. The information to be determined during the Production Area Pump Test includes: hydrologic characteristics of the ore zone aquifer, determination of any hydrologic communication between the ore zone aquifer and the overlying and underlying aquifers, the presence or absence of any hydrologic boundaries in the ore zone aquifer, determination of the degree of hydrologic communication between the ore zone and the monitor well ring, and the vertical permeability of the overlying and underlying confining units that have not already been tested.

Before conducting the Production Area Pump Test, the test plan would be submitted to the Safety and Environmental Review Panel (SERP) and WDEQ for review and comment. Standard Operating Procedures (SOP's) would also be developed that would detail the procedures of the Production Area Pump Test.

6.2.1.5 Production Area Pump Test Document

After the completion of the Production Area Pump Test field data collection, a Production Area Pump Test Document would be assembled and submitted to the WDEQ for review. Additionally the document would be reviewed by the SERP to verify that the results of the production area hydrologic testing and the planned production area activities are in compliance with NRC technical requirements. A written evaluation by the SERP would evaluate any safety and environmental concerns. The evaluation would also address compliance with applicable NRC requirements. The written evaluation would be located at the Uranerz offices.

Details to be contained in the Production Area Pump Test document are as follows:

1. A description of the location, extent, etc. of the production area.
2. Map(s) showing the proposed production area (production patterns) and location of all monitoring wells. This includes the monitor well ring, underlying, overlying, and ore zone wells.
3. Geologic cross-sections maps.
4. Isopach maps of the ore zone, underlying, and overlying confining units.
5. Discussion on pump test methods including well completion reports.
6. Discussion of the results and conclusions of the production area pump test including pumping data, drawdown match curves, potentiometric surface maps, water level graphs, drawdown map, and directional transmissivity data and graphs.
7. Data showing that the monitor well ring and the ore zone are in communication with the production patterns.
8. Any other information that is pertinent to the production area being tested.

6.2.1.6 Baseline Water Quality Determination

The importance of properly defining the baseline groundwater quality for individual production areas cannot be overemphasized as the data collected would be used to establish the UCL's and the restoration target values that would be used in groundwater restoration. SOP would be developed that would detail acceptable water quality sampling and handling procedures, as well as the statistical assessment of the groundwater data.

6.2.1.6.1 Data Collection

Water quality samples would be collected and analyzed from all monitor wells to establish baseline groundwater quality for the ore zone, ore zone aquifer, underlying aquifer, and the overlying aquifer. The sampling of the monitor wells would be in accordance to all sampling, preservation, and analysis procedures. The number of samples collected and the parameters that the samples would be tested for are as follows:

1. Ore Zone (Production Pattern) Wells (MP Wells) – All ore zone monitoring wells in a production area would be sampled four times, with a minimum of two weeks between sampling, during baseline groundwater quality determination. The first and second sampling events shall be analyzed for all parameters found in WDEQ Guideline No. 8 including uranium parameters. The third and fourth sample events can be analyzed for a reduced list of parameters. The parameters that can be deleted from analysis are those that were not detected during the first and second sampling events.

2. Ore Zone Monitoring Ring Wells (MR Wells) – Monitoring ring wells would be sampled four times, with at least two weeks between sampling, during the baseline characterization. The first monitor well ring sampling would include the analyses for the parameters listed in WDEQ Guideline No. 8 including uranium parameters. The remaining three samples would be tested for the potential UCL's parameters chloride, total alkalinity, and conductivity.

3. Overlying Aquifer Wells (MO Wells) and Underlying Aquifer Wells (MU Wells) – The overlying and underlying aquifer monitoring wells would be sampled four times with at least two weeks between sampling events. The first and second sampling events would be analyzed for the parameters listed in Table ER6-14. The third and fourth sampling events would be analyzed for the possible UCL parameters chloride, total alkalinity, and conductivity.

Table ER6-14 Restoration Target Values Parameters.

