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NICHOLS RANCH ISR PROJECT

URANIUM SOLUTION MINE

Campbell and Johnson Counties, Wyoming

Volume III
(Environmental Report)

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

November 2007

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

Page

TABLE OF CONTENTS

Page

TABLE OF CONTENTS

TABLE OF CONTENTS

Page

TABLE OF CONTENTS

Page

LIST OF FIGURES

Page

LIST OF FIGURES (Continued)

LIST OF EXHIBITS

LIST OF TABLES

LIST OF TABLES

1.0 INTRODUCTION

1.1 GENERAL

Uranerz Energy Corporation plans to license the Nichols Ranch ISR Project that will mine the Nichols Ranch Unit (Township 43N, Range 76 West, Sections 7, 8, 17, 18, and 20) and Hank Unit (Township 44N Range 75 West, Sections 30 and 31; Township 43N Range 75W, and Sections 5, 6, 7 and 8) Wyoming ore zones using the in situ recovery (ISR) extraction method. This is the same method that is used by Power Resources Inc. ("PRI") at the Smith-Highlands mine in the southern Powder River Basin and is the same method used by COGEMA (AREVA) at the nearby Christensen Ranch site.

The Nichols Ranch ISR Project will combine the Nichols Ranch and Hank ore zones 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 Energy Corporation to produce uranium (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) will be carried out by the Wyoming Department of Environmental Quality as they are a primacy state with the EPA.

Uranerz Energy Corporation plans on starting production with the Nichols Ranch ISR Project in 2010. Figure 3-12 (see map pocket) of the Uranerz Energy Corporation, Nichols Ranch ISR Project U.S.N.R.C. Source Material License Application Technical Report provides a schedule of planned activities for the Nichols Ranch ISR Project.

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 (yellowcake) produced at the Nichols Ranch ISR Project will be used in the manufacturing of nuclear fuel to be used by the nuclear power industry. The yellowcake produced will 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 Nichols Ranch ISR Project 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. The Nichols Ranch ISR Project is divided into two units, the Nichols Ranch Unit and the Hank Unit. The central processing plant (CPP) will be located at the Nichols Ranch Unit, and a satellite facility will be located at the Hank Unit. The Hank satellite facility is approximately 6.0 mi northeast of the central processing plant at Nichols Ranch. Uranerz desires licenses for a central processing plant, satellite facility and accompanying wellfields for an in situ recovery operation with ion exchange columns.

The Nichols Ranch ISR Project consists of approximately 3,370 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 Figure 1-1 (see map pocket) of the NRC Technical Report.

Extraction of the uranium ore contained in the Wasatch formation of the Powder River Basin will be through the in situ recovery method of mining. A sodium carbonate/sodium bicarbonate solution and an oxidizing agent such as oxygen will be injected and recovered through a complex of well patterns. 4-spot, 5-spot, and 7-spot well patterns will be used in the ore recovery process. The central processing plant at Nichols Ranch will have a nameplate capacity to produce 2,000,000 pounds per year of U_3O_8 (yellowcake). Initially the Nichols Ranch Unit will have a designed flow rate of 3,500 gallons per minute (gpm) and a maximum annual production of 500,000 pounds. The satellite facility at the Hank Unit will have a designed flow rate of 2,500 gpm and an annual designed production of 300,000 pounds. Construction for the two units is estimated at approximately one year. The Nichols Ranch Unit should have a six month ramp up to the full annual production, and after the Nichols Ranch Unit ramp up, The Hank Unit will start a six month ramp up phase to the full annual production. It will take an estimated 3-4 years to extract the uranium from the Nichols Ranch Unit and an estimated 4-5 years to extract the uranium from the Hank Unit.

The wellfields at the Nichols Ranch and Hank Units will be divided into production areas. Once mining is completed in a production area, reclamation of that production area will begin. Figures 3-10 and 3-11 (see map pockets) of the NRC Technical Report show the production areas for the Nichols Ranch and Hank Units. Groundwater will 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 four to six years from start to finish. Solid material such as pipelines, buildings, etc. will 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 10-1 of the Uranerz Energy Corporation, Nichols Ranch ISR Project U.S.N.R.C. Source Material License Application Technical Report. Prior to the start of mining (the injection of lixiviant into the ore zone aquifer), Uranerz Energy Corporation will have obtained all the necessary permits, licenses, and approvals required by the Wyoming Department of Environmental Quality and the Nuclear Regulatory Commission.

The location of the Nichols Ranch ISR Project has also been subject to numerous federal environmental reviews over the past few years. With the presence of coal bed methane (CBM) extraction on the land in and adjacent to the permit boundaries of the Nichols Ranch ISR Projects, the area has been subject to one environmental impact statement (EIS), two completed environmental analysis (EA), and one on-going environmental analysis. The environmental analysis for the CBM activities can be found at the following BLM website link: http://www.blm.gov/wy/st/en/info/NEPA/bfodocs.html. The Anadarko Dry Willow Phase I and

Phase II EA contain the area where the Hank Unit is located. The Powder River Basis (PRB) EIS covers the entire Powder River Basin and William Production is currently undergoing an EA for their Tex Draw Project which contains the land where the Nichols Ranch Unit is located. Exhibits and tables detailing the location of all CBM 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, and land use, brief history of the Nichols Ranch ISR Project area and the radiological assessment for the Nichols Ranch ISR Project can also be found in the attached Appendix D. This information is required by the Wyoming Department of Environmental Quality–Land Quality Division (WDEQ-LQD) to obtain a Permit to Mine for the Nichols Ranch ISR Project.

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 Nichols Ranch ISR Project would not take place because the NRC would not issue a license for Nichols Ranch ISR Project. In situ recovery extraction would not take place in the Nichols Ranch ISR Project area and no environmental impacts associated with the in situ recovery extraction would occur.

2.1.2 Proposed Action

Uranerz Energy Corporation is applying for a source license with the U.S. Nuclear Regulatory Commission (NRC) for in situ recovery of uranium. The applications for operating and reclamation are being submitted to the NRC and the Wyoming Department of Environmental Quality–Land Quality Division (WDEQ).

The Nichols Ranch ISR Project 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. The Nichols Ranch ISR Project is divided into two units, the Nichols Ranch Unit and the Hank Unit. The central processing plant (CPP) will be located at the Nichols Ranch Unit, and a satellite facility will be located at the Hank Unit. The Hank satellite facility is approximately 6.0 mi northeast of the central processing plant at Nichols Ranch. Uranerz desires licenses for a central processing plant, satellite facility and accompanying wellfields for an in situ recovery operation with ion exchange columns.

The current land surface ownership of the Nichols Ranch ISR Project includes approximately 3,090 acres of private ownership and approximately 280 acres of United States Government ownership administrated by the Bureau of Land Management (BLM).

Uranerz Energy Corporation estimates the U_3O_8 content for the Nichols Ranch Unit to 2,521,000 pounds and the U_3O_8 content for the Hank Unit to be 1,852,000 pounds. The central processing plant at Nichols Ranch will have a nameplate capacity to produce 2,000,000 pounds per year of U_3O_8 (yellowcake). Initially the Nichols Ranch Unit will operate at a designed flow rate of 3,500 gallons per minute (gpm) and a maximum annual production of 500,000 pounds. The satellite facility at Hank will have a designed flow rate of 2,500 gpm and a maximum annual production of 300,000 pounds. Construction for the two units is estimated at approximately one year. Nichols Ranch should have a six month ramp up to the full annual production, and after the Nichols Ranch ramp up, Hank will start a six month ramp up phase to the full annual production. It will take an estimated 3-4 years to extract the uranium from the Nichols Ranch Unit and an estimated 4-5 years to extract the uranium from the Hank Unit.

The plans for project waste management and disposal are twofold. Uranerz plans to drill a deep disposal well at both the Nichols Ranch and Hank Units. The deep disposal wells will receive liquid waste. Uranerz will also have an agreement with an approved waste disposal facility for 11e(2) byproduct material.

A detailed description of the proposed Nichols Ranch ISR Project facilities including process and wellfield descriptions can be found in Chapter 3.0, Description of the Facilities, in the NRC Technical Report. Details surrounding the reclamation and restoration activities for the proposed Nichols Ranch ISR Project can be found in Chapter 6.0, Reclamation Plan, of the NRC Technical Report.

2.1.3 Reasonable Alternatives Considered But Eliminated

Alternated methods of mining available for the Nichols Ranch ISR Project 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 in situ recovery (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

2.2 OTHER ALTERNATIVES CONSIDERED BUT ELIMINATED

2.2.1 Alternative Sites

The planned location of the Central Processing Plant for the Nichols Ranch ISR Project is shown in Figure 1-2 (see map pocket) of the NRC Technical Report. The Hank Unit Satellite Facility is shown in Figure 1-3 (see map pocket) of the NRC Technical Report. All of these facilities were located off of the ore zone on the most topographically suitable land within the project area. Additionally the ease of access with the minimum disturbance was considered in selecting the plant locations. With these considerations, no realistic alternative site locations exist.

2.2.2 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 the Nichols Ranch ISR Project. The solution was selected based upon its successful use in recovering uranium and aquifer restoration in several pilot plant projects and commercial 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 the difficulties in restoring and stabilizing the affected ore zone aquifers. Because of these reasons, the solutions were not considered for the Nichols Ranch ISR Project.

2.2.3 Groundwater Restoration Alternatives

Uranerz Energy Corporation 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 Nichols Ranch ISR Project. 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 Energy Corporation will consider incorporating these technologies into groundwater restoration.

2.2.4 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. The deep disposal wells to be used will be drilled to a depth of approximately 6,000 ft deep or greater. Each deep disposal well must be authorized by the State of Wyoming and the EPA UIC Program to receive the liquid effluent wastes.

2.3 CUMULATIVE EFFECTS

Past, present, or reasonably foreseeable future actions may or may not result in cumulative impacts when combined with the Nichols Ranch ISR Project. Such items that will be discussed, but are not limited to, are air quality and noise, soils, groundwater, road construction and transportation risks, coal bed methane development (CBM) development, oil/gas development, ecology, and rural development.

2.3.1 Air Quality and Noise

The development and operation of the proposed project would not make a significant contribution to the cumulative impacts on air quality and noise in the region. Existing air quality in the project vicinity is good with the impacts of the project on air quality being minimal. Other activity in the region of the Nichols Ranch ISR Project includes the present development of coal bed methane and the past development and continued operation of oil/gas wells. These two activities result in minimal cumulative impacts to the region even when combined with the Nichols Ranch ISR Project. When the Nichols Ranch ISR Project starts construction, all coal bed methane development including drilling of CBM wells, installation of pipelines, water lines, and utility corridors will be completed. No future oil/gas development is expected or currently planned in the region of the Nichols Ranch ISR Project. Current oil/gas well pumping facilities will remain intact and operational.

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 will 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.

2.3.2 Soils

The proposed project will contribute to impacts on soils in the project area. Past and current oil/gas development and operation combined with the coal bed methane industry have affected soils that will be located in the Nichols Ranch ISR Project area. Both the oil/gas industry and the coal bed methane 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 Energy Corporation will have to disturb since engineered and improve roads all ready exist in the project areas from the oil/gas and CBM producers.

The Nichols Ranch ISR Project would involve disturbing up to 300 acres for buildings and wellfields. The contribution of this disturbance to past, present, and future impacts on soils in the region is not expected to create a significant cumulative impact because Uranerz Energy Corporation is required to decommission and reclaim each of the project sites. As has been demonstrated at other ISR facilities in Wyoming, the proposed project's contribution to cumulative impacts on soils is likely to be small and temporary.

2.3.3 Groundwater

Cumulative impacts that could contribute to the groundwater in the proposed project area include future in situ recovery uranium mining. Two licensed operations exist in the area near the Nichols Ranch ISR Project. Power Resources' North Butte ISR Project is located approximately two miles from the northern Hank Unit boundary. COGEMA's Christensen Ranch ISR Project is located approximately 6.0 mi to the north of the Nichols Ranch Unit and 4.0 mi to the northwest of the Hank Unit. Currently these two operations are not producing, but when the operations do start up, they could potentially be mining in the same aquifer as the Nichols Ranch ISR Project. Additionally, reasonably foreseeable future mining activities by Uranerz Energy Corporation have the potential of being in the same aquifer as the Nichols Ranch 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 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 aquifers use.

Cumulative impacts on the groundwater resulting from in situ recovery uranium extraction and coal bed methane activity could occur, but are negligible since the coal bed methane production and the in situ recovery uranium mining occur in stratagraphically separate zones. The CBM production is at a deeper interval then the in situ recovery. For the Nichols Ranch ISR Project, the in situ recovery mining takes place at depths from 300 to 600 ft. In comparison, the CBM is produced from coal seams 1,000 ft and deeper. The possibility of communication between a uranium ore zone aquifer and a coal bed methane coal seam could happen if coal bed methane wells located near any of the wellfields is not completed property. Although this could happen, the chance of it actually occurring is low since the CBM producers use a well procedure that tests each well's integrity. The well completion procedure used by the CBM producers is very similar to that of uranium well. The well is drilled down to the top of the coal seam, cemented to the surface and then open holed completed in the coal seam. CBM producers typically run 9 5/8 inch surface casing to a depth of 10% of the total well depth or a minimum of 60 ft, then a 7-inch production casing is ran to the top of the coal seam. The surface casing will be set and cemented to isolate upper sands or coals before the 7-inch casing is set. Once the 7-inch casing is in place, the well is cemented to the surface with a cement bond log ran to ensure the integrity of the cement and well. Coal bed methane wells in the proposed project area will be in place and producing before the Nichols Ranch ISR Project begins operation. This will allow Uranerz Energy to monitor ore zone aquifers to see if any potential impacts (aquifer communication) are taking place between the ore zone aquifer and the CBM well. If any impacts are observed, problems can be addressed and resolved before any mining takes place.

Exhibit 2-1, Nichols Ranch CBM Infrastructure, and Exhibit 2-2, Hank Unit CBM Infrastructure (see map pockets) detail the current CBM infrastructure (wells, pipelines, utilities, and roads) that occur in both the Nichols Ranch Unit and Hank Unit license areas.

2.3.4 Transportation Risk

Shipments of process chemicals to the site and the shipment of product from the site will contribute to minimal transportation risks on the roads in the region of the proposed project, 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 Nichols Ranch ISR Project is low. Approximately one tractor-trailer per day will 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 the oil/gas and coal bed methane producers.

2.3.5 Ecology

The proposed project would have a minimal ecological impact to the region through the disturbance of land. Approximately 300 acres will be disturbed during the life of the proposed project, but the cumulative impact of this disturbance combined with past, present, and future actions are not expected to be significant. Much of the land near the Nichols Ranch ISR Project site has been affected by past and current actions such as livestock grazing, oil/gas development, and coal bed methane development.

The Nichols Ranch ISR Project disturbance to soils and vegetation during wellfield development and pipeline construction will be temporary since the areas disturbed will be reclaimed and reseeded as soon as possible after these activities occur. Also the land disturbed by the by the project is small relative to the amount of similar wildlife habitat available in the region. Any land that is disturbed by the project will be reclaimed and revegetated upon completion of the project. Additionally, there are no foreseeable future actions that would combine with the project to create significant cumulative impacts on ecological resources.

Cumulative impacts to wildlife, particularly greater sage-grouse, from the proposed project will be minimal when combined with past, present, and future actions. Greater sage-grouse activity along with raptor nesting is monitored on a yearly basis to assess bird populations and impacts. Uranerz Energy Corporation will also take measures to mitigate any potential impacts that may occur to the greater sage-grouse and raptors inhabiting the proposed project area. Such measures include moving traffic travel times during greater sage-grouse mating season if a lek is discovered to be an area where traffic occurs. Currently, there are no lek's identified on the Nichols Ranch ISR Project area. This in addition to the stipulations all ready imposed on CBM and oil/gas during the greater sage-grouse mating season will result in minimal disturbance to the wildlife.

2.3.6 Land Use

The proposed project will not make a significant contribution to the cumulative land use impacts in the region. With only 300 acres of disturbance expected during the life of the Nichols Ranch ISR Project, the main disturbance would be to the loss of grazing and wildlife habitat 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.

2.3.7 Cultural Resources

Minimum cumulative impacts to cultural resources would likely result from the proposed project. Past and current activities by the oil/gas and coal bed methane development have identified most of the cultural resources in the proposed project area. What has not been all ready surveyed has been or will be surveyed by Uranerz Energy Corporation. Steps will be taken by Uranerz Energy Corporation to mitigate any impacts to cultural resource sites. If any cultural sites are encountered at anytime during wellfield development and/or construction, proper measures will be taken to protect the site, with the proper regulatory agencies notified, so that a path forward could be determined.

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. The Hank Unit of the proposed project would have an adverse effect to the setting of a Traditional Cultural Property (TCP) that was identified in 2006 because of its location in regards to the TCP. However, any effect to the TCP would be only short term since the Hank Unit would be fully restored and reclaimed after completion of the uranium extraction. Also, the proposed project would not contribute to effects of archaeological resources outside of the project sites.

2.3.8 Public and Occupational Health

The proposed project would have no significant cumulative impact on public and occupational health. With the Nichols Ranch ISR Project being located in a remote, sparsely populated area, on private land, public access and interaction with the Nichols Ranch ISR Project would be limited to pre-arranged public tours.

The occupational health hazards of exposure to radioactive materials (uranium, radon, etc.) to employees will be minimal. The plant will 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 will also be designed to keep air circulating throughout the plant to prevent any buildup of radon gas. Localize ventilation will be available for situations when operators and other personnel will be working in such places that they could be exposed to radon gas or uranium dust.

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

Radiological monitoring of the permit area boundaries will also take place. The monitoring will be compared with base line data collected prior to any ISR activities to ensure that radiological exposure is minimized to the areas surrounding the Nichols Ranch ISR Project.

2.3.9 Socioeconomics

The proposed project 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 could be a concern if employees must come from areas outside of the project region. If additional uranium mining occurs in the future, it is likely that the positive socioeconomic effects would be accentuated.

2.3.10 Visual/Scenic Resources

The cumulative impacts to the visual/scenic resources to the region that the project is located in are not expected to be significant. The project is located in a remote area that is largely on private land with limited or no access. This restricts the number of people that will able to see the operations. Additionally measures will be taken to have processing facilities, office and maintenance buildings, header houses, and well casing covers painted to blend in with the natural landscape.

2.3.11 Waste Management

The proposed project would have some impacts to licensed NRC disposal facilities and local landfills from the solid wastes generated from the Nichols Ranch ISR 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.

Liquid wastes would not have significant cumulative impact since these wastes will be disposed of through a permitted deep disposal well.

2.3.12 Environmental Justice

The proposed project would not have any adverse cumulative impacts on minority populations or groups living below the poverty level. The area that the Nichols Ranch ISR Project is located is in a remote area surrounded by a rural population with no concentrated minority populations or people living below the poverty level. Additionally, minorities make up a small percentage of the population of the area that the project is located in and in the state as a hole. The average earnings for the areas surrounding the project area are also well above the poverty level with unemployment at an average of ~3.4%.

2.4 COMPARISON OF THE PREDICTED ENVIRONMENTAL IMPACTS

Table 2-1 outlines the predicted environmental impacts of the proposed Nichols Ranch ISR Project compared to two alternatives of Alternative A – Open Pit Mining and Alternative B – Underground Mining.

Table 2-1 Comparison of Predicated Environmental Impacts.

Predicated Environmental Impact	Proposed Action	Alternative A*	Alternative B**	No Action
AIR QUALITY AND NOISE				
Air quality in the region diminishes and noise increases	No change in air quality because of nature of ISR. Noise level increase is minimal from drilling operations. Drilling only occurs during daylight hours.	Air quality diminishes from dust from mining activities, noise increases from constant mining of open pit.	Air quality affected by dust from crushing operations, increased traffic coming into sites. Increase in noise level from mill operation and traffic	No additional impact
SOILS				
Soils are disturbed by mining operation resulting in loss of vegetation and wildlife habitat	ISR operation will disturb approximately 300 acres of land. All land will be restored and reclaimed after life of project.	More land disturbed with nature of open pit mining. Amplitude of disturbance also increases	More land disturbed with mining and mill operations. Amplitude of disturbance increases	No additional impact
GROUNDWATER				
Groundwater is contaminated and aquifer is dewatered	ISR operation will restore the affected groundwater in the mining ore zone back to pre-mining conditions or class of use. This has successfully been done in Wyoming.	Ore zone aquifer will be dewatered in order to mine. Surficial groundwater contamination could result through use of ponds	Ore zone aquifer will be dewatered in order to mine. Surficial groundwater contamination could result through use of ponds	No additional impact
TRANSPORTATION RISK				
Increase in traffic could lead to accidents resulting in spills of process chemicals and yellowcake product	Traffic from ISR operations is very low. One tractor-trailer per day along with 8 passenger vehicles per day will utilize roads.	Traffic volume will be higher because the number of people needed to run open-pit mine is higher than ISR.	Traffic volume will be higher because the number of people needed to run underground mine is higher than ISR.	No additional impact

* Alternative A is open-pit mining with a conventional processing mill.
** Alternative B is underground mining with a conventional processing mill.

Table 2-1 (Continued)

ECOLOGY				
Wildlife and vegetation affected through disturbance caused by mining.	ISR operation would only disturb 300 acres over life of project. Restoration and reclamation of disturbed lands would take place during and after mining activities.	Land disturbance with open pit mining is considerably higher than with ISR. More time involved in putting land back to pre-mining conditions.	Land disturbance with underground mining and milling is considerably higher than with ISR. More time involved in putting land back to pre-mining conditions.	No additional impact
LAND USE				
Land use is affected by mining operation. Grazing and wildlife habitat is lost.	ISR operation would only disturb 300 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.	Land disturbance with open pit mining is considerably higher than with ISR. More time involved in putting land back to pre-mining conditions.	Land disturbance with underground mining and milling is considerably higher than with ISR. More time involved in putting land back to pre-mining conditions.	No additional impact
CULTURAL RESOURCES				
Disturbance/destruction of cultural sites. Adverse effect on the setting of the identified TCP.	Surveys have been conducted to identify cultural sites. Measures will be taken to minimize/avoid disturbance of sites. Current activities of oil/gas and coal bed methane have also surveyed area for cultural sites. Overall disturbance by ISR mining is 300 acres, so should not impact cultural sites.	Similar to proposed action, but considerably more land disturbance.	Similar to proposed action, but considerably more land disturbance.	Would have an adverse effect to the setting of the identified TCP, however, proposed project would not have disturbance in the TCP and the effect would not be long-term.
PUBLIC AND OCCUPATIONAL HEALTH				
Exposure of public and workers to radioactive material. Possible contamination of groundwater.	Plant design and located such that any exposures to radiation to operators or public is none to minimal. Radiological detectors are placed on the permit boundaries to monitor radiological effects of operation. Groundwater is closely monitored so that an excursion will be detected quickly if one occurs.	Exposure to radioactive material is more likely to occur since people are physically removing ore. Groundwater contamination more likely with use of ponds.	Same as Alternative A	No additional impact

* Alternative A is open-pit mining with a conventional processing mill.
** Alternative B is underground mining with a conventional processing mill.

Table 2-1 (Continued)

SOCIOECONOMICS				
Strain on housing and community services	Positive effect on surrounding area through taxes, wages, and jobs. Employees come from surrounding communities. Low number of employees, ~60.	More labor intensive that might strain surrounding communities if workers come from outside of area.	More labor intensive that might strain surrounding communities if workers come from outside of area.	No additional impact. Overall positive contribution.
VISUAL/SCENIC RESOURCES				
Plants and wellfield would affect regional aesthetics	Nichols Ranch ISR Project is located on private land in a remote area with limited or no public access. Buildings, well casings, header houses, etc. will be painted to blend into natural landscape. Nature of ISR extraction has limited visual/scenic impact because of small surface disturbance. No disturbance would occur in the TCP. Project will be outside of the TCP, but close proximity would have adverse effect.	Visual/Scenic impact is more evident with open pit mining with large surface disturbance, ponds, and more people required for running operation.	Underground mining with conventional mill is recognizable. Mill operation is larger than ISR plant and wellfield. Additionally site would include tailings pond and larger workforce than proposed project.	No additional impact. After life of project, area will be restored and reclaim to original land use of livestock grazing and wildlife habitat.
WASTE MANAGEMENT				
Impact on NRC licensed disposal sites and local landfill from solid waste generated. Liquid wastes sent to Class I Non-hazardous deep disposal well.	Impacts would be minimal to disposal facilities since waste generated at ISR operations will 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.	Waste generated at open pit facility is much greater than ISR. Not all material can be removed from site (i.e., tailings ponds, waste rock stockpiles).	Same as Alternative A	Small impact to NRC licensed disposal sites and local landfills.
ENVIRONMENTAL JUSTICE				
Minority populations or people living below the poverty level being affected by the Nichols Ranch ISR Project	No cumulative 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.	Impacts would be the same as the proposed action.	Same as Alternative A	No additional impact.

* Alternative A is open-pit mining with a conventional processing mill.
** Alternative B is underground mining with a conventional processing mill.

3.0 DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1 LAND USE

3.1.1 Site Location and Layout

The Nichols Ranch ISR Project is located in the Pumpkin Buttes Mining District of the Powder River Basin in Johnson and Campbell Counties Wyoming. The project is divided into two project units, the Nichols Ranch Unit and the Hank Unit. The Nichols Ranch Unit encompasses approximately 1,120 acres of land located in Township 43 North, Range 76 West, Sections 7, 8, 17, 18, and 20. The Hank Unit encompasses approximately 2,250 acres of land located in Township 44 North, Range 75 West, Sections 30 and 31, Township 43 North, Range 75 West, and Sections 5, 6, 7, and 8. The Nichols Ranch Unit will be the site of the main processing facility consisting of the central processing plant (CPP), main office building, and a maintenance building. The Hank Unit will be a satellite operation consisting of a satellite ion exchange plant, an office building, and a maintenance building. 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 T-Chair Livestock ranch roads. 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 Nichols Ranch ISR Project includes approximately 3,090 acres of private ownership, mainly by the T-Chair Livestock Company, and approximately 280 acres of United States Government ownership administrated by the Bureau of Land Management (BLM).

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 Appendix A and B of the attached WDEQ Permit to Mine application. 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 Adjacent Lands and Waters

3.1.2.1 General

The lands within the Nichols Ranch ISR Project 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 extraction, coal bed methane extraction, and uranium recovery activities are all currently taking place on or near the project area. The immediate future land use for the project area and adjacent areas will be continued livestock grazing, in situ uranium recovery, coal bed methane extraction, and oil and gas extraction.

No residential sites are located within the two Unit permit areas. Two ranches are located near the Unit permit areas. The Pfister Ranch is located approximately 0.6 mi north of the Hank Unit in Township 44 North Range 75 West, Southwest Quarter of Section 19. The Dry Fork Ranch lies approximately 0.9 mi to the west of the Nichols Ranch Unit in Township 42 North Range 76 West, Northeast Quarter of Section 24. Other residential sites that are located near the Nichols Ranch ISR Project are listed in Table 3-1. All of these residents are located outside the Nichols Ranch ISR Project area. Figure D1-2 (see map pocket) of the attached Appendix D1, Land Use, shows the location of the residents listed in Table 3-1 in relation to the Nichols Ranch ISR Project.

Three NRC licensed in situ uranium recovery facilities are located within 50 mi of the Nichols Ranch ISR Project. COGEMA's Christensen Ranch ISR facility is located approximately 6.0 mi north of the Nichols Ranch Unit and approximately 4.0 mi to the Northwest of the Hank Unit. Power Resources Inc. (PRI) licensed North Butte amendment area lays approximately 2.0 mi to the North of the Hank Unit and 5.0 mi to the Northeast of the Nichols Ranch Unit.

Table 3-1 Nearest Residents.

Nearest Residences	Number of Inhabitants	Nearest Permit Area	Distance From Permit Area (mi)	Direction
T-Chair (Rolling Pin) Ranch*	5	Nichols Ranch, Hank	1.9, 2.9	E, SW
Pfister Ranch	3	Hank	0.6	N
Pumpkin Buttes Ranch	2	Hank	1.1	E
Van Buggenum Ranch	0	Hank	4	E
Ruby Ranch	2	Hank	6.1	E
Dry Fork Ranch	3	Nichols	0.9	W
Christensen Ranch	1	Hank	3.5	NW

* T-Chair Ranch sits between the Nichols Ranch and Hank Unit areas.

PRI's Smith-Highlands Ranch (SR-HUP) ISR facility is located approximately 45 mi to the Southeast of the Nichols Ranch ISR Project. Two of the licensed facilities, Christensen Ranch and SR-HUP, currently have existing yellowcake processing plants with the SR-HUP being in operation. The Christensen Ranch plant is currently idle, but is expected to be back in production in the near future. PRI's North Butte amendment area does not have any current processing or 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 Uranerz Energy Corporation's Nichols Ranch ISR Project.

After mining activities are completed, the land will 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 Agricultural

Livestock grazing is the main activity on the project area and adjacent lands. No known sources of mass food production for human consumption exist within 10 km of the project area. Hay was grown in the past on approximately 127.8 acres of the southern part of the Nichols Ranch Unit, but because of drought conditions over the last seven years, the crop has not been produced. The National Resources Conservation Service (NRCS) stocking rate for the Nichols Ranch ISR Project 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 outdoor activities such as camping, hiking, fishing, and hunting. Almost all of the land on and adjacent to the Nichols Ranch ISR Project area is private with limited access, but public lands such as the Thunder Basin National Grassland, located approximately 24 air 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. The Powder River, located approximately 9.0 air 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 groundwater rights on, adjacent to, and within 3.0 mi of the Nichols Ranch ISR Project are listed in Appendix D6, Hydrology, of this application. No adjudicated surface water rights are located in or adjacent (within 0.5 mi of the permit boundary) to the Nichols Ranch ISR Project. The surface water rights that do exist within the proposed Nichols Ranch ISR Project area are limited to stock/storage ponds and ephemeral creeks. Groundwater rights in the Nichols Ranch ISR Project area are mainly associated with old monitoring 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 Engineer's Office. Uranerz Energy Corporation also does not hold any adjudicated water rights in the project area. Most wells that are located within the Nichols Ranch ISR Project area were installed by prior uranium exploration companies, the T-Chair Livestock Company, or coal bed methane companies. Several additional wells have been completed in the project area by Uranerz Energy Corporation for use in collecting baseline groundwater quality data.

Wells in the area of the proposed Nichols Ranch ISR Project area are uniformly distributed over the area excluding monitoring/sampling wells that are permitted by Uranerz Energy Corporation. Most of the wells are used for livestock watering through the use of windmills or electric well pumps. Well depths vary from 180 ft to 1,000 ft in depth, most of which are completed in sands other than the ore zone sands. Those wells which are completed in the ore zone sand will either 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. A domestic water supply well is found on the Pfister Ranch, located approximately 0.6 mi north of the northern boundary of the Hank Unit. This well is completed at a depth that is stratigraphically below the zones planned for the ISR extraction. Additionally, the well is located at a distant from any planned wellfields and in sandstone units that do not contain any uranium mineralization of economic significance. Any extraction activities that take place in the area are very unlikely to affect this well because the well is completed in a sandstone unit that is separated from the ore zone sandstone by an aquiclude consisting of mudstone. The extensive groundwater monitoring program utilized during the extraction phase should detect any problems prior to this well being adversely affected.

Any water wells that Uranerz Energy Corporation constructs in the project area will be completed in sands that are stratigraphically below or above the ore zone. The purpose of the wells will be for providing process and wash down water to the plant facilities along with supplying water for lavatories, safety showers, and change house shower water. Bottled water will be provided for drinking water.

Appendix D6, Hydrology, attached to this license application contains detailed hydrologic information for the Nichols Ranch ISR Project.

3.1.2.5 Industrial

3.1.2.5.1 General/Oil/Gas

Coal bed methane and oil and gas development have and will be taking place in the proposed project area and on the lands adjacent to the Nichols Ranch ISR Project area. The Hank Unit lies within the Hartzog/Pumpkin Buttes Oil Fields. Presently six oil/gas wells exist on the lands within and adjacent to the Hank Unit. No oil/gas wells are located within or adjacent to the Nichols Ranch Unit. According to the Wyoming Oil and Gas Conservation Commission, no further oil and gas development will take place in the Nichols Ranch ISR Project. The locations of the oil/gas wells for the Hank Unit are shown in Exhibit D6-6 (see map pocket) of the attached Appendix D6, Hydrology. Table 2A-1 (of Addendum 2A) of the NRC Technical Report lists all oil/gas wells found within a 3.0 mi radius of the project area.

The oil/gas wells located in the Hank Unit should not cause any issues with the proposed extraction activities. The location of the wells and the depths that they are drilled to (< 9,000 ft deep) will not interfere with the ISR extractions since the ore zone is much shallower than the oil/gas wells. None of the oil/gas wells penetrate the ore zones. Additionally the completion techniques used by the oil/gas companies are such that the wells will not cause any potential excursions to occur. The oil and gas wells in the project area are typically cemented from at least 1,000 ft deep to the surface. This amount of cement is sufficient to protect the oil/gas wells from acting as a conduit for any uranium recovery fluids. Pressure monitoring on the oil/gas wells also ensures that the oil/gas wells are working properly and that the wells integrity is intact.

3.1.2.5.2 Coal Bed Methane

Coal bed methane (CBM) activity is widespread throughout the Powder River Basin. The methane is produced at a depth of approximately 1,000 ft and greater which is approximately

400 ft deeper than the uranium mineralization found in the Nichols Ranch and Hank Units. Since the CBM activity and uranium mineralization are stratigraphically separated with layers of sandstone, mudstone, and clay, it is very unlikely that any of the CBM wells will be impacted by the extraction activity and vice versa.

Currently there are 24 permitted and completed CBM wells located in or adjacent to the Nichols Ranch Unit. Thirty-three permitted and completed CBM wells are found in the lands in and adjacent to the Hank Unit. The Nichols Ranch ISR Project will not impact any of the current or proposed CBM wells as none of the existing or purposed CBM wells are or will be located within the planned wellfield areas. Communication between the CBM producers and Uranerz Energy Corporation has been established with all parties working together to avoid conflicts. Maps of the CBM producers proposed well sites, access roads, water and gas pipeline routes, and utility corridors have been provided to Uranerz Energy Corporation for use in developing extraction activities.

CBM discharge water will not be impacted by extraction activities in the Nichols Ranch ISR Project area. Both CBM producers on the Nichols Ranch and Hank Units will be piping water produced by CBM drilling to locations out of the project area and adjacent lands. The CBM produced water will then be either discharged on the surface or stored in large storage tanks, pumped some 30 mi away, and then re-injected into the ground.

Exhibits D6-3 and D6-4 (see map pockets) of the attached Appendix D6, Hydrology, show all CBM wells on, adjacent to, and within three miles of the Nichols Ranch and Hank Units. Table's 2A-2 through 2A-5 (of Addendum 2A) of Chapter 2.0 of the NRC Technical Report detail all CBM wells that are permitted and completed in the project area. NRC Technical Report, Chapter 2.0, Table 2A-6 (of Addendum 2A) defines the abbreviations used in Tables 2A-2 through 2A-5.

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 T-Chair Livestock ranch roads. 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 coal bed methane producers have improved the major ranch roads that Uranerz Energy Corporation will use. These roads range from 15 to 20-ft wide and are constructed and maintained by the land owner and the coal bed methane producers. These roads will allow for safe passage of both passenger cars and tractor trailers when traveling to and from the Nichols Ranch ISR Project. 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 Energy Corporation will use for the Nichols Ranch ISR Project.

Wellfield access roads will follow existing two track roads and coal bed methane well access roads. If a new wellfield access road is needed, the road will be constructed in such a manner as required by the landowner. The construction of the wellfield road will 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 to 8.0-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 will 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 will 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 will 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 will 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 Nichols Ranch ISR Project 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 SOILS

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 D5 of the attached WDEQ Permit to Mine Application. The geologic information is also found in Chapter 2.0 of the NRC Technical Report.

3.3.2 Soils

Soils within the Hank and Nichols Ranch Units 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 2006. A soil map delineating the soil types was prepared and 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 Hank and Nichols Ranch Units 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 toeslopes 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 will limit the suitability of topsoil as a plant growth medium during the reclamation phase. All 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 three samples collected in the Hank 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 Nichols Ranch ISR project area.

Detailed soils information for the Nichols Ranch ISR project area is presented in Appendix D7 of the WDEQ Mine Permit Application 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

A detailed discussion of the hydrology of the Nichols Ranch ISR Project is contained in the attached Appendix D6 and in Section 2.7 of Chapter 2.0 of the NRC Technical Report. Appendix D6 contains all information regarding baseline water quality sampling, Nichols Ranch and Hank Unit pump testing, surface and groundwater rights, abandoned drill holes, coal bed methane wells, and oil/gas wells found in and within 3.0 mi of the Nichols Ranch ISR Project.

Appendix D6 should be referred to for any water information/questions regarding the Nichols Ranch ISR Project.

3.5 ECOLOGICAL RESOURCES

3.5.1 Topography

The Nichols Ranch ISR project area 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 Hank Unit is located on the western flank of the North Middle Butte and is located in southwest Campbell County. Topography of the Hank Unit includes gently rolling hills and low ridges, as well as steep terrain near North Middle Butte and some steeply eroded areas associated with Dr Willow Creek (an ephemeral stream) located in the southern portion of this unit. Elevations in the Hank Unit range from 5,055 to 5,209 ft AMSL and the area is dissected by a series of unnamed and ephemeral drainages that generally drain west and southwest toward Dry Willow Creek.

The Nichols Ranch Unit is located approximately 4.2 mi southwest of the Hank 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 south toward Cottonwood Creek (an intermittent stream) that is located in the southern portion of the unit. Elevations in the Nichols Ranch Unit range from 4,670 to 4,900 ft AMSL.

3.5.2 Vegetation

Baseline vegetation studies of the Nichols Ranch ISR Mine permit area were conducted in June and July 2006 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 Rewrite (WDEQ 2004).

The project area is composed of eight vegetation/habitat types, with approximately 88% of the project area composed of two vegetation types (sagebrush shrubland and mixed grasslands) (refer to Table 3-2). Four wetland areas were found, and they will 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) and one selenium indicator species (two-groove milkvetch) were found during surveys; both were found in small numbers in disturbed areas. Table 3-2 presents the results of vegetation studies conducted in June and July 2006.

Table 3-2 Vegetation/Habitat Types, Number of Acres, and Sampling Intensity, Nichols Ranch ISR Project, 2006.

Vegetation/Habitat Type	Premine No. of Acres	Percent of Project Area	Estimated Affected Acres	Minimum Sample Size [1]	Adequate Sample Size (Nmin)[2] for Vegetative Cover
Sagebrush shrubland	1,914.4	56.8	7	20	6.3
Mixed grassland	1,058.3	31.4	5	20	10.2
Juniper outcrop	148.3	4.4		20	28.2
Bottomland	124.6	3.7		20	16.5
Greasewood shrubland	64.0	1.9		15	12.2
Wetland	1.1	<0.1		Not sampled	--
Rock outcrop	17.5	0.5		Not sampled	--
Disturbed lands [3]	42.3	1.2		Not sampled	--
Total	3,370.5	100	12 [4]		

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

2 Includes 8.3 acres of previously disturbed lands as evident by annual grasses and weeds and 8.8 mi (32 acres) of roads (30-ft wide disturbance).

3 Estimated disturbance from the two production plants. Disturbance from wells, pipelines, and additional access roads is unknown.

4 Estimated disturbance from the two production plants. Disturbance from wells, pipelines, and additional access roads is unknown.

Detailed vegetation information for the Nichols Ranch ISR project area is presented in Appendix D8 of the WDEQ Permit to Mine 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 threatened and endangered species, noxious weeds, and selenium indicator species.

3.5.3 Wildlife

3.5.3.1 General

The Nichols Ranch project area 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, elk, 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 elk, eagles, 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; wintering raptors included bald eagle, golden eagle, red-tailed hawk, and rough-legged hawk.

Detailed wildlife information for the Nichols Ranch ISR Project area is presented in Appendix D9 of the WDEQ Permit to Mine 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 Species

Two federal threatened, endangered, proposed, and candidate (TEPC) animal species have been identified by the U.S. Fish and Wildlife Service (USFWS) to have the potential to occur within or in the vicinity of the Nichols Ranch ISR project area. These species include black-footed ferret (endangered) and bald eagle (threatened).

Prairie dogs are the main food of the endangered black-footed ferrets (BFF) and several black-tailed prairie dog colonies occur in and adjacent to the two production units. However, specific surveys for BFF were not conducted because the USFWS has determined that BFF surveys are no longer required in black-tailed prairie dog towns statewide. The area has been block-cleared for the black-footed ferret; therefore, the project will have no affect on black-footed ferrets.

The USFWS defines communal roosts as six or more birds at one site; the BLM defines roosts as areas that bald eagles show consistent use. Consistent use areas are areas where eagles are seen two or more times within a given winter or multiple winters (personal communication, February 22, 2007, with Thomas Bills, biologist, BLM Buffalo Field Office). The BLM is moving away from the USFWS roost concept and protecting the "consistent use areas" because it is seldom that six or more birds are observed roosting in one area (personal communication, February 22, 2007, with Thomas Bill, biologist, BLM Buffalo Field Office). Based on the BLM database (2006), two roost sites have been recorded on the south side of North Pumpkin Butte and two roost sites have been recorded in Middle North Butte. No communal roosts, as defined by the USFWS, were observed; however, several bald eagles exhibited an affinity for certain areas adjacent the project area by either flying or roosting in the survey area. One adult bald eagle was observed perched in a cottonwood tree along Dry Willow Creek, just north of the Hank Unit during two of the three winter surveys.

Bald eagles were observed flying over or in the vicinity of the Nichols Ranch Unit during two of the three winter surveys. Two adult bald eagles were observed soaring above the Nichols Ranch Unit during the January 6th survey and one bald eagle was observed flying adjacent the Nichols Ranch Unit during the January 17th survey.

The nearest known bald eagle winter roost site is located 4.5 mi southwest of the Nichols Ranch Unit. The closest bald eagle nest is located along the Powder River in Johnson County approximately 10 mi west of the permit area (personal communication, February 22, 2007, with Thomas Bill, biologist, BLM Buffalo Field Office).

While a few bald eagles may hunt or forage in the project area there are no defined communal roosts or consistent use areas within or immediately adjacent to the project area. Therefore, the project is expected to have no affect on bald eagles.

Based on the results of site specific surveys and other available data, the ISR project is expected to have no affect on any federal TEC&P species.

3.5.3.3 BLM Special Status Species

The Bureau of Land Management (BLM), Buffalo Field Office also monitors and manages nonlisted (under the federal Endangered Species Act) special status (SS) species (i.e., species of concern) that could occur on federal lands to reduce potential impacts that might lead to their listing by the USFWS. The BLM list of SS species included six mammals, 15 birds, two amphibians, and one fish species.

No mountain plovers were seen during the two surveys or during opportunistic observations throughout the 2006 field season. In addition, there are no records that mountain plovers exist within the wildlife study area (BLM 2006; WNDD 2006). The closest BLM sighting of mountain plover is approximately 4.0 mi from the project area (BLM 2006). Therefore, the Nichols Ranch ISR project is expected to have minimal impacts to mountain plovers.

One swift fox, a BLM SS species, was observed crossing the Van Buggenum road approximately 5.0 mi east of the project area during the 2006 field season. It is likely that swift fox inhabit the wildlife survey area because of the suitable short mixed grassland habitat. Therefore, the Nichols Ranch ISR project is expected to have minimal impacts to swift foxes.

The greater sage-grouse, a BLM SS species, is a year-long resident in the project area and ten greater sage-grouse leks occur within the wildlife study area. All of the leks were active in 2006.

Direct potential impacts to greater sage-grouse from project activities would include habitat loss and fragmentation from mine, road, pipeline, and power line construction; alteration of plant and animal communities; increased human activity that could cause the birds to avoid an area; increased noise that could cause the birds to avoid an area or reduce breeding efficiency; increased motorized access by the public leading to legal and illegal harvest; direct mortality from increased vehicular traffic; and an increase in mortality from raptors if power poles are placed in occupied greater sage-grouse habitat.

To minimize impacts to breeding greater sage-grouse, project activities and vehicular traffic would be minimized in areas within 0.25 mi of an active lek between the hours of 8:00 pm and 8:00 am during the greater sage-grouse strutting period (March 1-May 15), and project activities (i.e., drilling and construction) would be minimized within 2.0 mi of an active lek between March 15 and July 15. 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 an active lek. To minimize impacts to greater sage-grouse and other upland bird species (i.e., Hungarian partridge), removal and disturbance of vegetation will be kept to a minimum through the use of existing roads for travel and for the placement of pipelines. All lands disturbed by project activities will be revegetated as soon as practical following the project disturbing activities following approved reclamation practices.

Therefore, with implementation of the mitigation measures described above, the Nichols Ranch ISR Project will have minimal impacts to greater sage-grouse.

The WNDD and BLM have occurrence records of several BLM SS species in the vicinity of the permit area including sage sparrow, Brewer's sparrow, loggerhead shrike, sage thrasher, burrowing owl, ferruginous hawk, and northern leopard frog. Based on the lack of any observations and existing data, the Nichols Ranch ISR Project is expected to have minimal impacts on these species. In addition, these are occurrence records or observations of any of the remaining BLM SS species; therefore, the Nichols Ranch ISR Project is expected to have no impacts on any of the remaining BLM SS species.

3.6 METEOROLOGY, CLIMATOLOGY, AND AIR QUALITY

3.6.1 Introduction

The Nichols Ranch ISR Project area 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).