Parameter	Lower Detection Limit[1]
Alkalinity	5
Ammonia	0.05
Arsenic	.001
Barium	0.1
Bicarbonate	5
Boron	0.1
Cadmium	0.005
Calcium	1
Carbonate	5
Chloride	1
Chromium	0.05
Copper	0.01
Electrical Conductivity@ 25 degrees C	5 uohm
Fluoride	0.1
Iron	0.05
Lead	0.001
Magnesium	1
Manganese	0.01
Mercury	0.001
Molybdenum	0.1
Nickel	0.05
Nitrate	0.01
pH	0-14 s.u.
Potassium	1
Radium-226	0.2 pCi/L
Radium-228	1 pCi/L
Selenium	0.001
Sodium	1
Sulfate	2
Total Dissolved Solids	10
Uranium	0.0003
Vanadium	0.1
Zinc	0.01
Gross Alpha	pCi/L[2]
Gross Beta	pCi/L[2]

[1] mg/L unless specified otherwise
[2] Minimum Detectable Concentrations determined on a sample by sample basis

6.2.1.7 Statistical Assessment of Baseline Water Quality Data

Baseline water quality for the overlying, underlying, ore zone, and monitoring ring wells would be determined by averaging the data collected for each parameter analyzed. In addition to calculating the average of the data, the variability of the data would also be calculated. Outliers would be determined by using the methods outlined in WDEQ Guideline No. 4 or other accepted methods. Any value determined to be an outlier would not be used in baseline calculations. Average data from wells that are not uniformly distributed would be calculated by weighting the data according to the fraction of area, or water volume, represented by the data. Baseline conditions would be calculated as follows:

1. Ore Zone Wells (MP Wells) – Baseline water quality would be calculated by using the average of each parameter that is analyzed. If the data collected shows that water from the entire production area is that of waters of different underground water classes, the data then would not be averaged together, but separated into sub-zones. Data within the sub-zones would then be averaged. The boundaries of the sub-zones, where required, would be delineated at half-way between the sets of sampled wells that define the sub-zones.

2. Monitoring Ring Wells (MR Wells) – Baseline water quality would be calculated by averaging each parameter that is analyzed. As with the ore zone wells, if sub-zones are present that have different classes of water, data in the sub-zones would be averaged separately.

3. Overlying and Underlying Aquifer Wells (MO and MU Wells) – The baseline water quality would be calculated by using the average of each parameter that is analyzed.

6.2.1.8 Restoration Target Values

The RTV's are calculated from the baseline water quality data collected from the ore zone monitoring wells. The RTV's are used in determining and assessing the effectiveness of groundwater restoration within a production area. Baseline water quality averages for the parameters sampled for the ore zone wells constitute the RTV's. If sub-zones exist in the ore zone, the RTV's would be determined for each sub-zone. The Restoration Target Value parameters are listed in Table ER6-14.

6.2.1.9 Upper Control Limits

UCL's are used to define excursions at monitoring wells. Through the installation of the monitoring ring wells, and the overlying and underlying aquifer monitoring wells, tracking of the lixiviant and processing fluids can be accomplished to ensure that the fluids are not leaving the defined ore zone. The process bleed or wellfield purge in combination with the production area pumping and injection rates assist in keeping all processing fluids within the ore zone.

An excursion occurs when the production area processing fluids reach a monitoring ring or overlying/underlying monitor well. This would cause the UCL's to be exceeded. If an excursion is determined to have occurred, operational changes would be implemented to reverse the flow of the processing fluids so that they are retrieved back to the ore zone and the affected monitor well(s) is no longer in a excursion status. UCL's for the monitor wells are determined from the collection of the baseline water quality data. For the Nichols Ranch ISR Project, the parameters to be used for UCL's would be chloride, conductivity, and total alkalinity.

6.2.1.10 Calculation of Upper Control Limits

The UCL's are based on the baseline water quality data and calculated as follows:

1. Chloride UCL – The chloride UCL would be calculated by taking the baseline mean plus five standard deviations or by taking the baseline mean plus 15 mg/L, whichever is greater. The chloride UCL would be expressed in mg/L.

2. Total Alkalinity UCL – The total alkalinity UCL would be calculated by taking the baseline mean plus five standard deviations. The total alkalinity UCL would be expressed in mg/L $CaCO_3$.

3. Conductivity UCL – The conductivity UCL would be calculated by taking the baseline mean plus five standard deviations. The conductivity UCL would be expressed in umhos/cm at 25°C.

6.2.1.11 Operational Groundwater Monitoring Program

The groundwater in a production area would be monitored during operation to detect and correct for any condition that could lead to an excursion. Process variables such as flow rates and operating pressures of each individual operating well would be monitored in addition to the flow rates and operating pressures of the main pipelines going to and from the plants.

6.2.1.11.1 Monitoring Frequency and Reporting

The ore zone, overlying aquifer, and underlying aquifer monitor wells would be sampled twice per month at intervals of approximately 2 weeks. The samples would be analyzed for and compared against the UCL parameters of conductivity, chloride, and total alkalinity. Static water levels would also be collected and recorded prior to the sampling event (but are not used as an excursion indicator). All static water levels and analytical monitoring data for the monitoring wells would be kept by Uranerz and submitted to the WDEQ on a quarterly basis. These data would also be available to the NRC for review.

6.2.1.11.2 Water Quality Sampling and Analysis Procedures

Water quality samples would be obtained for the monitor wells through permanently installed submersible pumps. Initially the monitor wells would have three casing volumes discharged before sampling to ensure that the water in the well is formation water. As operations continue, the monitor wells would be pumped for a determined amount of time, with a minimum of one casing volume removed, based on the particular monitor well's performance. Each individual monitor well would have its static water level recorded prior to pumping. Conductivity, pH, and temperature would be measured in the field and recorded in periodic intervals prior to sampling. This is done to demonstrate that the water quality conditions in the monitor wells have stabilized and that formation water is being sampled. All collected water quality data for each monitor well would be periodically reviewed to ensure that sampling and analytical procedures are adequate.

All water quality samples from the monitor wells would be analyzed at the Nichols Ranch Unit laboratory for chlorides, total alkalinity, and conductivity within 48 hours of the sample being collected. All samples would be analyzed in accordance with accepted methods. Standard Operating Procedures (SOP's) would be developed that would detail all water sampling and laboratory analysis procedures.

6.2.1.11.3 Excursions

If any two of the three UCL excursion parameters (chloride, total alkalinity, or conductivity) are exceeded, an excursion is suspected to have occurred. Within 24 hours of the first analysis, a second verification sample would be taken and analyzed to determine that two of the three excursion parameters have been exceeded. The verification sample is then split and analyzed in duplicate to assess any analytical error. If two of the three UCL's are exceeded, an excursion is then verified. If the second sample does not exceed the UCL's, then a third sample would be taken within 48 hours. During an excursion event, all monitoring wells that are placed on excursion status would be sampled at least every seven days for the UCL parameters.

If an excursion is verified by the second or third sample, the WDEQ and NRC Project Manager would be notified by telephone or email within 24 hours. The WDEQ and NRC Project Manager would also be notified in writing within seven days of a verified excursion. Corrective actions such as changes in the injection and recovery flow rates in the affected area would be implemented as soon as practical. The corrective actions would continue until the excursion is reversed. A written report describing the excursion event, corrective actions, and the corrective action results must also be submitted to the NRC Project Manager within 60 days of the excursion confirmation.

In the event that the concentration of the UCL parameters that were detected in the monitor well(s) do not begin to decline within 60 days after the verification of an excursion, all injection into the ore zone (production zone) adjacent to the excursion would be suspended to further increase the amount of net water withdrawal from the excursion area. Injection would be suspended until such time that a declining trend in the UCL parameters concentration is established. If a declining trend is not established in a reasonable time period, additional measures would be implemented. When

a significant declining trend is established, normal operations would resume with injection and/or production rates monitored such that net water withdrawals for the excursion area would continue. The declining trend would be maintained, until the concentrations of excursion parameters in the affected monitor well(s) have returned to concentrations less than the established UCL's.

6.2.2 Quality Assurance

The quality of data generated for the baseline groundwater quality measurements and monitoring was managed throughout the effort. All groundwater sample collection and analysis were controlled and monitored.