There are no meteorological stations within or immediately adjacent to the Nichols Ranch ISR Project area. Therefore, meteorological data has been collected from seven meteorological stations surrounding the project area; six of the stations are operated by the National Weather Service and one station is operated by a private firm (Intermountain Laboratory [IML]) and it is located at the Antelope Coal Company Mine (Antelope) (Table 3-2a and Figure 3-1). The NWS stations were selected because they are the closest meteorological stations to the Nichols Ranch ISR Project area and will provide regional and local weather information that is relevant to the Nichols Ranch ISR Project area. All of the selected meteorological weather stations provide temperature and precipitation data. The Casper Natrona Airport, Antelope, Gillette, and Buffalo stations provide wind data and only the Casper Natrona Airport station reports relative humidity and evaporation data. The Antelope station was chosen based on its relative close proximity to the Nichols Ranch ISR Project area. It is located in an area with similar topographic features to the project area and the site records wind data that is not available at most of the other meteorological stations in the area. The Antelope station offers the most representative data for the generation of the monthly wind roses and seasonal diurnal temperature norms required by the NRC. The NRC also approved use of the Antelope station for Energy Metals Corporation's Moore Ranch Uranium Project License Application that is located approximately 10 mi south of the Nichols Ranch ISR Project area. The other meteorological stations will be used in the discussion of regional climatology and meteorology.

Table 3-2a Meteorological Stations Included in Climate Analysis.

Weather Station (ID Number)	Data Collected By	Distance from Nichols Ranch ISR Project Area (miles)	Direction from Nichols Ranch ISR Project Area (compass)	Elevation (ft above sea level)	Meteorological Parameters Used in this Report	Period of Records [2]
Antelope Mine [3]	IML	48.5	SW	4,675	Wind, temperature, precipitation	1987-2007
Buffalo (481165) [1]	NWS	58	NW	4,670	Wind, temperature, precipitation	1899-2007
Casper Natrona County Airport (481570) [1&4]	NWS	60	SSW	5,338	Wind, temperature, precipitation, humidity, evaporation	1948-2007
Dull Center 1 SE (482725) [1]	NWS	54	ESE	4,415	Temperature, precipitation	1926-2007
Gillette 9 ESE (483855) [1]	NWS	46.5	NNW	4,640	Wind, temperature, precipitation	1902-2006
Glenrock 5 ESE (483950) [1]	NWS	62	S	4,948	Temperature, precipitation	1941-2006
Midwest (486195) [1]	NWS	25	SW	4,860	Temperature, precipitation	1939-2006

1 Data was obtained from the western Regional Climate Center website http://www.wrcc.dri.edu/summary/Climsmwy.html. Temperature is measured 2 m Above Ground Level (AGL) anemometers are 20 ft AGL and precipitation is collected 2-3 ft AGL.

2 The period of record indicates the beginning and ending dates for which the station was open. IMPORTANT: The availability of data from any given station is not directly related to the period of record. Many stations do not provide data to NCDC. To determine what data is available for a given station, please check the station's Data Inventories. Please contact NCDC if confirmation of data availability is needed.

3 IML = Inter-Mountain Labs Temperature is measured 3 m AGL and anemometers are 10 m AGL.

4 Data was obtained Wyoming Climate Atlas Curtis and Grimes 2004.

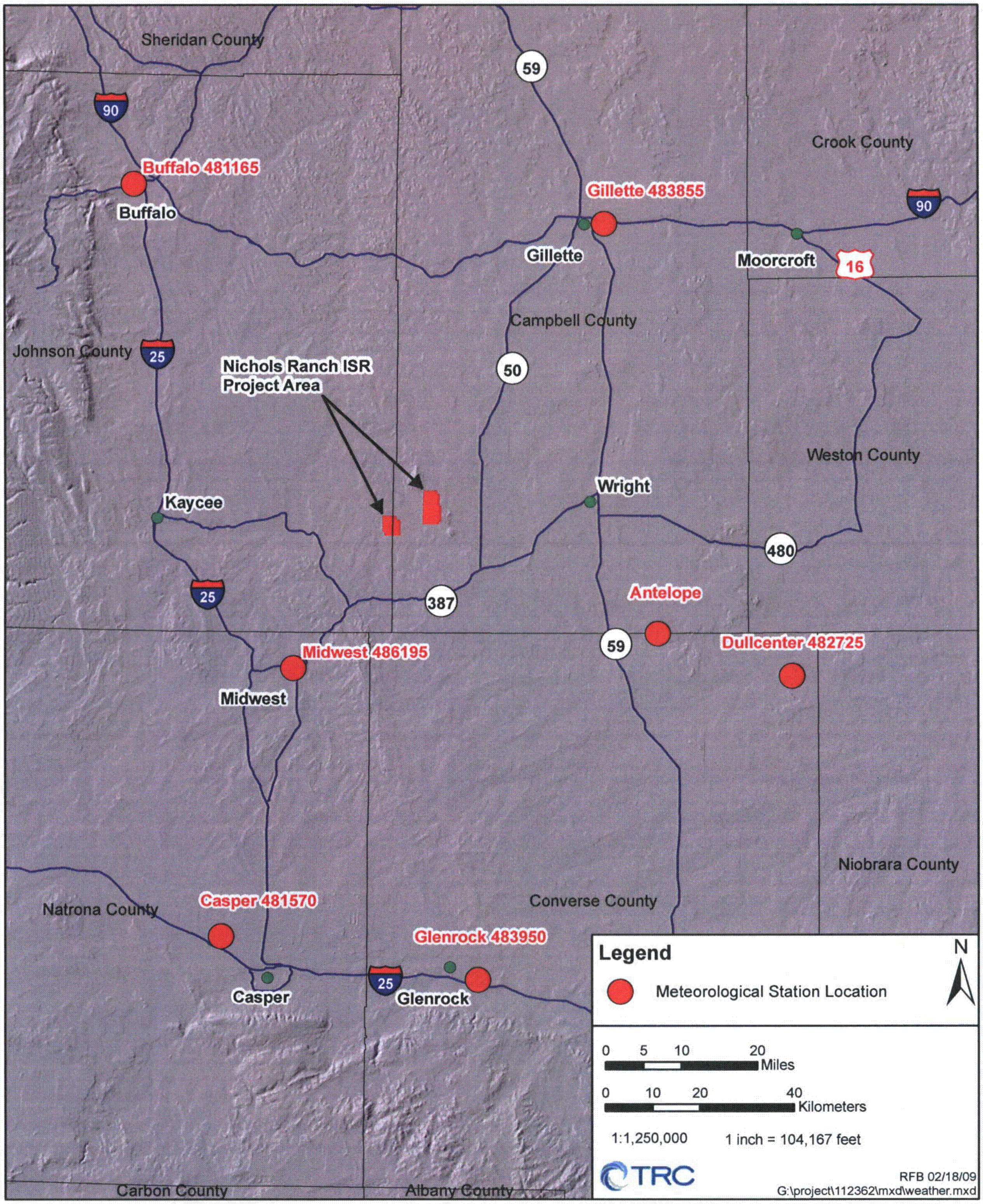

Figure 3-1 Location of Regional Meteorological Stations.

3.6.2 Regional Overview

3.6.2.1 Temperature

Regional temperature information was collected from the seven meteorological stations listed in Table 3-2b. Regional monthly average, monthly minimum, and monthly maximum temperatures is presented in Figures 3-2, 3-3, and 3-4 respectively. The region has an average annual temperature between 45-50°F (Curtis and Grimes 2004) (Table 3-2c), an average monthly maximum temperature between 85-90°F (which occurs in July), and an average monthly minimum temperature between 10-18°F (that occurs in January) (refer to Figures 3-3 and 3-4). According to Curtis and Grimes (2004) there are approximately 101-120 frost-free days a year in the region, with the number of frost-free days decreasing with increasing elevation.

Large diurnal temperature variations are found in the region due in large part, to its altitude and low humidity. Figure 3-4a depicts the seasonal diurnal temperature variations at the Antelope Station (Intermountain Laboratory 2009). As expected summer has the highest average diurnal temperature with winter and spring recording the lowest average diurnal temperatures. The highest daily temperatures occur between 12:00 noon and 6:00 pm local time. The coolest temperatures are in the early morning hours between 4:00 and 6:00 am.

Table 3-2b Annual Average Temperature for Select Stations.

Station	Average Annual Temperature (°F)
Antelope Mine	46
Buffalo	46
Casper Natrona County Airport	45
Dull Center	46
Gillette	45
Glenrock	47
Midwest	46

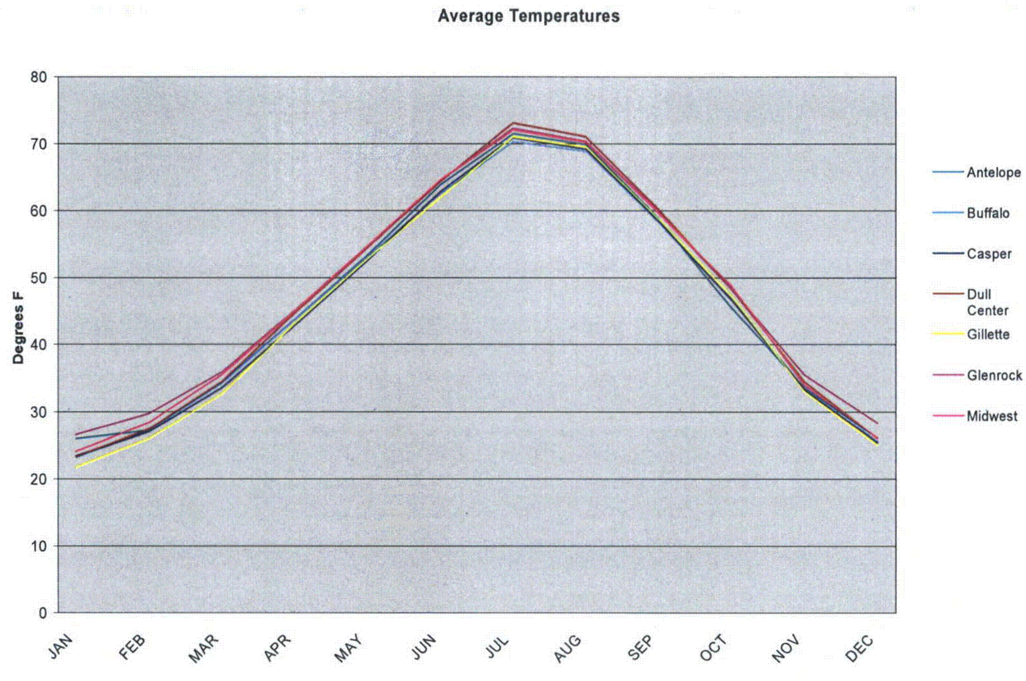

Figure 3-2 Average Monthly Temperatures for Select Meteorological Stations.

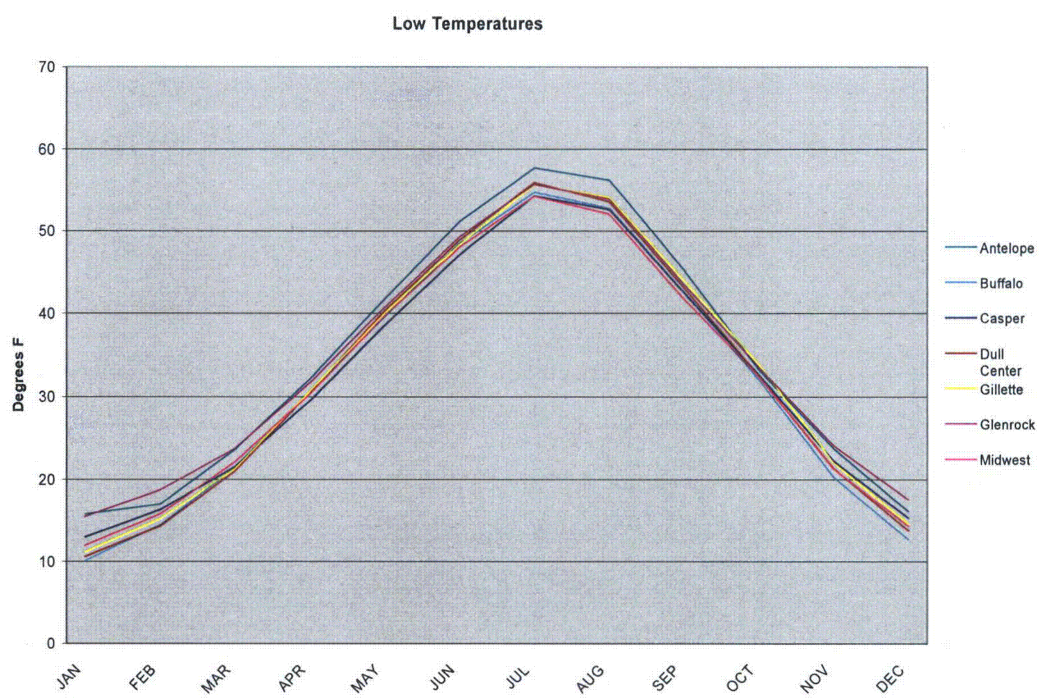

Figure 3-3 Average Monthly Minimum Temperatures for Select Meteorological Stations.

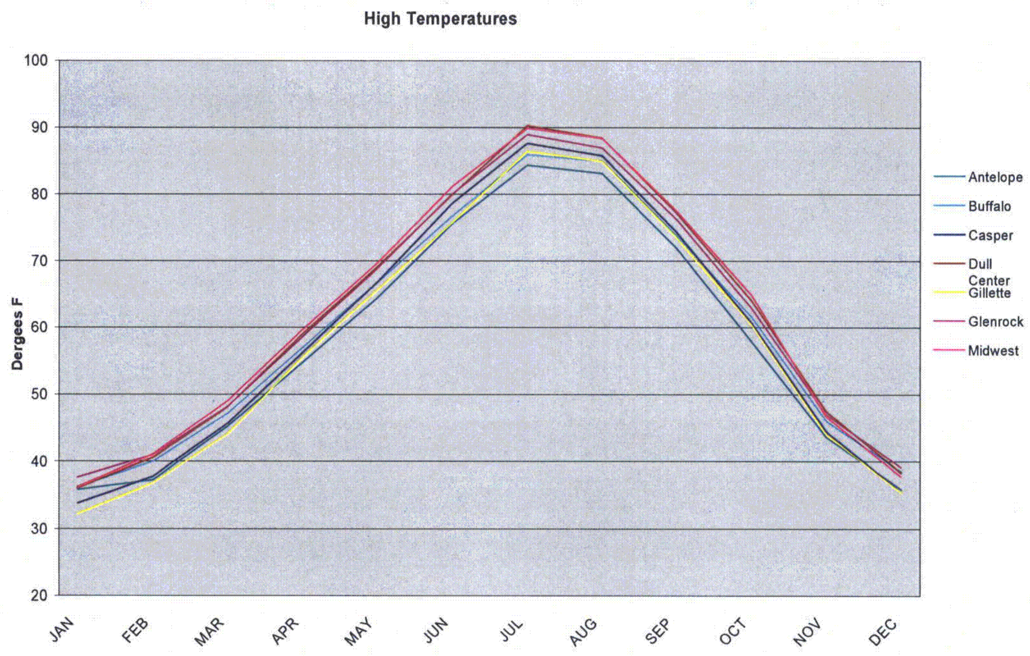

Figure 3-4 Average Monthly Maximum Temperatures for Select Meteorological Stations.

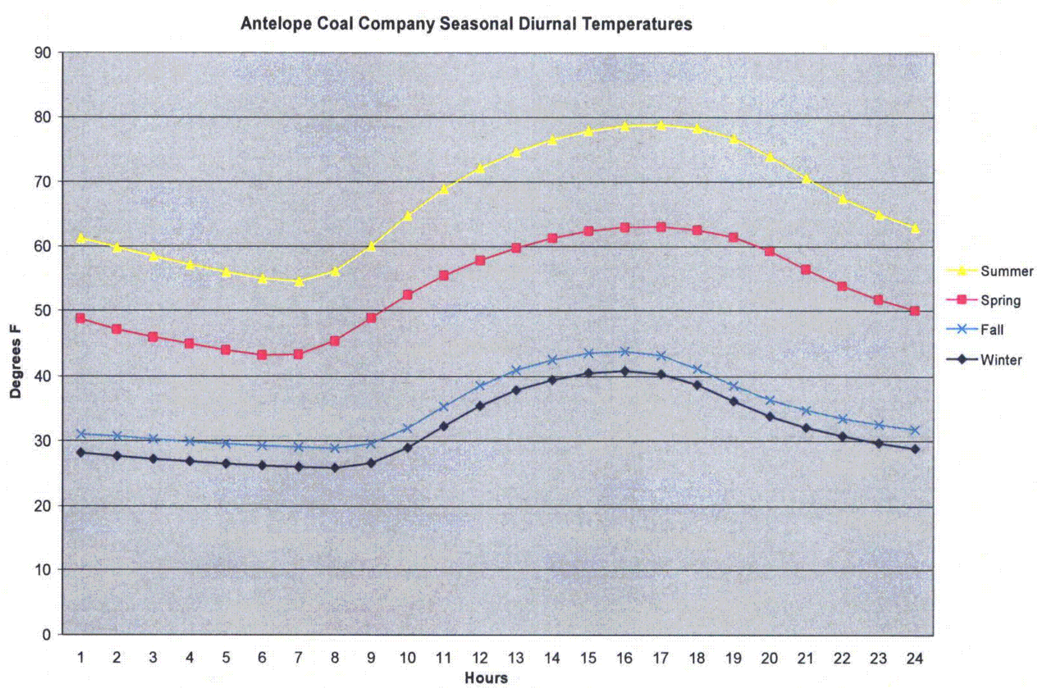

Figure 3-4a Seasonal Diurnal Temperature Variations at the Antelope Station.

3.6.2.2 Precipitation

The regional near the Nichols Ranch ISR Project area is representative of the high plains in Wyoming and receives an average of 11-15 inches of precipitation per year (Table 3-2c) (Curtis and Grimes 2004). Of the seven stations used to report precipitation data, the Gillette Station has the highest annual average precipitation with 15.6 inches per year and the Antelope Mine Station had the lowest annual average precipitation of 11.2 inches per year. Monthly average precipitation for the seven stations is presented in Figure 3-4b. The average monthly maximum precipitation for all satiations ranges between 0.16 and 2.75 inches per month and the seven meteorological stations show a similar pattern of precipitation. Most precipitation occurs in May or June across the region and the least amount of precipitation occurs in the months of December, January, and February.

Monthly minimum and maximum precipitation for the selection meteorological stations is presented in Figures 3-4c and 3-4d respectively. Minimum precipitation amounts for the select stations are generally less than 0.10 of an inch, with only a few months for a few stations consistently having a minimum of more than 0.20 inches. The maximum monthly precipitation amounts for the select stations are much more variable with a majority of the stations recording a maximum between 1.0 and 8.0 inches per month and documents heavy thunderstorms that are common in the region during the late spring and summer months. Only the Gillette Station has ever recorded monthly maximum precipitation of more than 8.0 inches, and these were 10.0 and 11.0 inches.

Table 3-2c Average Annual Precipitation for Select Stations.

Station	Average Annual Precipitation (In)
Antelope Mine	11.2
Buffalo	13.4
Casper Natrona County Airport	11.9
Dull Center	12.6
Gillette	15.6
Glenrock	12.5
Midwest	12.7

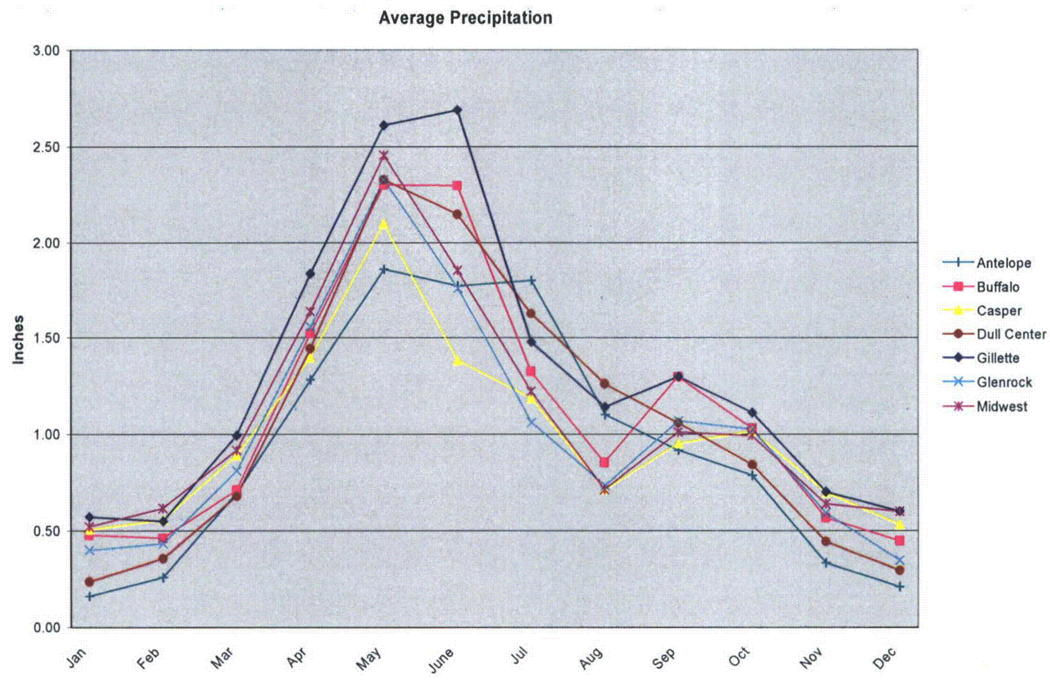

Figure 3-4b Monthly Average Precipitation (in inches) for Select Station.

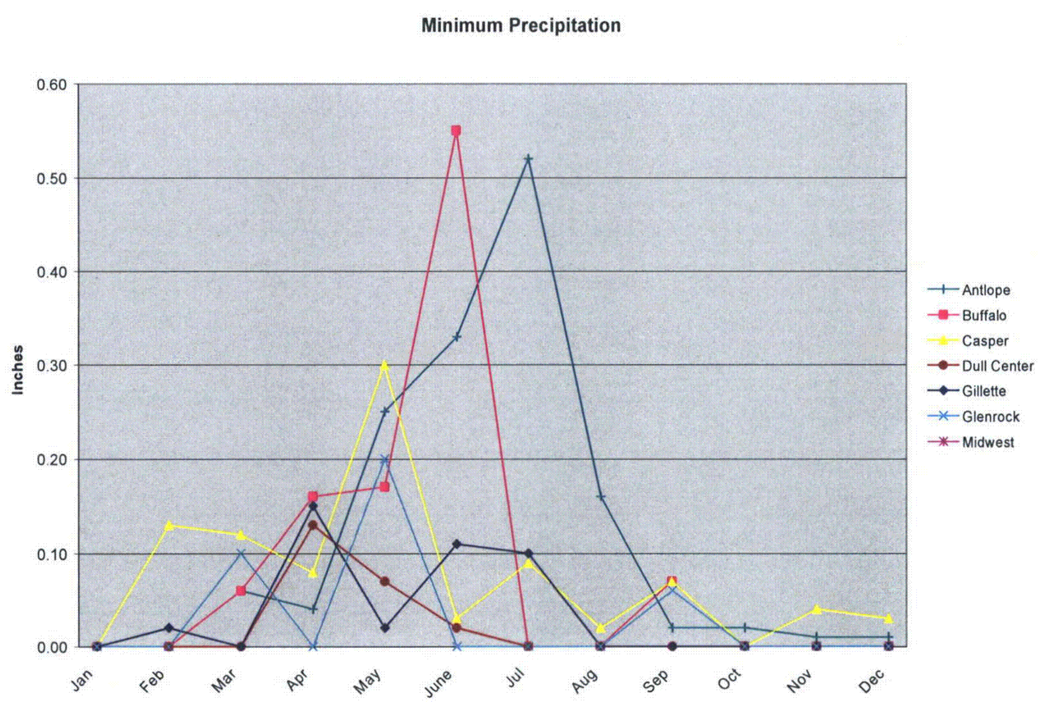

Figure 3-4c Monthly Minimum Precipitation (in inches) for Select Stations.