6.2.2.1 Sample Collection

Groundwater baseline sample collection was conducted based on guidance provided by the Uranerz Groundwater Sampling Procedure and by the WDEQ Guideline No. 8-Hydrology (2014). These documents detailed the methods to be used in collecting groundwater samples to ensure that the samples are handled and obtained correctly so that the proper information can be obtained.

6.2.2.2 Sample Analysis

Analysis of the groundwater collected was preformed according to all associated quality control measures implemented by the laboratory. No issues or problems with the analyses of the data occurred.

6.2.2.3 Results

The completeness of the groundwater quality data set was evaluated by comparison of valid data to the amount of data expected to be obtained. The completeness criteria included use of proper collection and sampling methods, review of quality control data, and approval of laboratory reports. Review of chain's-of-custody and final laboratory reports confirmed that the proper analytical methods were used during analysis of samples. Any case of unaccepted or uncertain

data is otherwise described previously with presentation of the results. Each data set was approved by the laboratory.

The comparability of the data sets was also evaluated. Several conditions allow that subsequent data sets can be compared to the data collected during baseline groundwater quality measurements and monitoring. These are:

- The plans for measurements and monitoring provided for collection of representative samples;
- Sample constituents measured in each sample were reported in the correct units;
- Data quality was confirmed by the laboratory; and
- Results are consistent with results of previous comparable efforts and expected conditions.

6.3 ECOLOGICAL MONITORING

6.3.1 Wildlife

Wildlife monitoring for the Jane Dough Unit would include annual raptor and sage grouse surveys as required by the WDEQ. Raptor surveys would take place in late April or early May. Sage grouse surveys would take place at the same time. The purpose of the surveys would be to observe identified raptor nesting activity within the permit area, observe and count sage grouse activity on known leks within one mile of the permit boundary, and to observe if any new nests or leks are in the permit or surrounding one mile area.

Baseline field studies conducted for the Jane Dough Unit found that there is one greater sage-grouse leks within the permit area and three additional leks located within 2.0 mi of the permit area. Seventy one raptor nests were found within the permit area and a one-half mile buffer of which seven were determined to be active in 2012. All nests were located in areas that would not be affected by wellfield or associated activities with the Jane Dough Unit. All nests within 0.5 miles of the Jane Dough Unit boundary would be monitored annually for continued activity. In the unlikely event that it becomes necessary to disturb a raptor nest, a mitigation plan would be

developed including consultation with the WDEQ, Wyoming Game and Fish, and the U.S. Fish and Wildlife Service. Any required permits would be obtained from the appropriate agencies.

Appendix JD-D9 attached to this license application provides further detailed discussions on the sampling methods used in conducting the baseline wildlife surveys and the results of those studies for the Jane Dough Unit. The locations and activity status of raptor nests in 2012 are provided in Table JD-D9-4 and illustrated on Exhibit JD-D9-3 in Appendix JD-D9 of the NRC Technical Report. The results of the baseline sage grouse surveys and historic lek activity data are presented in Table JD-D9-3. Sage grouse lek locations are illustrated on Exhibit JD-D9-3. Also included in Appendix JD-D9 is the documentation of contact with all applicable regulatory agencies.

6.4 NO ACTION ALTERNATIVE

No environmental measurements and monitoring programs would be needed if the No Action Alternative were implemented since no mining would take place.

7.0 COST BENEFIT ANALYSIS

7.1 GENERAL

Uranium that would be mined at the Jane Dough Unit would be used to replace the uranium consumed in the production of power from nuclear power plants. The Jane Dough Unit would also supply a domestic source of uranium that would help alleviate the need of nuclear power plant operators in the United States to seek uranium supplies from foreign sources. Currently the United States imports approximately 30 million pounds of uranium from foreign countries while only producing approximately 5 million pounds per year. The Jane Dough Unit would have the beneficial effect of helping the United States offset this deficit in domestic production.

In evaluating the benefits of energy produced during reactor licensing, the environmental costs of the reactor are weighed against the energy produced by including a prorated share of the environmental costs associated with recovering uranium for fuel. The incremental impacts of mining uranium for the use in reactor fuel are justified in terms of benefits of energy generation to society. With that, the benefits and costs of an in situ recovery facility are evaluated in terms of benefits to the United States and society in general against local environmental costs for which there may be no directly related compensation.