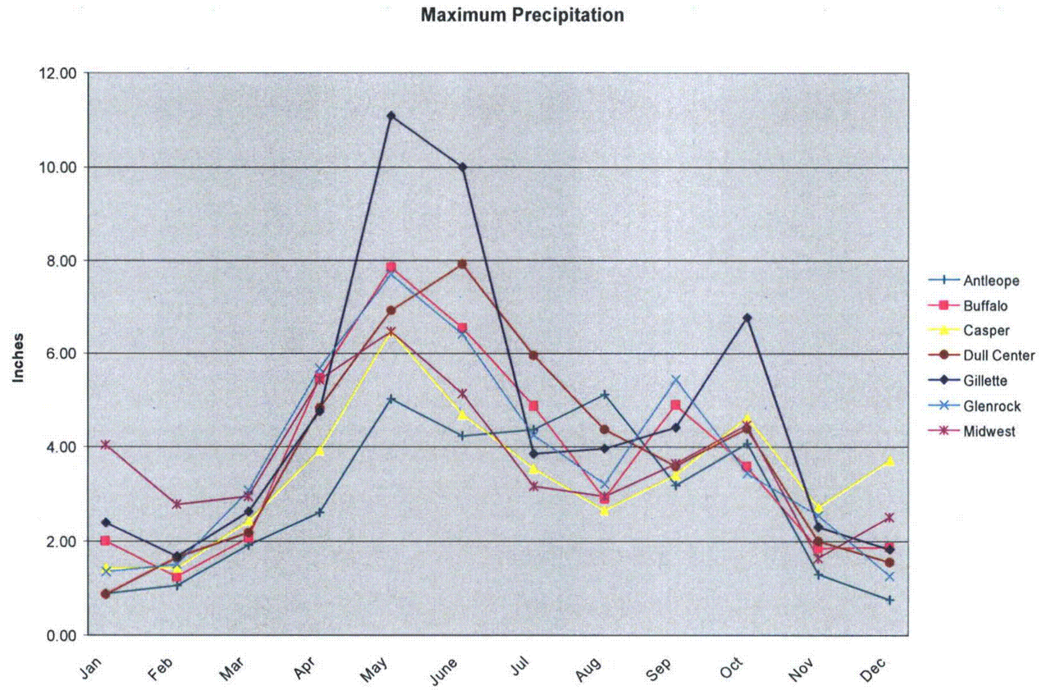

Figure 3-4d Monthly Maximum Precipitation (in inches) for Select Stations.

3.6.2.3 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). Of the meteorological stations used in this regional analysis only four stations have any wind data and these are the Antelope, Buffalo, Casper, and Gillette Stations. Both the Antelope Station and the Nichols Ranch ISR project area are located in open rolling hill country and it is closest to the project area. The Antelope Station is located approximately 48 mi southeast of the Nichols Ranch ISR project area and is slightly lower than the Nichols Ranch ISR project area. The Antelope Station is located at an elevation of 4,675 ft above mean sea level (AMSL) and the elevation within the Hank Unit ranges from 5,055 to 5,860 ft AMSL and the elevation within the Nichols Ranch Unit ranges 4,670 to 4,920 ft AMSL. Wind data from the Antelope meteorological station are reasonably representative of the climate in the general area and are consequently used as the basis for the following discussion. On-site analysis of wind is more in depth and will be discussed later on.

3.6.2.4 Wind Speed

Based on the Antelope Station, the annual average wind speed is approximately 11 mph and the maximum wind speed averages approximately 47 mph. Based on wind data from the four meteorological stations it appears that the winds are weakest in the pre-dawn hours and strongest in the mid-afternoons, tapering off again as night falls. Wind speeds are highest in the early spring and significantly reduced during winter months (Curtis and Grimes 2004).

3.6.2.5 Wind Direction

Based on the data from the four select stations, the regional wind directions are highly variable and are strongly influenced by local topography and general weather patterns. The wind pattern for the stations located in the northern portion of the region (Buffalo and Gillette) show a general westerly pattern with a relatively strong component from the north. Stations in the central and southern portion of the region (Antelope and Casper) also show a generally westerly pattern with a stronger west-southwestern component.

For the central and southern portion of the region (including where the Nichols Ranch ISR project is located), winter months show wind primarily from 200-230 degrees, roughly south southwest. Then by spring and into summer winds are from the south-southwest early in the day and become more southerly toward evening. By the fall, winds return to a south-southwest pattern for most of the day (Curtis and Grimes 2004).

3.6.2.6 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 will be as low as five to 10%. Late at night, when the temperature is lowest, the humidity will 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).

3.6.2.7 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 Nichols Ranch ISR project area 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).

3.6.2.8 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).

3.6.2.9 Mixing Height

Mixing height or inversion height data is limited for the Nichols Ranch ISR project region. The meteorological station at Lander Wyoming reports the only archived mixing height data for the state and it is available at http://www.epa.gov/scram001/mixingheightdata.htm. Mixing height for the state fluctuates widely. The extreme low, one meter and extreme high over 57,900 m were recorded in the same year. The average morning mixing height for the 5-year period at the Lander Station between 1987 and 1991 was 659 m. For the same period, the average afternoon mixing height was 4,074 m.

3.6.3 Site Specific Analysis

Due to the similar topography and proximity of the Nichols Ranch ISR Project area, the Antelope Station will be used to describe local weather conditions at the Nichols Ranch ISR Project area.

3.6.3.1 Temperature

Temperature data collected at the Antelope Station are illustrated on Figures 3-2, 3-3, and 3-4 and present the monthly average, monthly minimum, and monthly maximum temperatures, respectively. Seasonal diurnal temperature data for the Antelope Station indicates large daily variations as expected in locations with high altitude and low humidity such as that in the Nichols Ranch ISR project area (see Figure 3-4a). This data indicates that average daily variations can be as much as 15° to 25° in dry summer months and the daily temperature varies only 10° to 15° during cooler, more humid times of year.

3.6.3.2 Precipitation

Precipitation data for the Antelope Station is presented in Figures 3-4b, 3-4c, 3-4d and will not be repeated here. The Antelope Station recorded slightly less precipitation throughout the year compared to the other selected stations but it exhibits a seasonal trend that is comparable to other selected stations in the area.

3.6.3.3 Wind

Average wind speed data for the Antelope Station is presented in Figure 3-4e. The annual average wind speed is approximately 11 mph and the maximum wind speed averages approximately 47 mph. Based on this data it appears that the winds are weakest in the pre-dawn hours and strongest in the mid afternoons, tapering off again as night falls. Wind speeds are highest in the early spring and significantly reduced during winter months.

The annual and monthly wind rose data for the Antelope Station is presented in Figures 3-4f through 3-4i. The annual wind rose indicates predominantly west and west-southwest winds for the area. Wind from those two sectors make up well over 20% of annual wind. These figures show a pronounced seasonal difference with still a strong west and west-southwest direction and a larger percentage of the wind during the spring coming from the northwesterly direction. The wind direction also shows a distinct increase in winds from the southeast and northwesterly direction during the summer, transitioning to a more westerly direction during the late summer through the fall. The prominent wind direction during the winter is strongly dominated by west and west south-west winds.

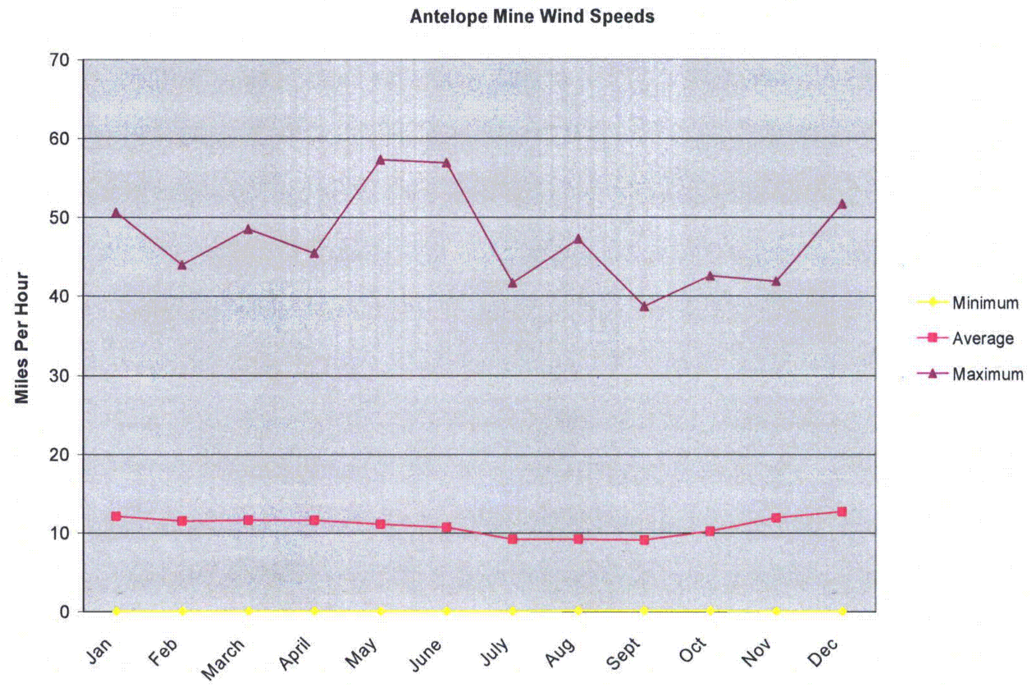

Figure 3-4e Average Monthly Wind Speeds (mph) at the Antelope Station.

The Joint Frequency Distributions for the Antelope Station are included in the MILDOS section (see Addendum 7C) of this document. The distributions show the frequencies of average wind speed for each direction based on stability class. More than 55% of winds at the Antelope Station fall into stability class D which represents near neutral to slightly unstable conditions. The light winds which accompany stable environments can be seen by the stability Class F (stable) summaries.

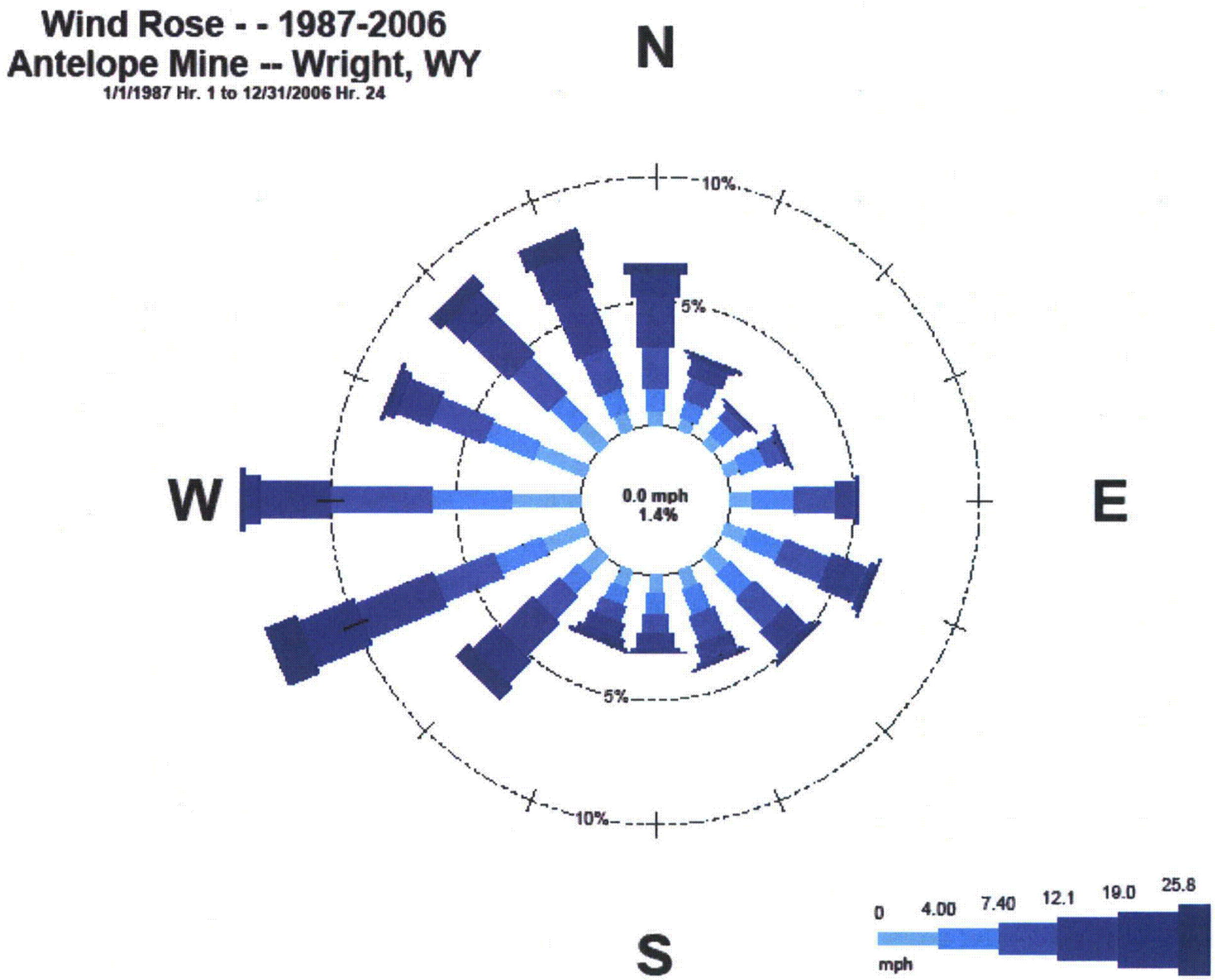

Figure 3-4f Annual Wind Rose 1987-2006 for Antelope Mine.

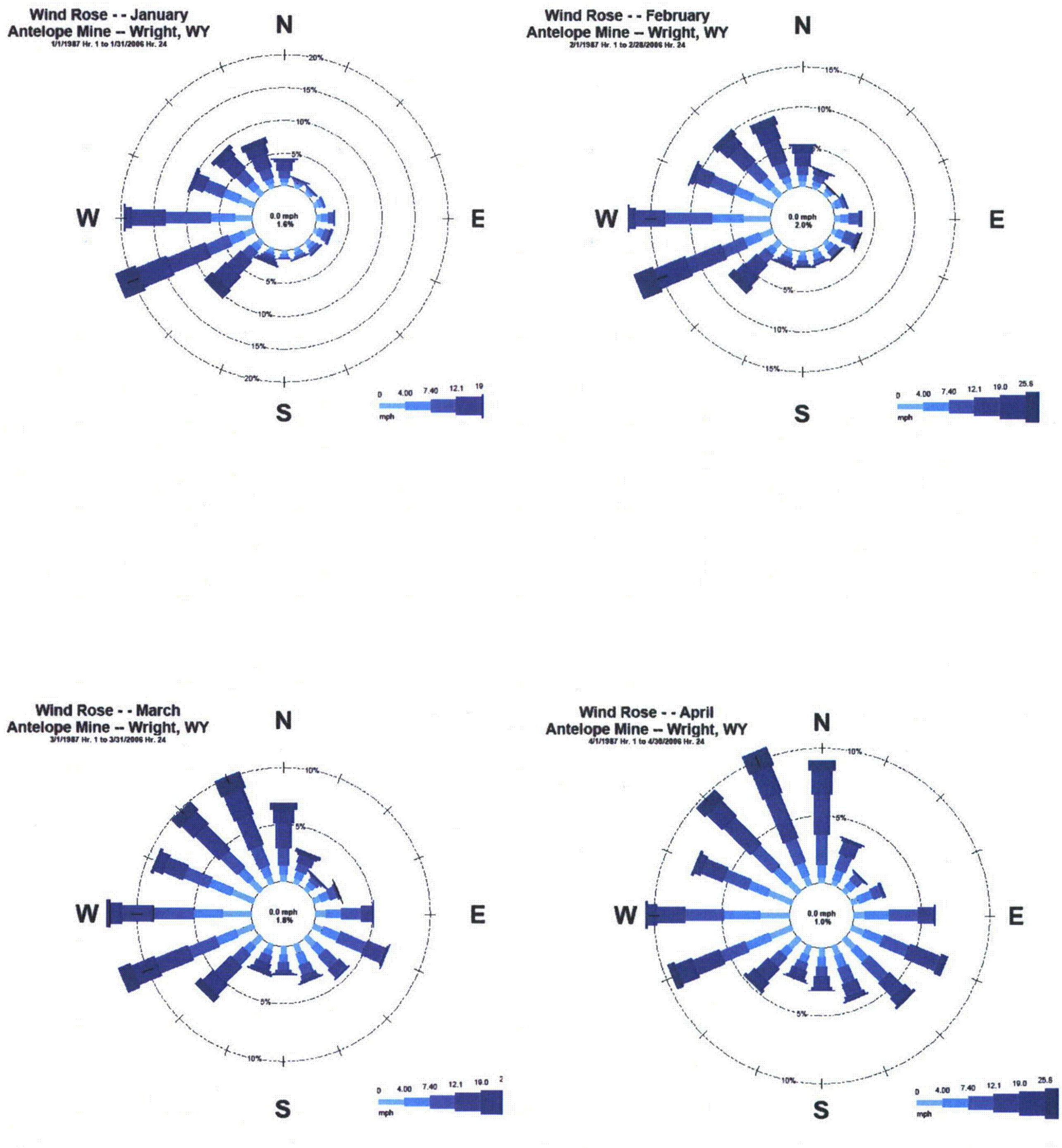

Figure 3-4g January through April Wind Roses.

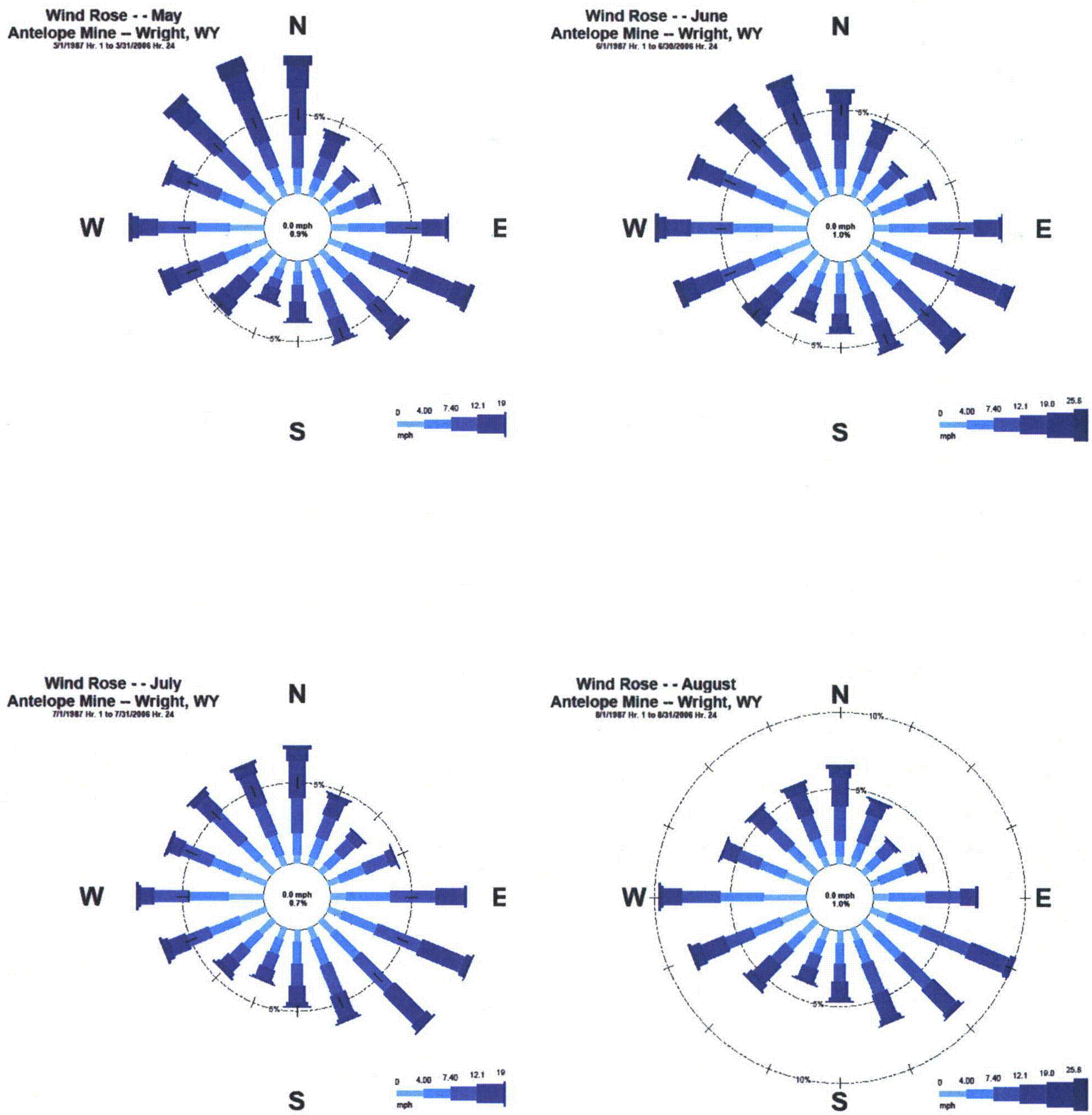

Figure 3-4h May through August Wind Roses.

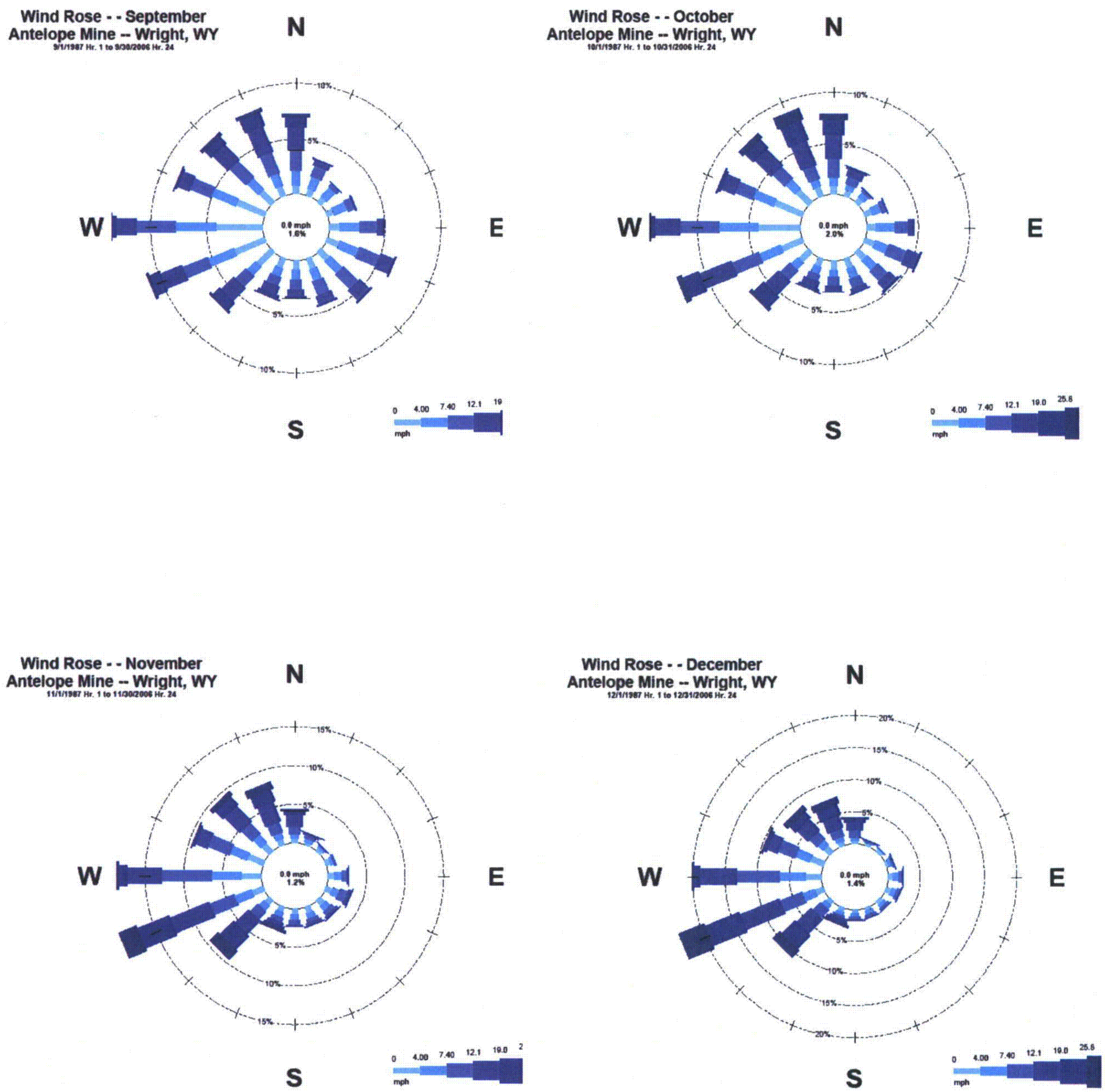

Figure 3-4i September through December Wind Roses.

3.6.3.4 Effects of Local Terrain

Immediately to the east of the Hank Unit and approximately 4.0 mi to the east of the Nichols Ranch Unit is a series of buttes known as Pumpkin Buttes. These buttes rise approximately 1,000 ft above the proposed project area of the Hank Unit and slightly more than that above the Nichols Ranch Unit. The proximity of the Pumpkin Buttes to the Nichols Ranch ISR project area cannot be ignored, but should have limited impacts on the climate surrounding the project area. Considering that the prevailing winds in the area are from the west and west-southwest, 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. It is possible that the buttes do produce some micro climatic 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 little magnitude.

3.6.2 Air Quality

3.6.2.1 General

There is no known air quality permits required for the Nichols Ranch ISR Project area, and there are no known air quality permits near the project area. A meeting between Uranerz Energy Corporation and the WDEQ was held to discuss the potential air quality permits that may be required for the Nichols Ranch ISR Project. After discussing the Nichols Ranch ISR Project, Uranerz Energy Corporation agreed to submit an emission inventory to the WDEQ in order to establish if any air quality permits are needed. Because of the minimal amount of emissions produced by the plant operations and the minimal surface disturbance and vehicular traffic associated with the operation Uranerz Energy Corporation believes that no air quality permits will be required. If any air quality permits are required by the WDEQ, then these permits will be obtained prior to beginning any construction activities for the Nichols Ranch ISR Project.

3.6.2.2 Impacts

Impacts on air quality associated with the operations of the Nichols Ranch ISR Project will be very minimal. Access to the project area will be via 8.5 mi of Campbell County maintained gravel road, then 8.5 mi of gravel ranch roads if accessing the project area from Wyoming Highway 50, or approximately 22.3 mi of gravel ranch roads if accessing the property from U.S. Highway 387. Both the county and ranch roads are currently used by numerous oil/gas and coal bed methane companies that are active in the region. These roads have been developed and range from 18 to 24-ft wide crowned-and-ditch roads. The closest residence to the access route is the Pfister Ranch located approximately less than a 0.25 mi to the west of the route and approximately 0.6 mi to the North of the Hank Unit. With the prevailing wind direction out of the southwest, dust produced by the mining operations and vehicular traffic will generally be blown to the northeast which should not affect ranching operations.

Particulate emissions associated with the Nichols Ranch ISR Project will also be minimal. Of the 3,370 acres within the project area, only approximately 300 acres or less of lands will be disturbed with stripping of topsoil occurring approximately 100 acres or less. In order to reduce particulate emissions in the well field by drilling equipment and well field maintenance vehicles, access roads will be maintained via motorized patrol. Natural vegetation will also be left undisturbed whenever possible to prevent wind erosion.

Vehicle traffic entering the Nichols Ranch ISR Project is estimated at eight passenger vehicles per day per week along with six tractor trailers per week. Fugitive dust emissions from this traffic are estimated at approximately 135.9 tons per year using the longer of the two access routes as a basis for the fugitive dust calculations. Wellfield fugitive dust emissions were not considered in calculating the overall fugitive dust emissions since the wellfield is not considered a major source of emissions. Estimated fugitive dust emissions during construction of the facilities of the Nichols Ranch ISR Project were also not included in the fugitive dust emission calculation since the amount of vehicular activity that will be taking place during the construction will be similar to the traffic of the actual operation. Figure D4-5 (of the attached Appendix D4) outlines the methods used to calculate the fugitive dust emissions.

From Figure D4-5, it is estimated that an emission rate of 135.9 tons per year can be expected for the Nichols Ranch ISR Project. As this is below the 250 tons per year threshold for PSD review, an analysis to determine air quality impact is considered unnecessary.

All other emissions from the Nichols Ranch ISR Project are minimal. Table 3-3 details the other potential operation emissions and their potential emission quantity.

Table 3-3 Emissions Inventory.

Emission	Estimated Emission (tons/yr)
CO_2	353.70
HCL	0.017
H_2O_2	0.003
NaOH	0.0003
Fugitive Dust	135.9

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 3-4). 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 IRS Project area; 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 generic environmental impact statement for in situ leach uranium milling facilities (Nuclear Regulatory Commission [NRC]) and Wyoming Department of Environmental Quality [WDEQ] 2008) estimates existing ambient noise levels in the undeveloped rural areas if the Wyoming East Uranium Milling Region (in which the ISR Project is located) would be 22 to 38 dBA. 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.

Table 3-4 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 [5 m])	30	Very quiet
Library	40	
Quiet office	50	Quiet
Normal conversation (at 3 ft [1 m])	60	
Busy traffic	70	
Noisy office with machines; factory	80	
Heavy truck (at 49 ft [15 m])	90	Constant exposure endangers hearing

[1] Tipler (1991).

3.8 HISTORIC AND CULTURAL RESOURCES

Reports containing information regarding historic, cultural, and paleontological resources for the Nichols Ranch ISR Project are discussed in detail in Addendums 3A and 3B. Addendum 3A contains the cultural resource report for the Hank Unit. Addendum 3B contains the results of a paleontological survey conducted for the Nichols Ranch ISR Project. Addendum 3C contains the results of an 80-acre block inventory that was completed for a previously uninventoried area in the Hank 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 Cultural Resources

Class I Literature Search for Uranerz Energy Corporation's Nichols Ranch ISR Project Permit

File searches (Nos. 20980, 20981, and 22571) was conducted on November 19, 2007 and August 19, 2008, through the Cultural Records Office of the Wyoming State Historic Preservation Office (SHPO) for Sections 7, 8, 17, 18, and 20, T43N, R76W; Sections 30 and 31, T44N, R75W; and Sections 5-8, T43N, R75W. Uranerz Energy Corporation's proposed Nichols Ranch ISR Project occurs within these legal descriptions.

Ten projects have been conducted within the sections for seven block and three block/linear surveys; they were completed for five mine blocks, three well pads and access roads, and two well pads (Table 3-4). A few recent projects have yet to be approved by the BLM and have not been accessioned into the SHPO database; therefore, they are not included in Table 3-4. Fifty sites, however, have been recorded in the sections. Of these, 43 are prehistoric sites, five are historic sites, and two are multicomponent prehistoric/historic sites. The sites are summarized in Table 3-5 and presented in Exhibit D3-1 (of the attached Appendix D3). Of the prehistoric sites, 16 are eligible for listing on the National Register of Historic Places (NRHP), 19 are not eligible, seven are not eligible with SHPO concurrence, and one is unevaluated with SHPO concurrence. Of the historic sites, one is eligible and four are not eligible. One multicomponent site is eligible for the NRHP and one is not eligible with SHPO concurrence.

Table 3-4a Previous Cultural Resource Inventories Within or near Uranerz Energy Corporation's Nichols Ranch ISR Project Permit Area.

Accession No.	Project Name	Contractor [1]	Type [2]	Legal Location
76-352-0	Brown's Ranch Uranium Mine	OWSA	B	Section 6, T43N, R75W
77-1-0	Brown's Ranch Uranium Mine	OWSA	B	Section 30, T44N, R75W
79-680-0	Brown's Ranch Uranium Mine	PE	B/L	Section 6, T43N, R75W
80-1209-0	Fed BZ 1	AS	B/L	Section 7, T43N, R76W
81-2054-0	Fed B-R-1	AC	B	Section 6, T43N, R75W
81-2054-0	Parker Fed 34-6 Testing	AEC	B	Section 17, T48N, R71W
4-2191-0	East Bullwhacker CBM POD	SWCA	B	Section 20, T43N, R76W
6-1350-0	Dry Willow CBM POD #1	SWCA	B	Section 31, T44N, R75W
6-1350-2	Dry Willow POD 1 Supplement	SWCA	B	Section 31, T44N, R75W
6-1465-0	Dry Willow POD Block Survey	Arcadis	B	Section 20, T43N, R76W

1 AC = Archeo Consultants; Arcadis = Arcadis U.S. Inc.; AEC = Archaeological Energy Consulting; AS = Archaeological Services; OWSA = Office of the Wyoming State Archaeologist; PE = Powers Elevation.
2 B = block; B/L = combination block/linear.

Table 3-5 Previously Recorded Sites Within or near Uranerz Energy Corporation's Nichols Ranch ISR Project Permit Area.

	Legal Location					NRHP		
Site No.	Township	Range	Section	Site Type	Landowner	Eligibility Status [1]	Time Period [2]	Accession No. [3]
48CA379	44N	75W	31	Lithic scatter	Private	NE/SHPO	P	6-1350
48CA5386	43N	76W	8	Lithic scatter	Private	NE	P	--
48CA5390	43N	76W	17	Lithic scatter	Private	E	P	--
48CA5391	43N	76W	17	Lithic scatter	Private	E	P	--
48CA5393	43N	76W	20	Inscription	Private	NE	P	--
48CA5406	43N	76W	17	Lithic scatter	Private	NE	P	--
48CA6146	44N	75W	31	Open camp	BLM	NE/SHPO	P	6-1350
48CA6147	44N	75W	31	Open camp/trash scatter	BLM	NE/SHPO	P/H	6-1350
48CA6148	44N	75W	31	Lithic scatter	BLM	NE/SHPO	P	6-1350
48CA6149	44N	75W	31	Lithic scatter	BLM	NE/SHPO	P	6-1350
48CA6150	44N	75W	30	Lithic scatter	Private	NE/SHPO	P	6-1350

Table 3-5 (Continued)

Site No.	Legal Location: Township	Range	Section	Site Type	Landowner	NRHP Eligibility Status [1]	Time Period [2]	Accession No. [3]
48CA6151	44N	75W	30	Lithic scatter	Private	NE/SHPO	P	6-1350
48CA6153	44N	75W	30	Open camp	Private	U/SHPO	P	6-1350
48CA6155	44N	75W	30	Lithic scatter	Private	NE/SHPO	P	6-1350
48CA6342	43N	75W	6	Open camp	BLM	NE	P	--
48CA6343	43N	75W	6	Open camp	BLM	NE	P	--
48CA6344	43N	75W	6	Open camp	BLM	NE	P	--
48CA6345	43N	75W	6	Open camp	BLM	NE	P	--
48CA6474	43N	75W	8	Rockshelter	Private	E	P	--
48CA6475	43N	75W	7	Open camp	Private	E	P	--
48CA6476	43N	75W	8	Open camp	Private	E	P	--
48CA6477	43N	75W	7	Lithic scatter	Private	NE	P	--
48CA6478	43N	75W	8	Open camp	Private	E	P	--
48CA6479	43N	75W	8	Open camp	Private	E	P	--
48CA6480	43N	75W	8	Open camp	Private	E	P	--
48CA6481	43N	75W	8	Open camp	Private	E	P	--
48CA6489	43N	75W	8	Open camp	Private	E	P	--
48CA6490	43N	75W	6, 7	Open camp	Private	E	P	--
48CA6491	43N	75W	7	Lithic scatter	Private	NE	P	--
48CA6498	43N	75W	8	Lithic scatter	Private	NE	P	--
48CA6499	43N	75W	6, 7	Lithic scatter	Private	NE	P	--
48CA6748	43N	75W	6	Open camp	BLM	E	P	--
48CA6749	43N	75W	6	Lithic scatter	Private	NE	P	--
48CA6750	44N	75W	31	Lithic scatter	BLM	NE	P	--
48CA6751	44N	75W	31	Open camp	BLM	E	P	--
48CA6752	44N	75W	31	Open camp	BLM	NE	P	--
48CA6753	44N	75W	31	Open camp	BLM	E	P	--
48CA6754	44N	75W	31	Lithic scatter	BLM	E	P	--
48JO2944	43N	76W	8	Trash scatter	Private	NE	H	--
48JO2945	43N	76W	8	Trash scatter	Private	NE	H	--
48JO2946	43N	76W	7, 8	Open camp	Private	E	P	--
48JO2947	43N	76W	7	Lithic scatter	Private	NE	P	--
48JO2948	43N	76W	17	Lithic scatter	Private	NE	P	--

Table 3-5 (Continued)

Site No.	Legal Location: Township	Range	Section	Site Type	Landowner	NRHP Eligibility Status [1]	Time Period [2]	Accession No. [3]
48JO2949	43N	76W	17	Trash scatter	Private	NE	H	--
48JO2950	43N	76W	17	Trash scatter	Private	NE	H	--
48JO2951	43N	76W	18	Homestead	Private	E	H	--
48JO2953	43N	76W	20	Lithic scatter/ building remains	Private	E	P/H	--
48JO2957	43N	76W	17	Lithic scatter	Private	NE	P	--
48JO2959	43N	76W	18	Lithic scatter	Private	NE	P	--
48JO2960	43N	76W	18	Lithic scatter	Private	NE	P	--

1 E = eligible; NE = not eligible; NE/SHPO = not eligible with SHPO concurrence; U/SHPO = unevaluated with SHPO concurrence.
2 H = historic; P = prehistoric; P/H = multicomponent prehistoric/historic.
3 -- = sites that are not yet accessioned with projects, sites associated with projects that have not yet been accessioned in the cultural records office, and sites with projects that do not extend into this section.

The entire area encompassed by the Nichols Ranch Unit permit boundary (within Sections 7, 8, 17, 18, and 20, T43N, R76W) was inventoried at the Class III level by Western Land Services, Sheridan, Wyoming, for the Tex Draw CBM POD, which has not been analyzed by the BLM (personal communication, November 21, 2007, with Clint Crago, Archaeologist, BLM Buffalo Field Office).

Within the Hank Unit permit boundary, all of Section 30 and all but the SENE, NESE, and SESE of Section 31 were inventoried for the Dry Willow 1 POD, which has been approved by BLM (personal communication, November 21, 2007, with Clint Crago, Archaeologist, BLM Buffalo Field Office). The SENE, NESE, and SESE of Section 31 were inventoried in 2007 for the Uranerz Energy Corporation's Hank In-situ Uranium Project, but it has not been reviewed by BLM. All of Sections 6-8 T43N, R75W, were inventoried at the Class III level in 2006 by Arcadis U.S., Inc. for the Dry Willow Phase 4 POD (report in progress). In August 2008, the WSW (80 acres) of Section 5, T43N, R75W, were inventoried by TRC Environmental Corporation at the Class III level and the accompanying report is presented in Addendum 3C. All areas within the Hank Unit have been inventoried at a Class III level for cultural resources.

Traditional Cultural Property Site 48CA268

The Hank Unit within Uranerz Energy Corporation's Nichols Ranch ISR Project permit area occurs adjacent to the west side and lower slopes of Pumpkin Buttes. In 2004, the entire summit area of Pumpkin Buttes (North, North Middle, South Middle, and South buttes) was recommended as a Rural Historic Landscape (RHL) with a contributing Traditional Cultural Property (TCP) (Site 48CA268) (Seletstewa et al. 2004). This recommended designation followed Native American consultation with affected Native American tribes. A Memorandum of Agreement was signed September 25, 2006, between Native American tribes and participating agencies and Site 48CA268 was determined to qualify as a TCP but not a RHL (personal communication, November 29, 2007, with Clint Crago, Archaeologist, BLM Buffalo Field Office). The final 2006 report and site form have, to date, not been accessioned by SHPO. The site boundary of the TCP follows the elevation contour of 5,500 ft above mean sea level (1,676 m) that corresponds to the average summit elevation of the four buttes that comprise Pumpkin Buttes. Therefore, due to the immediate proximity of the Hank Unit permit boundary, any ground disturbance within the permit boundary would constitute an adverse effect to the setting of the TCP, which is eligible for listing on the NRHP. Further, if ground disturbance is proposed within the boundary of the TCP, such activity would constitute an adverse effect to the TCP and would require Native American consultation and a subsequent Memorandum of Agreement between all affected participants.

3.8.2 Paleontological Resources

A paleontological survey was conducted for the Nichols Ranch ISR Project. From the survey performed, the Nichols Ranch ISR Project was concluded to have no major impact to significant fossil remains because of the geology and poor exposures of fossil bearing sediments. One recommendation from the survey is to have a monitor present to oversee any major ground disturbing events when more than a few feet of surface are removed. Uranerz Energy Corporation will comply with this recommendation when conducting any construction that will involve the removal of several feet of soil. Additionally, if any fossil remains are found during any construction activities, Uranerz Energy Corporation will immediately contact the appropriate state and federal agencies.

The complete paleontological survey is attached as Addendum D3B.

3.9 VISUAL/SCENIC RESOURCES

The Nichols Ranch ISR Project area 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 Hank Unit is located on the western flank of the North Middle Butte and is located in southwest Campbell County. Topography of the Hank Unit includes gently rolling hills and low ridges, as well as steep terrain near North Middle Butte and some steeply eroded areas associated with Dry Willow Creek (an ephemeral stream) located in the southern portion of this unit. Elevations in the Hank Unit range from 5,055 to 5,209 ft AMSL and the area is dissected by a series of unnamed and ephemeral drainages that generally drain west and southwest toward Dry Willow Creek. Figure 3-5 (see map pocket) depicts the Hank Unit from an aerial view.

The Nichols Ranch Unit is located approximately 6.0 mi southwest of the Hank 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 south toward Cottonwood Creek (an intermittent stream) that is located in the southern portion of the unit. Elevations in the Nichols Ranch Unit range from 4,670 to 4,900 ft AMSL. Figure 3-6 (see map pocket) depicts the Nichols Ranch Unit from an aerial view.

The Nichols Ranch ISR Project area encompasses approximately 3,370 acres; 1,120 acres for the Nichols Ranch Unit and 2,250 acres for the Hank Unit. The current land surface ownership of the Nichols Ranch ISR Project includes approximately 3,090 acres of private ownership, mainlyby the T-Chair Livestock Company, and approximately 280 acres of United States Government ownership administrated by the BLM. The two closest residences are the Pfister Ranch and the Dry Fork Ranch. The Pfister Ranch is located approximately 0.6 mi to the north of the northern most Hank Unit boundary. The Dry Fork Ranch is located approximately 0.9 mi to the west of the Nichols Ranch Unit western boundary. Table 3-1 in Section 3.1 details all residences and inhabitants near the project area.

Because the Nichols Ranch ISR Project is located almost 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. The 280 acres of BLM land near the Hank Unit is landlocked by private land limiting access to the land.

The Nichols Ranch Unit will be the site for CPP along with an office building and a maintenance building. The plant and buildings would be the prominent features of the landscape since the area where they are to be located is mostly flat with little to no other cover. Even though the plant and buildings will stand out, their existence will not be seen by the public.

The Hank Unit will be the site of a satellite plant along with one maintenance building. These facilities will sit to the west of the Pumpkin Buttes on private land. Several oil/gas wells exist in the region, so the Hank Unit satellite plant will not be the only prominent feature in the area. Additionally coal bed methane development has and will take place in the Hank Unit area. Coal bed methane well houses will be present in the area. The Hank Unit will not be visible from the main T-Chair Livestock Company ranch road, but will be visible from the top of the Pumpkin Buttes. The Pumpkin Buttes have been recognized as a potential TCP by the BLM. Visual concerns from coal bed methane development and coal bed methane development in general were addressed in an Environmental Assessment for Anadarko Petroleum Corporation Dry Willow Phase I and Dry Willow Phase II. These environmental assessments detail the agreement that was reached between the Bureau of Land Management and Anadarko Petroleum Corporation in regards to what mitigation steps would be taken to minimize the visual effects of coal bed methane in regards to the Pumpkin Buttes as a potential TCP. The main concerns that were voiced were to avoid development on the tops and sides of the Pumpkin Buttes, bury pipelines, power lines, etc, and to paint structures so that they will blend into the natural landscape. Uranerz Energy Corporation plans on doing these measures for both the Hank and

Nichols Ranch plant sites. Pipelines running to and from the wellfield to the plants will be buried not only to mitigate a visual impact, but for freeze protection of the pipelines. No extraction activities will take place on top of North and South Middle Butte, and buildings, well head covers, and header houses will be painted a color that will allow the structures to blend in with the existing landscape.