7.2 QUANTIFIABLE ECONOMIC IMPACTS

The major potential benefits of the Jane Dough Unit include the added income and revenues to local communities in the area near the project area, the State of Wyoming, and the federal government through employee income, royalty income, and tax revenues generated by the mining operation. Some items that may go against these potential benefits involve the incremental costs and strains on schools, fire and medical response, and other community services for the continued operation of the Jane Dough Unit as part of the Nichols Ranch ISR Project, but these costs are relatively small since most of the workforce that would be used for the Jane Dough Unit would already be employed at the adjacent Nichols Ranch ISR Project. Because of uncertainties in the

market place and other factors such as counties being able to alter various taxing rates, a numerical balance between the benefits and costs of any one community, or for the project cannot be arrived.

7.3 ENVIRONMENTAL COSTS

The Jane Dough Unit would basically have three types of environmental costs: 1) radiological impact, 2) disturbance of the land, and 3) groundwater impact. The radiological impacts of the project during its operation are minimal since all potential radiological containing materials would be confined in the process. During reclamation, any remaining solid radioactive wastes would be disposed of at an NRC licensed facility. This results in no long-term impact at the site from the radiological materials. The disturbance of the land is also a small environmental impact. All lands that are disturbed during the life of the project would be reclaimed, and after the project is decommissioned, would be returned back to the pre-mining use. Groundwater impacted by the Jane Dough Unit would be restored back to pre-mining conditions such that pre-mining use suitability of the groundwater is maintained.

7.4 SUMMARY

The overall economic benefits to local communities, the State of Wyoming and the federal government along with the minimal radiological impacts, surface disturbance, and groundwater impacts that result from the production of uranium to make nuclear power for the use of the general public, make the benefit-cost balanced in favor of the development of the Jane Dough Unit. Additionally, the domestic production of uranium for the use of producing nuclear power helps the United States reduce its need to import uranium from foreign sources. With this, issuing a source material license for the Jane Dough Unit is the desired regulatory action.

8.0 SUMMARY OF ENVIRONMENTAL CONSEQUENCES

The Jane Dough Unit would use the ISR method of mining uranium. The project would be located in Johnson and Campbell counties, Wyoming, in the Pumpkin Buttes Mining District of the Powder River Basin. The location of the Jane Dough Unit is located immediately adjacent to Uranerz Nichols Ranch ISR project. In addition, it is also located near the currently licensed and operational uranium ISR facility, Uranium One Inc.'s Willow Creek (Christensen Ranch/Irigaray) ISR project and one area that is licensed and under development (Cameco's North Butte ISR project).

The ISR mining method environmental impacts are temporary and not significant (NRC 2008). Information concerning specific resource impacts resulting from the Jane Dough Unit is presented in Table ER2-1 and will not be repeated here. Impacts to groundwater resources, radiological doses to workers and the surrounding area, soils, ecology, and land use are small and limited. Groundwater affected by the recovery facilities would be returned to pre-mining conditions, or if alternately approved, to its pre-mining class of use standard when completion of a production area occurs. Radiological doses to workers and the surrounding area (general public) would be below the regulatory limits in 10 CFR Part 20. Any radioactive (contaminated) waste generated by the Jane Dough Unit operations would be disposed of in approved methods such as disposal at a licensed NRC facility or in a deep disposal well.

Land use impacts would be small as only approximately 101 acres would be disturbed during the life of the project. Measures would be taken to stockpile topsoil in areas where disturbances would last the life of the project. In areas such as the wellfield, any disturbance to the soils would be temporary as the soils would be reclaimed and reseeded immediately after any constructions activities. Construction activities include pipeline installation, wellfield construction, and temporary wellfield roads. Final reclamation of the wellfield and site facilities would return the land affected by the Jane Dough Unit to its pre-mining use of livestock grazing and wildlife habitat.

The total cumulative impacts of the proposed project would not result in a significant impact to the general public and surrounding areas. Mitigation measures would be put in place to minimize environmental impacts from the Jane Dough Unit so that upon completion of the project all groundwater and lands affected by the operation would be returned to their pre-mining condition or use.

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