3.10 SOCIOECONOMICS

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 mi away. Casper, Wyoming is the next closet major urban area to the mine site located approximately 61 mi 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 3-6 lists the cities located within a 50 mi radius of the project area. Table 3-6 lists the estimated populations of all major towns within 50 mi (80 km) 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 Nichols Ranch ISR Project.

Table 3-6 Cities Within a 50-mi Radius of the Nichols Ranch ISR Project Area.

City	Population[1]	Distance From Permit Area (mi)	Direction
Gillette	22,685	46	Northeast
Buffalo[2]	4,290	57	Northwest
Kaycee	273	35	West
Midwest	431	25	Southwest
Edgerton	173	23	Southwest
Wright	1,425	22	East
Casper[2]	51,738	61	Southwest

[1] Source: U.S. Census Bureau Population Division (2006).
[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%.

Gillette, Wyoming is the County Seat of Campbell County. The city has been experiencing major growth over the last few years. Coal bed 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 CBM support services.

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 coal bed methane in Johnson County.

Several ranches are found within five miles of the Nichols Ranch ISR Project area. The closest inhabited dwelling is the Pfister Ranch. This ranch is located approximately 0.6 mi north of the Hank Unit. Currently three people reside at the ranch. The next closest inhabited dwelling is the Dry Fork Ranch located 0.9 mi to the west of the Nichols Ranch Unit. Three people also reside at this ranch. Four other ranches lie within 5.0 mi of the Nichols Ranch ISR Project area. The name of the ranches and the number of inhabitants are listed in Table 3-1. All together, the six ranches result in a total of 14 people residing within 5.0 mi of the Nichols Ranch ISR Project permit areas. This results in an occupational density of 0.31 persons per square mile for the area within 5.0 mi of the project area.

Because of the remote location of the Nichols Ranch ISR Project, visitation to the project location will be limited mainly to vendors, contractors, regulatory agency personnel, coal bed methane employees, and prearranged public tours.

Figures 4-1 through 4-3 of Chapter 4.0 of this report provides detailed information regarding the county profiles of Campbell, Johnson, and Natrona County. Included in this information are details about minority populations, county employment statistics, and landowners in the county.

The Nichols Ranch ISR Project economic contribution to the state of Wyoming the counties surrounding the project will 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 Energy Corporation and its employees for goods and services in the surrounding counties, and the wages paid to Uranerz Energy Corporation employees. The monies collected by the state and counties will go to support the funding of items such as state public schools, county infrastructure projects, and special county projects.

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 radionulclides in the soils and rocks. Table 3-7 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 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 3-7 Natural Background Radiation Dose Rates (mrem/year).

	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	50	----	----
Sea Level	26	----	----
U.S. Average	27	28	55
U.S. Average	----	----	300 (Natural Sources)
U.S. Average	----	----	360 (All 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. As can be seen in Table 3-8 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 3-8 Radiological Exposure from Various Sources in the United States.

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%**

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 3-9 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 will be exposed to radiation levels in excess of the

Table 3-9 Radiation Dose Comparisons.

	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**

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

standards. To avoid redundancy, details of the model run will not be discussed here. However, to illustrate minimal impact that the project will have on public health Table 3-10 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 both the Nichols and Hank Units.

The table lists seven of the nearest ranches to the Nichols and Hank Units and eight license boundary receptors. The boundary receptors were located in four different directions; north,

Table 3-10 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	
Rolling Pin Ranch	0.17
Dry Fork Ranch	0.07
Christensen Ranch	0.24
Pfister Ranch	0.90
Pumpkin Butte Ranch	0.70
Van Buggenum Ranch	0.21
Ruby Ranch	0.15
License Boundary Receptors	
Nichols Ranch Unit North	2.27
Nichols Ranch Unit East	0.86
Nichols Ranch Unit South	0.46
Nichols Ranch Unit West	3.40
Hank Unit North	1.22
Hank Unit East	5.31
Hank Unit South	0.82
Hank Unit West	1.51
Public Dose Limit	**100**

*Total Effective Dose Equivalent (whole body).

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. During this period, the maximum dose is projected to be 0.90 mrem at the Pfister Ranch Receptor. When compared to the public dose limit of 100 mrem, the minimum impact is clearly evident. This dose is over a hundred times lower than the federal standard. Values for the other public receptors are even lower. To summarize, the proposed operations will not have a significant impact on public health.

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 3.6.2.2, 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 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 Energy Corporation, 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 Nichols Ranch ISR Project would be disposed of through the deep disposal wells. These wastes include the production bleed stream; wash down water, and groundwater restoration water from groundwater sweeping and groundwater treatment activities. The deep disposal wells will be permitted through the WDEQ and operated according to permit requirements.

Sanitary wastes from the restrooms and lunchrooms at the Nichols Ranch ISR Project would be disposed of in approved septic systems. The septic systems at the Nichols Ranch ISR Project will be subject of approval from the State of Wyoming.

Solid wastes generated at the Nichols Ranch ISR Project 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. 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 the wastes are disposed of, they will be held in an area with a restricted boundary. Any noncontaminated wastes will be disposed of at a landfill located near Gillette in Campbell County, Wyoming.

4.0 ENVIRONMENTAL IMPACTS

The following chapter will analyze and describe the impacts for those resources described in Chapter 3.0, Description of the Affected Environment. Each alternative scenario (no action, proposed project, and alternatives) will be reviewed.

4.1 LAND USE

4.1.1 Proposed Action

Construction and operation of the proposed project would have the most adverse impacts on existing land uses. Although these impacts would be short-termed and minimal because of the extraction method and methods or restoration and reclamation proposed by Uranerz Energy Corporation, some of the impacts would require appropriate mitigation.

The environmental impacts of site preparation and construction for the Nichols Ranch ISR Project will be minimal. Even though the project boundaries will encompass a total of approximately 3,370 acres, disturbance and impacts will be limited to an area of approximately 300 acres or less. Local soils and vegetation will be impacted during the construction of the processing facilities and during the life time operation of the project. Wellfield activities such as drilling of wells and installation of pipelines will result in temporary disturbance to the soils and vegetation in those areas that the activities are taking place. The impact by the wellfield activities and processing facilities is small as demonstrated by existing uranium ISR operations in the Powder River Basin of Wyoming, Nebraska, and the southern portion of Texas. Since the Nichols Ranch ISR Project is located in a remote part of Wyoming, on private land, no impacts to any public services or public activities will result from the operation.

Construction and site preparation of the processing facilities located at both the Nichols Ranch and Hank Units will be limited to an area of approximately 2-4 acres at each site. During the construction of the facilities, all topsoil will be removed and stockpiled in a designated area where it will remain for the life of the project. During reclamation of the processing facilities, the original topsoil will be replaced in its original location where it will then be reseeded to return the area back into its original land use of livestock grazing and wildlife habitat.

Access roads to the wellfield and processing facilities will also result in surface impact to the local soils and vegetation. The impacts caused from the access roads will be for the life of the project. As a result, all topsoil will be removed and stockpiled in a designated location. When the access roads are no longer needed for the operation of the project, the areas affected by the access roads will be re-contoured, topsoiled, and reseeded.

With the construction and site preparation activities of the access roads and processing facilities, livestock grazing and wildlife habitat will be excluded in these areas. An estimated 80 acres will be fenced off to grazing activities at any given time during the life of the operation. Because the areas that will be affected by the surface disturbance of the access roads and processing facilities will be reclaimed and restored to the pre-mining use, no long term surface impacts will result from the project.

Surface disturbance associated with the drilling of wells and pipelines result in temporary disturbance of the soils and vegetation in the areas of these activities. The impact that results from these activities is minimal in that when an area is being drilled and pipelines constructed the disturbance results from the digging of mud pits or from the trenching of the pipeline. When the mud pits or trenches are excavated, the topsoil from the area of the mud pit or trench is removed and placed in a separate location. The subsoil is then removed and placed next to the excavation site. As soon as the mud pit is no longer needed or the trench has the pipeline in place, the subsoil is immediately put back into the excavation followed by the replacement of the topsoil. Re-seeding then follows as soon as possible. Depending on the time of year of the completion of construction and weather conditions re-seeding will take place in late spring or early fall.

The Nichols Ranch ISR Project will not result in any subsidence to the project area or surrounding areas. The proposed in situ recovery process does not remove any physical structures underground that would cause a void to occur and subside. The in situ process removes only the uranium mineral that is present on the surface of the host sandstone formation. The physical structure of the host sandstone is unaffected. Because the host sandstone formation is not affected subsidence will not result from the in situ process therefore no subsidence mitigation or control plans have been developed or included in this application.

The Nichols Ranch ISR Project is anticipated to minimally affect the areas in and adjacent to the project areas since the in situ recovery process will be used to recover the uranium. The in situ recovery process has demonstrated that its impacts to air, surface water, groundwater, land, land use, and ecological systems are minor and temporary as seen by the past and current in situ recovery operations that are located in the areas near the proposed project and in currently operating facilities in Wyoming, Nebraska, and Texas.

Exhibit 4-1, Nichols Ranch Area Wellfield Plan, and Exhibit 4-2, Hank Area Wellfield Plan have been included to show the preliminary layout of the wellfield including proposed power lines, injection and recovery well locations, header house and trunkline locations.

4.1.2 Alternatives

Land use environmental impacts associated with open pit and underground uranium mining is very significant when compared to ISR mining. Large amounts of overburden and tailings will be generated from the mining of the uranium. Groundwater aquifers will have to be dewatered where the mining will take place in order to remove the uranium. Additionally, with the removal of overburden, ore stockpiles, and tailings piles comes the generation of fugitive dust generated from the wind. Reclamation and restoration of the land affected also takes a considerable longer amount of time when compared to ISR mining.

4.1.3 No Action Alternative

The no action alternative would result in any land use impacts. There would be no project related land disturbances, access restrictions, and disturbance of grazing and wildlife habitat.

4.2 TRANSPORTATION RISK

Transportation of employees, product, process chemicals, and miscellaneous mine supplies will be either via Wyoming State Highway 50 to Van Buggenum Road to T-Chair Livestock ranch roads, or from U.S. Highway 387 north on T-Chair Livestock ranch roads. Figure 2-1 (see map pocket) of the NRC Technical Report shows the general location and access to the project areas. Once vehicles turn off of either Highway 50 or Highway 387, the vehicles will be traveling on a combination of county maintained gravel roadways and gravel ranch roads. The Van Buggenum county road is 24-ft wide, crowned-and-ditched road. The ranch roads, located mainly on T-Chair Livestock Company property, have been developed into 15 to 20-ft wide crowned-and-ditched roads by the coal bed methane producers that are active in the project area. All roads are four season roads that are capable of handling all traffic from the Nichols Ranch ISR Project. The speed limit for the Van Buggenum road is posted at 45 miles per hour while the speed limit on the ranch roads is posted at 30 miles per hour.

4.2.1 Proposed Action

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 Nichols Ranch ISR Project are consistent with those of the NRC analyses. Therefore, independent accident analyses will not be conducted for the Nichols Ranch ISR Project. However, assessments are provided of applicable accident types and scenarios to include site specific conditions. More specifically, discussion is provided with respect to coal bed methane recovery, which is unique to the region.

Written operating procedures will be maintained that describe requirements for response to postulated accidents and mitigation of consequences. Written operating procedures will be developed 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.

4.2.1.1 Transportation Incidents

Materials transportation to and from the Hank and Nichols Ranch Units can be classified into four categories:

1) Shipment of refined yellowcake from the Nichols Ranch Central Processing Plant to a uranium conversion facility.
2) Shipment of loaded resin from the Hank Unit to the Nichols Ranch Central Processing Plant.
3) Shipment of process chemicals from suppliers to the Hank and 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.

4.2.1.2 Shipment of Refined Yellowcake

Refined Yellowcake produced at the Nichols Ranch Central Processing Plant will 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. The following information on transportation accidents is based on the analysis on the earlier NRC study.

Refined yellowcake produced at the Nichols Ranch Central Processing Plant will be packaged in 55-gallon steel drums. Yellowcake will 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.

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 will 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 will 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 Energy Corporation Incident Response Guide. This guide will be included with every shipment of yellowcake that leaves the Nichols Ranch Central Processing Plant. The carrier will 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.

4.2.1.3 Shipments of Loaded Resin

The Hank Unit of the Nichols Ranch ISR Project is designed as a satellite ion-exchange (IX) facility. This IX satellite operation will require the shipping of resin loaded with uranium to the Nichols Ranch CPP located approximately 6.0 mi away. The uranium that is loaded on the resin will then be processed, dried, and packaged at the Nichols Ranch CPP. The route for moving the resin from the Hank Unit to the Nichols Ranch Unit is shown on Figure 2-1 (see map pocket) of Chapter 2.0 of the NRC Technical Report. No public roadways will be utilized during the shipping of resin for the Hank Unit to the Nichols Ranch CPP.

The uranium that is loaded onto the resin will remain attached to the resin until it is removed by a strong brine solution. 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 will 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 will 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.

4.2.1.4 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 4-1 lists the process chemicals that may be utilized at the Nichols Ranch ISR Project. 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 Energy Corporation 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 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 will be trucked to the Nichols Ranch ISR Project in bulk shipments of approximately 7,500 gallons. The frequency of shipments will be approximately 10-12 trucks per year. The trucks will originate from Casper and travel to the project site. The distance to be covered is approximately 85 road mi. Using the accident rate of 4.8×10^{-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.

Table 4-1 Bulk Chemicals Required at the Nichols Ranch ISR Project.

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

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

All 11e(2) by-products generated at the Nichols Ranch ISR Project site will 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 4.2.1.1 using the Model I criteria.

The risk of an accident involving the transporting of 11e(2) byproduct material and resulting in a spill will 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 Energy Corporation Incident Response Guide. This guide will be included with every shipment of 11e(2) byproduct material that leaves the Nichols Ranch Central Processing Plant. The carrier will also be required to maintain accident response capability to specifically include spill response.

4.2.1.6 Transporting Employees To and From Project Site

The Nichols Ranch ISR Project site is in a remote location in Wyoming. Employees that work at the Nichols Ranch ISR Project site will 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 mi away to as far as 61 mi away from the project site. Transportation to and from the project site will either be from personal vehicles or company provided transportation.

Potential risks to employees coming to and from the Nichols Ranch ISR Project 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 Nichols Ranch ISR Project are impassible or closed, then measures will be taken so that employees, contractors, vendors, and visitors will 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 Nichols Ranch ISR Project is estimated at 2.2×10^{-6}/mi based on NUREG 0780, NRC, 1980. All travel will be on either two lane rural highways with some rural interstate travel depending if employees come from Casper. Work schedules will 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 Alternatives

The alternatives, open pit and underground mining, pose the same risks as does the proposed action, but the amount of vehicle traffic to and from the mining site would increase with the amount of people needed to operate an open pit or underground mine. These two types of mining require more people to run them when compared to ISR mining. Additionally there is more potential for accidents occurring at the mine site with open pit mining because of the heavy equipment that is needed to remove overburden and the ore from the pit to the central processing facility. Fugitive dust emissions would increase substantially resulting in additional hazards and costs.

4.2.3 No Action Alternative

No transportation risks would occur with the no action alternative. Traffic in the area would continue to be limited to the landowner, oil/gas, and coal bed methane personnel.

4.3 GEOLOGY AND SOILS IMPACT

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 100 acres during the life of the project. Soils would be disturbed in the area of the plant facilities, 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 will be handled accordingly. All topsoil removed from construction activities will be preserved by adopting construction practices the prevent erosion and loss of topsoil. Chapter 5.0 will detail the methods that will 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 Alternatives

Geologic impacts associated with open pit and underground mining are more severe than ISR mining in that they both remove the rock matrix and structure where the uranium is located. By removing the rock matrix or structure, surface subsidence could and would result from the collapse of the overlying rock strata in the mining zone. Additionally the geologic environment in the project area would be disrupted by the removal of the overburdened during open pit mining operations and the sinking of shafts and mining operations of an underground mine.

Soil impacts by the alternative mining operations are much greater and longer termed than the proposed project. Much more soil is disturbed by the open pit mining since overburden has to be removed before mining of the ore takes place. Additionally, the plant sites (mill sites) for the open pit and underground mining operations have a greater foot print than the ISR processing facilities. Reclamation and restoration of soils for the alternatives also takes a longer time than ISR mining since ISR mining methods can reclaim and restore soil disturbances, especially in the wellfield, since reclamation will take place following the installation of pipelines, wellfields, etc.

4.3.3 No Action Alternative

With the no action alternative, there would not be any geologic or soil impacts since no mining activities would occur.

4.4 WATER RESOURCE IMPACT

4.4.1 Proposed Project

4.4.1.1 Surface Water Impacts

Surface water impacts that result from the Nichols Ranch ISR Project are considered to be nonexistent to minimal. Any impacts that might arise to surface water from the Nichols Ranch ISR Project will be temporary.

Surface water for the Nichols Ranch ISR Project is limited to four identified jurisdictional wetlands located on the Nichols Ranch Unit. These wetlands are in such locations that they will 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. The attached Appendix D10 provides more information regarding the 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; when and where possible berms and contouring will be utilized to minimize potential erosion and sediment movement. Re-seeding with native seed mixture or cover crops will also occur upon completion and reclamation of the project area. Re-seeding of an area will 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, office and maintenance buildings, pipelines, and processing facilities (both main and satellite facilities). In the event that surface runoff flows are impeded by any facilities, culverts and diversion ditches will be implemented to control the runoff and prevent excessive erosion. If the surface runoff is concentrated in an area, measures such as energy dissipaters will be used to slow the flow of the runoff so that erosion and sediment transport are minimized. Figure 2-15 (see map pocket) of Chapter 2.0 of the NRC

Technical Report provides a map of the surface drainage areas for the Nichols Ranch ISR Project.

Exhibit 4-4 depicts all surface water reservoirs, drainages, and wetlands for the Nichols Ranch ISR Project. All surface water features for the Nichols Ranch ISR Project are man-made. No natural surface water is present at either the Nichols Ranch or Hank Unit.

4.4.1.2 Ephemeral Drainages Impacts

The Nichols Ranch ISR Project area contains three main drainages, one at the Nichols Ranch Unit, and two at the Hank Unit. In the Nichols Ranch Unit, drainage from surface precipitation and snowmelt is to the southwest to Cottonwood Creek via small ephemeral moderately to deeply incised channels (1 to 30-ft high banks) that range from 1 to 15-ft wide. Cottonwood Creek has been altered with a system of irrigation ditches and spreader dikes that have been constructed in the past to supply water to the area for past hay production. Drainage in the Hank Unit generally is to the northwest and west off North Middle and South Middle Buttes via Dry Willow Creek and Willow Creek. Channel widths generally range from 1 to 2 ft in the headwater areas and increase to 20 to 30 ft-wide where the drainages leave the western edge of the Hank Unit. In general, the drainages are deeply incised with 10 to 50-ft high banks in the southern and northeastern portions of the Hank Unit and less incised in the other parts of the unit.

All flows within both units are ephemeral with no perennial or intermittent stream flows. The volume of flow from these ephemeral drainages is seasonal and directly related to local climatic conditions. The climate is semi-arid with an annual precipitation varying from 10 to 14 inches. Most of the precipitation occurs during May through June with snowfall contributing slight amounts to the overall total.

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 will be utilized. If an ephemeral drainage may be impacted by the roads or wellfield operations, appropriate measures will be taken to minimize the impact to the ephemeral drainage including the prevention of erosion and sediment transport into the drainage.

Access road construction will be minimized by using existing roads within the project area. When new roads are needed, design and construction practices will 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 will 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 will be examined and implemented.

Wellfield construction activities will result in some short term or temporary effects on erosion. The ongoing drilling, well development, pipeline construction, header house construction, lateral pipeline placement, and access road construction activities will incorporate erosion protection measures 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, re-seeding of the disturbed area will take place along with the erosion protection measures mentioned in the previous paragraph. The re-seeding will take place in the spring or fall, whichever comes first after the construction activity takes place.

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 will 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 will 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 will be utilized.

4.4.1.3 Groundwater Impacts

In situ recovery impacts to the groundwater are minimal. During the uranium recovery process, the groundwater will be impacted by the elevated concentration of certain constituents that are present in the groundwater in the ore zone. These impacts are temporary as the groundwater will be returned to pre-mining condition or class of use as defined by the Wyoming Department of Environmental Quality when the mining of the ore zone is completed.

One other impact to the groundwater will be the removal of water from the ore zone aquifers during the life of the Nichols Ranch ISR Project from the wellfield bleed. The water that is removed from the ore zone aquifers will result in a net loss of water from the ore zone aquifer, but the water that is lost will be replaced over time by the recharging of the aquifer. Water that is removed from ore zone aquifers will be sent to a deep disposal well.

The bleed rate from the ISR operation at Nichols Ranch Unit will cause a steady stress on the A Sand aquifer. For production of 3,500 gpm and a 1% bleed rate. The bleed rate will average 35 gpm. This stress for a three year operation at Nichols Ranch Unit was simulated with the aquifer properties of 350 gal/day/ft for transmissivity and a storage coefficient of 1.8E-4. Figure 7-1 (see map pocket) of the NRC Technical Report presents the results of these drawdowns. These drawdowns were calculated from three different stress locations. Pumping wells were placed in the southeastern portion of the wellfield, north central and southwestern portion; each for one year pumping period. One pumping location in the center of the wellfields would produce very similar drawdown. These predictions show that 30 ft of the drawdown will extend 7,000 ft outward from the center of the wellfields. The 5.0 ft contour is projected to extend out 22,500 ft or approximately 4.0 mi from the Nichols Ranch ISR Project area.

The flowing wells that are inside the 10 ft 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 flowing well is completed in the A Sand and will very likely cease flowing during the ISR operation. In a 5.0-mi radius of the Nichols Ranch Unit, there are approximately 10 free flowing wells that are located in the A Sand. These wells may be impacted by the drawdown associated with the Nichols Ranch Unit. Exhibit 4-3 shows the approximate location of the wells in relation to the Nichols Ranch Unit. As stated in the Technical Report, Uranerz has confidential surface use agreements in place with the landowners detailing mitigation measures that Uranerz will implement if a free flowing well is impacted by the Nichols Ranch ISR Project.

The analysis of the potential predicted drawdowns in the F Sand from the Hank Unit ISR operation were calculated with average aquifer properties of transmissivity (400 gal/day/ft) and storage value of 0.05 and 3 years of operation. For a production rate of 2,500 gpm and a 3% bleed rate, the predicted drawdowns are presented in Figure 7-2 (see map pocket) of the NRC Technical Report. Twelve stresses were used to simulate these drawdowns. Six stresses for a total of 75 gpm for 1.5 years was located on the northern wellfield and a second set of six stresses for the following 1.5 years was located in the southern wellfield. This figure shows that for the 10 ft contour extends only near the area of the southern wellfield while the 5.0 ft unit contour extends out approximately 900 ft from the edge of the wellfields.

No flowing wells exist in the F Sand in this area and therefore the limited drawdowns are not likely to significantly affect any existing water users.

4.5.1 Alternatives

Open pit and underground mining impacts on the water resources are more substantial than the proposed ISR method. With each of the alternatives, the ore zone would have to be de-watered prior to mining activities. This would result in a complete removal of all water in the ore zone. Additionally, the conventional mill that each alternative would use consists of constructing surface tailings ponds. These ponds add to the potential for surface and groundwater resources to be impacted by potential leaks that could occur in the ponds.

With the removal of overburden by the open pit mining alternative, impacts to ephemeral drainages would occur at those locations were the ore zone is present under the ephemeral drainage. The drainage would have to be altered for the duration of the project which would result in more land disturbance.

4.6.1 No Action Alternative

With the no action alternative, there would not be any water resource impacts since no mining activities would take place.

4.7 ECOLOGICAL RESOURCE IMPACT

4.7.1 Proposed Action

4.7.1.1 Wildlife Impacts

A wildlife survey/study was conducted for the Nichols Ranch ISR Project. The wildlife study area includes the Nichols Ranch ISR Project area and a 2.0-mi buffer (see Exhibits D9-1 through D9-4 of the attached Appendix D9). The entire wildlife survey area (project area plus the 2.0-mi survey area) encompasses approximately 62.0 mi2 (39,659.6 acres).

4.7.1.1.1 Endangered Species

There are no know endangered species or endangered species habitat within the Nichols Ranch ISR Project area. Impact to endangered species is therefore nonexistent and no mitigation factors are needed.

4.7.1.1.2 Wildlife

Mining activities within the proposed Nichols Ranch ISR Project area will result in limited short-term loss of approximately 300 acres of wildlife habitat over the approximate 10-year life of the mine. Short-term habitat losses will occur in those areas that are temporarily disturbed during drilling operations and during the construction of the ancillary facilities. The losses in wildlife habitat will be limited to small areas (less than 60-80 acres/year) and will be short-term in nature. The loss of wildlife habitat will be mitigated with the completion of reclamation activities.

All wildlife habitat disturbed during the life of the mine will be revegetated following the completion of mining operations. Reclamation will be directed toward the restoration of the site primarily for livestock grazing and wildlife habitat.

4.7.1.1.2.1 Big Game

The entire project area lies within winter/yearlong pronghorn antelope and mule deer range of the Pumpkin Buttes Herd Units (WGFD 2005a). 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 300 acres will be incrementally mined or otherwise disturbed during the approximate 10-year life of the mine. As a result of these habitat disturbances, the winter/yearlong range carrying capacity for big game will be reduced during the life of the mine and for several years following mining until vegetative growth on the revegetated areas becomes productive enough to support big game. Since only 60-80 acres will be withdrawn from use as wildlife habitat at any given time, the Nichols Ranch ISR Project is not expected to have any adverse impacts on pronghorn antelope or mule deer. No significant increase in the potential for vehicle collision with big game is expected because of the short distances and low speeds required on the access roads. Also, 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 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 will aid in the reduction of big game conflicts associated with the Nichols Ranch ISR Project.

4.7.1.1.2.2 Upland Game Birds

Ten greater sage-grouse leks occur within the wildlife study area (refer to Exhibit D9-3 of the attached Appendix D9). All of the leks were active in 2006. Direct impacts to greater sage-grouse from project activities would include habitat loss and fragmentation from mine, road, pipeline, and power line construction; alteration of plant and animal communities; increased human activity that could cause the birds to avoid an area; increased noise that could cause the birds to avoid an area or reduce breeding efficiency; increased motorized access by the public leading to legal and illegal harvest; direct mortality from increased vehicular traffic; and an increase in mortality from raptors if power poles are placed in occupied greater sage-grouse habitat.

To minimize impacts to breeding greater sage-grouse, project activities and vehicular traffic would be minimized in areas within 0.25 mi of an active lek between the hours of 8:00 pm and 8:00 am during the greater sage-grouse strutting period (March 1-May 15), and project activities (i.e., drilling and construction) would be reduced in areas adjacent to an active lek between March 15 and July 15. 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 an active lek. To minimize impacts to greater sage-grouse and other upland bird species (i.e., Hungarian partridge), removal and disturbance of vegetation will be kept to a minimum through the use of existing roads for travel and for the placement of pipelines. All lands disturbed by project activities will be revegetated as soon as practical following the project disturbing activities following practices outlined in the Reclamation Plan.

4.7.1.1.2.3 Waterfowl and Shorebirds

During the 2006 field season, waterfowl were seldom observed on the project area. This minimal use is probably 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 Nichols Ranch ISR Project is not expected to have any adverse impacts on waterfowl or shorebirds. No mitigation efforts are needed.

4.7.1.1.2.4 Mammalian Predators

The use of the project area by mammalian predators will be temporarily reduced due to mining activities at the Nichols Ranch ISR Project. In addition, the recent outbreak 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 Nichols Ranch ISR Project is not expected to have any adverse long-term impacts on mammalian predators. No mitigation efforts are also needed.

4.7.1.1.2.5 Lagomorphs

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. The natural outbreak of Tularemia has caused noticeable mortality to the 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 Nichols Ranch ISR Project is expected to have negligible short-term adverse impacts on lagomorph populations. No adverse long-term impacts are likely to occur.

4.7.1.1.2.6 Small Mammals

Some small mammals may be displaced by the mining activities over the life of the mine. Prairie dog habitat (i.e., towns) occurs on the project area. Prairie dog towns would not be avoided during mining activities; however, steps will be taken to minimize disturbance in their habitat. However, due to the low frequency of small mammal occurrence in the project area, the Nichols

Ranch ISR Project is expected to have a negligible short-term adverse impact on small mammal populations. No adverse long-term impacts are likely to occur.

4.7.1.1.2.7 Raptors

Forty raptor nests occur within the wildlife study area, of which 10 were determined to be active as in 2006. Nine of the 10 active nests were located in the Hank Unit and one of the active nests was located in the Nichols Ranch Unit. Three active red-tailed hawk, three active long-eared owl and three active great-horned owls were observed in the Hank Unit. The remaining active nest was a golden eagle in the Nichols Ranch Unit. Based on the proposed permit boundaries, those trees with nests will not 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 reproduction success. Potential conflicts between active nest sites and project-related activities will be mitigated by annual raptor monitoring and mitigation plans such avoiding areas, when possible, where raptor nest sites are located, and limiting the constructing of overhead power lines so that raptors will not come in contact with them or use them as perches for viewing prey such as sage grouse.

The temporary disturbance of approximately 300 acres of raptor prey species habitats is unlikely to result in a reduction in the raptor population in the area because only 60-80 acres will be disturbed at any time. Additionally, this reduction is expected to be short-term and negligible. Therefore, the Nichols Ranch ISR Project is not expected to have any adverse long-term impacts on raptor populations.

4.7.1.1.2.8 Nongame/Migratory Birds

The temporary disturbance of approximately 300 acres of habitat will result is some 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 will be minimal in relation to the amount of comparable habitats that are available in the general area. Therefore, the Nichols Ranch ISR Project is not expected to have any adverse long-term impact on any passerine bird populations.

4.7.1.1.2.9 Reptiles and Amphibians

The two species of reptiles that were documented in or near the project area during fieldwork are common in Wyoming. 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 Nichols Ranch ISR Project is not expected to have any adverse long-term impacts on any reptiles or amphibian populations.

4.7.1.1.2.10 Threatened, Endangered, Proposed, and Candidate Species and Special Status Species

Based on state and federal wildlife agencies and habitat preference, two TEPC animal species and 17 BLM SS species have the potential to occur in the project area (refer to Tables D9-3 and D9-4 of the attached Appendix D9). Bald eagle was the only protected species observed within the wildlife study area and may use the area for foraging during the winter months and migration; however, no nests or communal roosts occur within the Nichols Ranch ISR Project wildlife survey area. Project lands disturbed as a result of mining will be unavailable for foraging bald eagles until these areas are reclaimed and prey species return. The area has been block-cleared for the black-footed ferret (refer to Addendum D9A of the attached Appendix D9; therefore, the mine will have no affect on black-footed ferrets. Two BLM SS species, the swift fox and Brewer's sparrow, were observed within or adjacent to the project area. Since only 60-80 acres will be withdrawn from use as wildlife habitat at any given time, the Nichols Ranch ISR Project is not expected to have any adverse impacts on TEPC species or SS. No special mitigation plans for TEPC species or SS are planned at this time.

4.7.1.2 Vegetation Impacts

Approximately 300 acres or less of land will be disturbed by the proposed Nichols Ranch ISR Project. The impacts to vegetation will be short term as most disturbances are associated with wellfield development that will be immediately reclaimed and reseeded. Additionally, the small amount of vegetation that may be affected by the proposed project will occur over the life of the project with only 60-80 acres of land being affected at any given time. 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 Nichols Ranch ISR Project. One noxious weed species, Canada thistle, is found in the proposed project area along with one selenium indicator species, two-groove milkvetch. Mitigation measure 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.

4.7.2 Alternatives

The ecological resource impacts associated with the alternatives of open pit and conventional mining are much greater than those associated with the proposed ISR operation. The amount of land affected by the alternatives is far greater than that of the proposed project resulting in greater loss of wildlife and vegetative habitat over a greater length of time.

4.7.3 No Action Alternative

With the no action alternative, ecological resource impacts would be limited to those impacts associated with present and future coal bed methane extraction taking place in the proposed Nichols Ranch ISR Project area.

4.8 AIR QUALITY IMPACTS

4.8.1 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 will 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 Nichols Ranch ISR Project as they are during the operation of the proposed project since the amount of vehicle traffic is expected to be the same. A detailed calculation of the amount of estimated fugitive dust to be released by the project is depicted in Figure D4-5 (of the attached Appendix D4). 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 will 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 will be small because of low traffic volume.

The processing facilities for the Nichols Ranch ISR Project will also be the source for several other process emissions. These emissions and their potential emission quantity are found in Table 3-3 in Section 3.6 of Chapter 3.0. These emissions are generated from the venting of process vessels during filling and normal plant operations. These emissions will be released to the atmosphere by vent pipes located on either process equipment or on the equipment used to fill the tanks.

Air quality in the wellfields and near the processing building could be affected radon gas. 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 ion exchange system at each processing plant could also provide a pathway for potential escape, but by using pressurized down flow ion exchange columns the radon would be kept in solution. Radon could then be released when disconnecting individual ion exchange columns to remove or elute the resins in the column. Localized ventilation will aid in minimizing exposure in this case. The vacuum dryer used for drying yellowcake along with the packaging area could release airborne particulate emissions, including natural uranium and radon daughters, to the environment.

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 Nichols Ranch ISR Project are small fractions of the allowable does limit for the general public.

4.8.2 Alternatives

Air quality from underground and open-pit mining would result in a greater impact to the local and regional areas surrounding the Nichols Ranch ISR Project. The amount of fugitive dust generated by the increase in traffic, larger processing plant footprint, and mining operations is considerably greater than the proposed project. Additionally, the health and safety exposures to radon are greater at open-pit and underground mining operations by having people exposed to the ore zones. Dust emissions with overburden piles, ore stockpiles, and tailings impoundments will also increase.

4.8.3 No Action Alternative

There would be no air quality impacts from the no action alternative since no mining and processing facility would exist.

4.9 NOISE

4.9.1 Proposed Action

Noise related to development of the ISR Project would 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. It would also include transportation of the IX resin to the processing facility and the operation of the processing facility. 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 4-4 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 59 dBA at 0.6 mi--the distance from the Hank Unit boundary to the nearest residence. Referring to Table 3-4, 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 39 dBA at 0.6 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.

Some localized impacts to wildlife could occur, especially to greater sage-grouse and nesting raptors. These impacts are discussed in section 4.7.1.1.2.

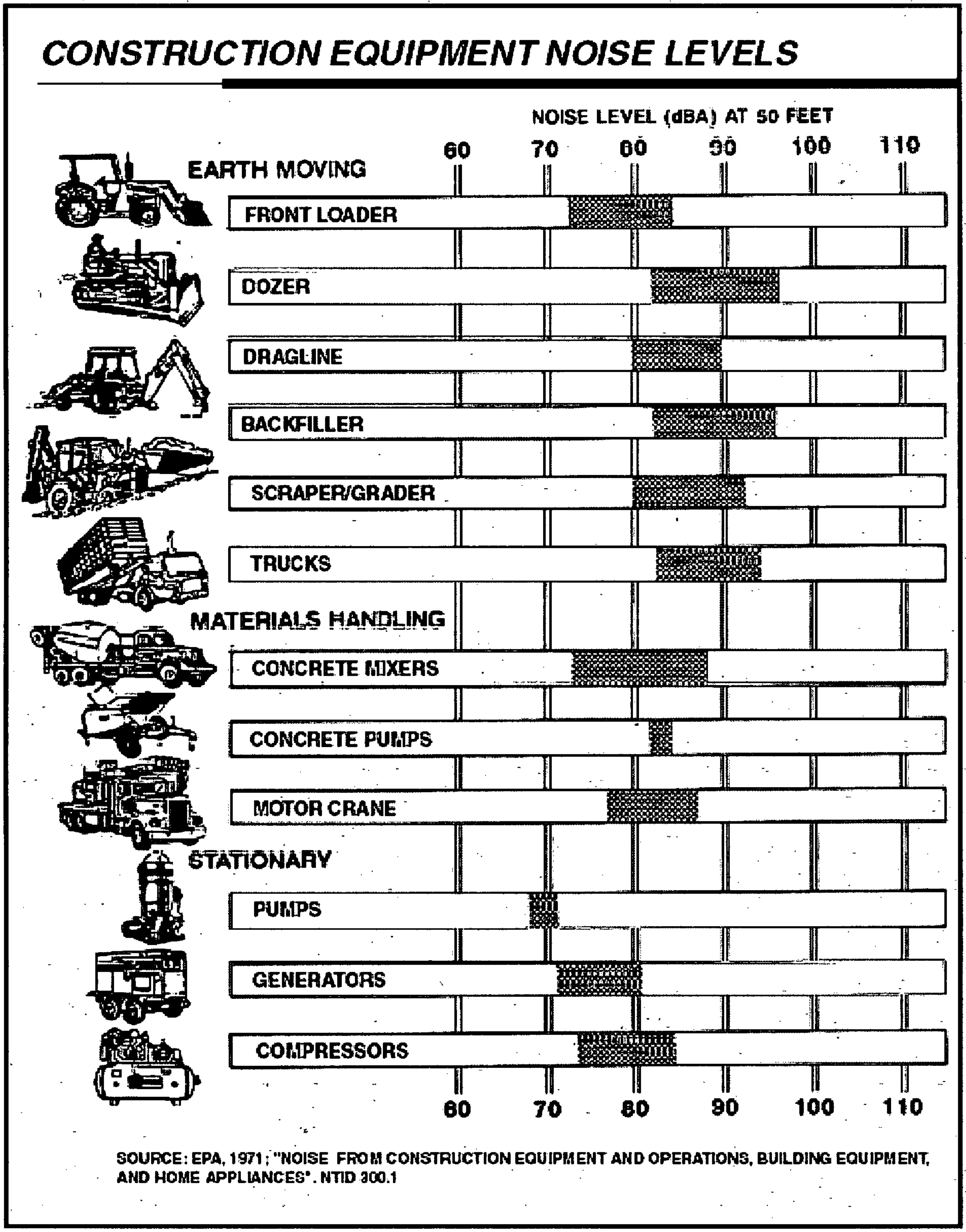

Figure 4-4 Construction Equipment Noise Levels.

4.9.2 Alternatives

The noise produced by open pit or underground mining would generate higher and more constant noise levels over a longer period of time. Noise levels associated with the removal and crushing of the uranium ore are substantially higher than the noise levels associated with the processing of the uranium with an ISR mining operation. Noise from heavy trucks and mining equipment associated with the removal of ore in open pit and underground mining operations can produce noise at levels above 85 decibels, exposing workers operating the equipment to levels of noise that could cause deterioration of hearing. Noise impacts to the residents living in the area would be marginally greater than as described in the Proposed Action, primarily because of the added truck traffic and the more constant use of heavy equipment generating high dBA levels.

4.9.3 No Action Alternative

Under the no action alternative, noise levels would remain near current levels and would not increase due to activities associated with in situ uranium mining.

4.10 HISTORIC AND CULTURAL RESOURCE IMPACTS

4.10.1 Proposed Action

The Nichols Ranch ISR Project would have limited impacts to historic and cultural resources located within the project area. As mentioned in Chapter 3, Section 3.8 of this report, many cultural surveys have been conducted in the areas of the proposed project with cultural sites identified. The only adverse effect that would occur with the Nichols Ranch ISR Project would be at the Hank Unit. The Hank Unit permit boundary extends into a recently identified Traditional Cultural Property (TCP). Because of the close proximity of the propose project at the Hank Unit to the TCP, the Hank Unit would have an adverse effect to the setting of the TCP from the minor ground disturbance that would occur with the operation of the Hank wellfield. However, no ground disturbance would take place inside the TCP area at the Hank Unit and any effect to the TCP by the Hank Unit would not be long term. Additionally, measures such as painting of buildings with colors that blend in with the surrounding environment would be implemented to aid the reduction of the adverse effect to the TCP.

4.10.2 Alternatives

Using open pit or underground mining to extract the uranium at the Nichols Ranch ISR Project would have a considerable impact to historic and cultural resources, especially at the Hank Unit. Ground disturbance created by these two methods of mining would have an even greater adverse effect to the setting of the identified TCP than the proposed action. Additionally, ground disturbance would more than likely occur in the TCP boundary. This would constitute an adverse effect to the TCP that would require Native American consultation and a subsequent Memorandum of Agreement between all affected participants. Consultation and a Memorandum of Agreement could result in significant delays and costs that would not make the alternatives a cost effective alternative to the proposed project.

4.10.3 No Action Alternative

No adverse effect to the setting of the TCP or any cumulative effects to the historic and cultural resources found the in the area of the Nichols Ranch ISR Project would occur with the no action alternative since no disturbance would take place.

4.11 VISUAL/SCENIC RESOURCE IMPACTS

4.11.1 Proposed Action

Because the Nichols Ranch ISR Project is located almost 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. The 280 acres of BLM land near the Hank Unit is landlocked by private land limiting access to the land.

The Nichols Ranch Unit will be the site for central processing facility (CPP) along with an office building and a maintenance building. The plant and buildings would be the prominent features of the landscape since the area where they are to be located is mostly flat with little to no other cover. Even though the plant and buildings will stand out, their existence will not be seen by the public.

The Hank Unit will be the site of a satellite plant along with one maintenance building. These facilities will sit to the west of the Pumpkin Buttes on private land. Several oil/gas wells exist in the region, so the Hank Unit satellite plant will not be the only prominent feature in the area. Several transmission towers are completed outside of the Hank Unit permit boundary on top of South Middle Butte. Additionally coal bed methane development has and will take place in the Hank Unit area. Coal bed methane well houses will be present in the area. The Hank Unit will not be visible from the main T-Chair Livestock Company ranch road, but will be visible from the top of the Pumpkin Buttes. The Pumpkin Buttes have been recognized as a Traditional Cultural Property (TCP) by the Bureau of Land Management (BLM). Visual concerns from coal bed methane development and coal bed methane development in general were addressed in Environmental Assessments for Anadarko Petroleum Corporation Dry Willow Phase I and Dry Willow Phase II. These environmental assessments detail the agreement that was reached between the Bureau of Land Management and Anadarko Petroleum Corporation in regards to what mitigation steps would be taken to minimize the visual effects of coal bed methane in regards to the Pumpkin Buttes as a potential TCP. The main concerns that were voiced were to avoid development on the tops and sides of the Pumpkin Buttes, bury pipelines, power lines, etc, and to paint structures so that they will blend into the natural landscape. Uranerz Energy Corporation plans on doing these measures for both the Hank and Nichols Ranch plant sites. Pipelines running to and from the wellfield to the plants will be buried not only to mitigate a visual impact, but for freeze protection of the pipelines. No extraction activities will take place on top of North and South Middle Butte, and buildings, well head covers, and header houses will be painted a color that will allow the structures to blend in with the existing landscape.

The following is an excerpt from the Dry Willow Phase II Environmental Assessment on the visual resource impact regarding the coal bed methane development in the same area that the

Nichols Ranch ISR Project will take place in. Much of what is observed will be the same for the proposed Nichols Ranch ISR Project with the exception that the Hank Unit will sit at the base of North and South Middle Buttes. The Nichols Ranch Unit central processing plant will be located approximately 6.0 mi to the west of the Buttes.

> "Recently constructed oil and gas related facilities are visible from the base of the Buttes to approximately 15 miles westward. Modern visual distractions include conventional gas and oil wells, well pads, pump jacks, access roads (both crowned and ditched and two track), pipeline scars, reservoirs, fence lines, power lines, a large water storage facility, uranium mine facilities, ranch buildings and dust from vehicle traffic. The setting of the Pumpkin Buttes as they face the project area is nearly dominated by modern visual distractions.
>
> As excerpted from *Pumpkin Buttes Visual Assessment* by Gary D. Long, Outdoor Recreation Planner for the Wyoming BLM State Office:
>
>> Roads and Trails: Roads were readily visible at distances up to five miles. Roads were most visible where located in darker, sagebrush-dominated landscapes. This was because of the contrast created by a light colored linear feature in a dark colored landscape that was devoid of similar natural linear features.
>>
>> Coal Bed Natural Gas Development (CBM): While this could be seen, the structures associated with CBM are not readily seen at distances over one mile. What is seen are the roads and well site locations, particularly when cleared in sagebrush-dominated landscapes.
>>
>> Reservoirs: Reservoirs were readily seen at distances equal to or exceeding two miles.

<u>Power Lines:</u> Several single pole power lines were noted. They could be seen but at distances exceeding a mile would not attract the attention of the casual observer.

A few proposed wells and accesses are within 2 and 1/2 miles of North Middle and South Middle Buttes. The project area can be viewed from all the Buttes. At distances over two miles, the frost boxes associated with CBM wells will be painted to blend into the background and will not be visible. All major access roads (crowned and ditched roads) associated with the project are already constructed and are visible from the Buttes. Construction of pipelines and parallel two track roads accessing wells are over two miles away, will re-vegetate and will not be visible from the Buttes. There is very little sage in the project area (mostly grass) and the construction and reclamation of new accesses or pipelines will not create a vegetation contrast. There are not any reservoirs or other large production related facilities associated with the project. The majority of the power lines associated with the project will be buried.
Overhead lines associated with the project will be well over 2 miles from the buttes.

It does not appear that the construction of the Dry Willow II POD will add visual distractions to the setting of Pumpkin Buttes, especially considering the existing developments that attract the viewers' attention. Additionally, the setting of the buttes is nearly compromised by modern oil and gas related activities. Construction of the project will result in "no effect" to Pumpkin Buttes (48CA268)."

Figures 3-5 and 3-6 of Chapter 3.0 of this report show an aerial view of the Hank and Nichols Ranch Units. The location of the proposed plant sites along with the location of oil/gas wells, transmission towers, and roads are depicted on the figures.

4.11.2 Alternatives

The visual and scenic resource impacts of the alternatives will be greater than those of the proposed project. The larger size of a conventional mill compared to the size of an ISR processing plant will stand out greater than the proposed project along with disturbing more land. Additionally, the overall land disturbance with an open-pit mine and underground mine would be more noticeable than that of the ISR project. Open pit mining operations would have to remove and stockpile hundreds of feet of overburden before reaching the ore zone. Underground mines would also have hoist house structures that would be taller than any of the proposed project buildings.

Mitigation factors for aiding in reducing the overall visual/scenic impact of the alternatives would be the same as those used by the proposed project. Buildings and other structures would be painted so that they blended in will the natural landscape and power lines and pipelines would be buried where applicable.

4.11.3 No Action Alternative

No visual or scenic resources would be impacted for the no action alternative since there would be no activity taking place.

4.12 SOCIOECONOMICS IMPACTS

4.12.1 Proposed Action

The socioeconomic impacts of the Nichols Ranch ISR Project would be seen by the communities in the surrounding area of the project. Businesses in towns such as Gillette, Wright, and Casper would see some additional income from purchase of goods and services by Uranerz Energy Corporation and its employees. Currently Uranerz Energy Corporation anticipates employing approximately 45-55 people when the Nichols Ranch ISR Project is up and running. These are

45-55 jobs for the people from the start of the project in 2010 continuing to the end of the project.

The 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 Nichols Ranch ISR Project, but could add to the current housing shortage being seen in Wyoming. The communities of Gillette, Casper, and Wright are all seeing an economic boom contributed to the continued growth of coal bed methane and oil/gas activity in the state. To help alleviate the housing burden, Uranerz Energy Corporation plans on employing people from the area surrounding the project.

The proposed project will 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 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.

4.12.2 Alternatives

The socioeconomic impacts of the open pit and underground mining alternatives are similar to those of the proposed project. The demand for housing may be higher for the two alternatives since the operations will employ more people than the ISR mining method. Additionally, more out of area/out of state workers may be required to fill all the open positions of an open pit and underground mining operation.

4.12.3 No Action Alternative

Under the no action alternative, socioeconomic conditions in the project area would be the same as the conditions that currently exist in the area.

4.13 ENVIRONMENTAL JUSTICE

4.13.1 Proposed Project

The estimated population of Campbell, Johnson, and Natrona counties in 2004 by the U.S. Census Bureau was approximately 113,388. 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. 2004 unemployment levels for the three counties averaged ~3.4% with average yearly earning ranging from ~$24,000 per year in Johnson County to ~$41,000 per year in Campbell County. The average earning ranges for the areas surrounding the Nichols Ranch ISR Project are well above the 2004 poverty level of $18,850 for a four family member household and even above the 2007 poverty level of $20,050 for a four family household.

Based on the data above, no concentrations of people living below the poverty level or no concentrated minority populations are located near the Nichols Ranch ISR Project; therefore, no adverse environmental impacts would result to minority populations or those living below the poverty level.
Figure 4-1 through Figure 4-3 (see map pockets) detail employment, population, and earnings data for the Campbell, Johnson, and Natrona County, Wyoming.

4.13.2 Alternatives

The alternatives to the proposed Nichols Ranch ISR Project would result in the same impacts as the proposed project.

4.13.3 No Action Alternative

With the no action alternative, environmental justice would not be impacted since no ISR operation would take place.

4.14 PUBLIC AND OCCUPATIONAL HEALTH IMPACTS

4.14.1 Proposed Action (Public Health)

The values in Table 4-2 show the maximum dose rates (based on MILDOS modeling) to seven public receptors near the Nichols and Hank Units. The highest dose is projected to be 0.90 mrem at the Pfister 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 over a hundred 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 0.90 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 will not have a significant radiological impact on public health.

Table 4-2 Projected Dose Rates to Public Receptors (Time-Step 4, Maximum Activity Period).

Receptor	Dose (mrem/yr)*
Public Receptors	
Rolling Pin Ranch	0.17
Dry Fork Ranch	0.07
Christensen Ranch	0.24
Pfister Ranch	0.90
Pumpkin Butte Ranch	0.70
Van Buggenum Ranch	0.21
Ruby Ranch	0.15
Public Dose Limit	**100**

*Total Effective Dose Equivalent (whole body).

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.

4.14.2 Alternatives (Public Health)

Other methods for recovering uranium include underground mining and open pit (surface mining). Both methods have significantly higher production costs than ISR and therefore the economics of the ore reserve must be commensurately higher to justify this type of recovery. As is true of other ISR projects, the nature of the deposits (ore grade, recoverable pounds and depth) at the Nichols and Hank Units do not lend themselves to recovery by costly surface or underground mining. Other than ISR, there is no other recovery alternative that is economically feasible.

4.14.3 No Action Alternative (Public Health)

Exercising this option obviously would mean that the minimal radiological and nonradiological affects of the project would not be generated. Although the insignificant impact that the project would have on public health would not occur, consideration must be given to the potential impacts from other energy sources (oil, natural gas and coal) that would be developed to compensate for the loss from the nuclear fuel cycle. For environmental reasons (primarily reduction in greenhouse gasses), it is generally acknowledged that nuclear power must be made a larger part of our energy mix. From this view point the no action alternative, does not appear to be in the best interest of public health.

4.14.4 Proposed Action (Occupational Health)

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 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.

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 TLD 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 just listed provides a high level of assurance that occupational health is well protected.

4.14.5 Alternatives (Occupational Health)

As discussed in 4.12.2 above, the only economically feasible method for recovering the uranium resources at the Nichols and Hank Units is ISR. Occupational health and safety statistics (by industry) show underground mining and surface mining to be in the higher risk categories. Since these methods are not economically feasible in this setting, they will not be employed.

4.14.6 No Action Alternative (Occupational Health)

The no action scenario would mean that job opportunities would not be generated, and prospective employees would find work in other occupations. Some of those jobs would likely have higher occupational health risks associated with them and some would be lower. In short, there is no evidence to suggest that the no action scenario would improve the occupational health and safety of the prospective employees. For this reason, the no action scenario does have a basis of support.

4.15 WASTE MANAGEMENT IMPACTS

4.15.1 Proposed Project

Three types of waste will be generated with the proposed project; liquid, solid, and sanitary. All liquid wastes generated at the Nichols Ranch ISR Project would be disposed of through deep disposal wells. 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 will be permitted through the Wyoming Department of Environmental Quality and operated according to permit requirements. The deep disposal wells will be designed to handle a injection flow rate of ~100 gallons per minute.

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 will be isolated in drums or other suitable containers prior to disposal offsite. Until wastes are disposed of they will be held in an area with a restricted boundary. Any noncontaminated wastes will be disposed of at a landfill located near Gillette in Campbell County, Wyoming. Other solid contaminated wastes such as wellfield piping will either be reused in a different production area, or flattened, surveyed, and shipped to a licensed NRC disposal site.

Sanitary wastes from the restrooms and change houses will be disposed of in approved septic systems. The septic systems at the Nichols Ranch ISR Project will be subject of approval from the State of Wyoming.

The cumulative impacts of the waste generated at the Nichols Ranch ISR Project are minimal. All waste that is generated will either be disposed of at an NRC licensed facility if it is contaminated or at a county landfill if it is not contaminated. The wastes would add some volume to the disposal facilities, but that amount would not cause any concerns on landfill capacity.

4.15.2 Alternatives

The open pit and underground mining alternatives would produce similar wastes as the proposed action, but in some greater quantity since these alternative use more people and have to dispose of larger quantities of solid wastes generated by the mining and processing. Large tailings ponds would have to be constructed for the retention and disposal of the solid wastes. Liquid wastes would either be disposed of in tailing ponds deep disposal wells, or a combination of both. Again, the quantity of liquid wastes generated by the two alternatives is greater than those associated with proposed action.

Sanitary wastes would be handled in the same way as the proposed action.

4.15.3 No Action Alternative

Waste generation would not take place with the no action alternative; therefore, no additional burden would be placed on NRC licensed disposal sites or local landfills.

5.0 MITIGATION MEASURES

5.1 PROPOSED ACTION

The mitigation measure that are planned for the Nichols Ranch ISR Project are intended to return the subsurface and surface of the Nichols Ranch ISR Project area to conditions compatible with the pre-mining uses. All groundwater that is affected by the Nichols Ranch ISR Project will be restored to a condition of use equal to or exceeding that which existed prior to project construction. All disturbed land will be reclaimed and restored to the pre-mining condition of livestock grazing and wildlife habitat.

5.1.1 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 will be implemented to decrease the restoration time.

5.1.1.1 Water Quality Criteria

The primary goal of the groundwater restoration efforts will 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 will 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 Energy Corporation will then use a secondary goal of returning the groundwater to the Wyoming Department of Environmental Quality–Water Quality Division class of use designation. This will 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 Wyoming Department of Environmental Quality–Water Quality Division. Pre-mining baseline water quality data, groundwater use category, available technology, and economics will be criteria used in attaining the final level of water quality during restoration.

5.1.1.2 Restoration Criteria

Groundwater restoration criteria in a production area will be based on the baseline water quality data collected for each production area. The baseline water quality data will include data collected from wells completed in the ore zone and perimeter monitoring ring wells. Baseline water quality parameters will 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 will be established prior to mining in each production area by computing specific restoration values for specific parameters. The restoration values will 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 will 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 Wyoming Department of Environmental Quality (WDEQ) and NRC reviewing and approving the change to restoration values.

The success of the restoration will 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 will be deemed complete. A summary report requesting approval will 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 will commence.

5.1.1.3 Groundwater Restoration Methods

For in situ recovery (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 will 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 will 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 will 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 will be utilized. Uranerz Energy Corporation will 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 will be contacted for agreement that restoration has been achieved in the production area. After this, the stability monitoring stage will 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 Energy Corporation will make a request to the WDEQ and NRC that the production area be deemed restored.

5.1.1.3.1 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 TDS (total dissolved solids) water from the production area in restoration will be recovered and injected into the production area beginning mining. The direct transfer of water will 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 (IX) 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 will 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.

5.1.1.3.2 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. Radium 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 will 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.

5.1.1.3.3 Groundwater Treatment

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

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

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

The number of pore volumes treated and re-injected during the groundwater treatment phase will 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.

5.1.1.3.4 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 will 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 will be contacted if any of the wells cannot be monitored within 65 days of the last sampling event.

5.1.1.4 Restoration Stability Monitoring Stage

Once a production area has been designated as restored by the Wyoming Department of Environmental Quality, 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 will 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 will 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 will be contacted if any of the monitor or production wells cannot be monitored within 65 days of the last sampling event.

5.1.1.5 Well Abandonment

When the groundwater has been adequately restored and determined stable by the regulatory agencies, surface reclamation and well abandonment will begin. All production, injection, monitor wells, and drill holes will 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 will be abandoned using the following procedure:

1. All pumps and piping will 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.

2. 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.

3. Cement or a plastic plug will 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 will be approved in advanced by the NRC and WDEQ.

5.1.2 Surface Reclamation and Decommissioning

5.1.2.1 Introduction

At the completion of mining of the Nichols Ranch ISR Project, all lands disturbed by the mining project will be restored to their pre-mining land use of livestock grazing and wildlife habitat. Any buildings or structures will 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 will be used as guide in evaluating the final reclamation. A final decommissioning plan will be sent to the NRC for review and approval at least 12 months prior to the planned decommissioning of a wellfield or project area.

5.1.2.2 Surface Disturbance

Because of the nature of ISR mining, minimal surface disturbance will be associated with the Nichols Ranch ISR Project. Surface disturbance will consist of construction activities associated with the construction of the central processing plant (CPP), satellite plants, and 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 will be for the life of those activities. Topsoil will 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.

5.1.2.3 Topsoil Handling and Replacement

Topsoil will 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 will be utilized. Topsoil salvage operations for the wellfield will be limited to the removal of topsoil at header house locations. Wellfield access roads topsoil removal will be in accordance with the landowner's road construction practices. These practices are outlined in the letter attached in Addendum 5A. All together, an estimated 100 acres of topsoil will be salvaged, stockpiled, and reapplied during the life of the Nichols Ranch ISR Project.

Topsoil that is salvaged during construction activities will be stored in designated topsoil stockpiles. These stockpiles will be located so as to minimize topsoil losses from wind erosion. Topsoil stockpiles will also not be located in any drainage channels or other locations that could lead to a loss of material. Berms will 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 will 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 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. These methods of topsoil salvaging have proven to be adequate as demonstrated by the successful revegetation and reclamation at prior and existing ISR operations.

5.1.2.4 Vegetation Reclamation Practices

All revegetation practices will 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, will be seeded with vegetation throughout the mining operation to reduce wind and water erosion. Final revegetation of the mine area will consist of seeding the area with one final reclamation seed mix. Table 5-1 shows the seed mixture that will be used for reclamation. 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 will be used when using a rangeland drill. On areas where it is not practicable to use a drill, the seed will be broadcast at a rate of 30 pounds pure live seed per acre.

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

Table 5-1 Uranerz Reclamation Seed Mixture.

Species	Percent of Mix	Pounds PLS/acre
Western Wheatgrass	28	4.2
Revenue Slender Wheatgrass	28	4.2
Bozoisky Russian Wildrye	19	2.85
Greenleaf Pubescent	9	1.35
Gulf Annual Ryegrass	6	0.9
Yellow Blossom Sweet Clover	5	0.75
Ladak 65 Alfalfa	5	0.75
Total	100	15

5.1.2.5 Road Reclamation

5.1.2.5.1 Access Roads

Two access roads will be built to connect both the Nichols Ranch central processing (CPP) plant and the Hank satellite plant with the existing ranch roads. The length of the Nichols Ranch CPP road is approximately 0.20 mi in length. The Hank satellite plant road will also be approximately 0.20 mi in length. If the landowner desires, the roads will be left in place when operations are complete. If not, the roads will be reclaimed. Even if the roads are left in place, third party reclamation costs will be included in the reclamation bond estimate.

If the access roads are to be reclaimed, the first step will be to pick up and remove the scoria/gravel on the road surface. Once the scoria/gravel has been removed the road bed will be disced or ripped. Next, the topsoil stored in the ditch will be re-applied on the road surface. Finally, the road surface will be mulched and seeded with the permanent seed mixture.

5.1.2.5.2 Wellfield Access Roads

The wellfield access roads will 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 will decide which wellfield access roads will remain and which roads will be reclaimed.

If wellfield access roads are to be reclaimed, the first step in reclaiming the wellfield access roads will 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 will be either disced or ripped. The disturbed area will then be mulched and seeded with the permanent seed mixture.

5.1.2.6 Site Decontamination and Decommissioning

5.1.2.6.1 Wellfield

Following the successful conclusion of the aquifer restoration stability period in a particular production area, the wellfield piping, well heads and associated equipment will be removed and, if serviceable, taken to a new production area for continued service. Wellfield equipment that is no longer usable will 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 will be trucked from the site to an approved NRC disposal facility.

5.1.2.6.2 Plant Dismantling

After groundwater restoration is complete in the final production area, decommissioning of the Nichols Ranch Unit central processing plant site and the Hank Unit satellite plant will commence. (The Nichols Ranch plant may continue to be used after completion of mining to process materials from other satellites). All process equipment associated with the plants will 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 will be disposed of at an approved NRC facility. After decontamination, materials that will not be reused or that do not have any resale value, like building foundations, will be removed and disposed of at an off-site facility.

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

Gamma surveying will also be conducted when each wellfield is decommissioned. Any material or substance identified during the gamma survey as having contamination levels that require disposal in a licensed NRC facility will be removed, packaged if necessary, and then shipped to the approved NRC disposal facility.

During decommissioning, if any soil cleanup is required of the wellfield or of the site facilities, 10 CFR 40 Appendix A, Criterion 6(6) clean up criteria for radium and other radionuclides (uranium and thorium) will be utilized based on the radium benchmark approach. NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual" (NRC, 2000) will also be utilized to ensure that acceptable survey methods are used in determining site sampling programs for the decommissioning.

5.1.2.7 Final Contouring

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

5.1.2.8 Financial Assurance

Uranerz Energy Corporation will maintain surety instruments to cover the costs of reclamation for the Nichols Ranch ISR Project. The surety instruments will 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 Energy Corporation will 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-LQD, NRC, and Uranerz Energy Corporation have agreed to the estimated reclamation and restoration costs, a reclamation performance bond, irrevocable letter of credit, or other acceptable surety instrument will be submitted to the WDEQ with a copy to the NRC.

Addendum 5B contains the calculations and estimate of the proposed surety bond for the first year of operation for the Nichols Ranch ISR Project. The surety estimate is based on the first year of operation consisting of the construction of the Nichols Ranch central processing plant and the start up of the first production area at the Nichols Ranch Unit. The construction of the Hank satellite plant and the first Hank production area are also included in the surety estimate. Although the first Hank production area will be put in place, it is not anticipated to be operational in the first year thus the surety bond will not include a cost estimate for restoring the groundwater at the Hank Unit.

5.1.3 Cultural Resource Mitigation

Uranerz Energy Corporation will comply with the following cultural resource mitigation measures.

1. Uranerz will not conduct any ground disturbing work in areas that have not been previously inventoried and cleared for cultural resources.

2. Uranerz will 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 SHPO and other regulatory agencies.

3. To protect a previously identified traditional cultural property, Uranerz will also not conduct any ground disturbing activities above the 5,500 ft elevation within the Hank Unit.

4. If cultural resources are discovered during operations, Uranerz will immediately stop ground disturbing activities in the area of the discovery and will immediately notify the WDEQ, the BLM, the SHPO, and any other appropriate regulatory agency.

5.2 ALTERNATIVES

In comparison with the alternatives of open pit and underground mining with conventional uranium mills, the Nichols Ranch ISR Project should not have any residual or unavoidable adverse impacts that remain after mitigation measures have been applied. Evaporation and tailings ponds used in conventional mining and milling operations will not be utilized for the Nichols Ranch ISR Project. Overburden removal from open pit mining and ore stockpiles associated with both open pit and underground mining will not occur with the Nichols Ranch ISR Project. These activities could result in unavoidable adverse impacts and residual impacts even after mitigation measures have been implemented. The amount of land disturbance is such that even after mitigation measures have been used, the area will have a different contour from the pre-mining conditions. The Nichols Ranch ISR Project will not result in any major impacts to the surface or underground matrices resulting in no major contour issues.

5.3 NO ACTION ALTERNATIVE

With the no action alternative, there would be no mitigation measures that would be needed since no mining would take place.

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 Nichols Ranch ISR Project (Project). The radiological measurement and monitoring programs to be implemented during operation of the Project are described in the license application Technical Report at Section 5.7.7.

6.1.1 Surface Soil, Subsurface Soils and Sediment

6.1.1.1 Purpose and Procedure

In June of 2007, an extensive soil and sediment sampling program was completed for the Nichols Ranch and Hank Units of the Nichols Ranch ISR Project. 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 (USGS) 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 in situ recovery (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 will 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 D11-1, Nichols Unit-Soil and Sediment Sample Location Map, and Exhibit D11-2 Hank Unit Soil and Sediment Sample Location Map in the attached Appendix 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. The calibration date on the meter for the June 2007 survey was June 8, 2007. 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 Nichols Ranch Unit Results

Table 6-1, Radiological Background in Surface and Subsurface Soil - Nichols Ranch Unit, provides a summary of the analyses for each sample point as well as some basic statistical measures (minimum, maximum, average and standard deviation).

Most of the surface soil sample and all of the subsurface samples have typical background radiological characteristics (approximately 1 pCi/g or less). For comparison purposes, normal soils typically have a Ra-226 content of 1 pCi/g (NCRP Report No.78). With the exception of one site, (LAS-5), which had a Ra-226 level of 26 pCi/g, the table shows normal background levels. The elevated level at LAS-5 might be attributed to old exploration activities.

With respect to sediment, Table 6-2 Radiological Background in Sediment - Nichols Ranch Unit shows that 40% of the samples exceed normal background levels of 1 pCi/g for Ra-226. Elevated levels were detected at sample sites SD-1, 8, 9 and 10. A possible explanation for this departure could be that earlier exploration activities may have left ore zone cuttings on the surface.

Because a significant percentage of the sites have elevated Ra-226, the average value of 9.6 pCi/g is well in excess of normal background. Pb-210 was also detected at higher than normal background levels at two of the sites, resulting in a slightly higher than normal average.

Table 6-1 Radiological Background in Surface and Subsurface Soil - Nichols Ranch 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
R-1	0-6	1.85	2.1	0.3	0.8	0.2	0.7	0.1
R-2	0-6	1.42	0.9	0.2	0.8	0.2	ND	
R-3	0-6	1.93	1.1	0.2	0.7	0.2	ND	
R-4	0-6	2.58	1.1	0.2	1.2	0.2	ND	
R-5	0-6	1.66	0.1	0.1	0.6	0.1	ND	
SS-6	0-6				0.8	0.2		
SS-7	0-6				1.3	0.2		
SS-8	0-6	1.12	0.7	0.1	0.6	0.2	ND	
SS-9	0-6				0.8	0.2		
SS-10	0-6				0.9	0.2		
SS-11	0-6	1.39	ND		0.9	0.2	ND	
SS-12	0-6				0.3	0.2		
SS-13	0-6				0.8	0.2		
SS-14	0-6				0.9	0.2		
SS-15	0-6				0.6	0.2		
SS-16	0-6				1.5	0.2		
SS-17	0-6				0.8	0.2		
SS-18	0-6				0.8	0.2		
SS-19	0-6	1.64	ND		1.4	0.2	0.1	0.1
SS-20	0-6				0.8	0.1		
SS-21	0-6				2.4	0.2		
SS-22	0-6	1.89	ND		0.9	0.1	0.8	0.6
SS-23	0-6				0.6	0.1		
SS-24	0-6				0.4	0.1		
SS-25	0-6				0.5	0.1		
SS-26	0-6				0.7	0.1		
SS-27	0-6				0.7	0.1		
SS-28	0-6				0.7	0.1		
SS-29	0-6				0.8	0.1		
SS-30	0-6				1.2	0.1		
LAS-1	0-6	0.97	ND		0.4	0.1	0.3	0.1
LAS-2	0-6	2.96	ND		0.9	0.2	0.7	0.1
LAS-3	0-6	2.58	ND		0.8	0.2	0.3	0.1
LAS-4	0-6	1.37	ND		1.0	0.2	0.7	0.1
LAS-5**	0-6	4.72	ND		26.4	3.9	0.6	0.1
LAS-6	0-6	2.19	ND		1.3	0.2	0.6	0.1
LAS-7	0-6	1.73	1.0	0.4	1.0	0.2	0.5	0.1
LAS-8	0-6	1.51	ND		1.0	0.2	0.5	0.1

Table 6-1 (Continued)

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
Plant Site								
Center	0-12	1.43	ND		1.0	0.2	0.5	0.1
	12-24	1.22	0.5	0.4	1.0	0.2	0.4	0.1
	24-36	1.37	ND		0.7	0.2	0.6	0.1
NW	0-6	1.43	0.4	0.1	1.2	0.2	ND	
NE	0-6	1.42	0.6	0.1	0.9	0.2	ND	
SE	0-6	1.2	0.3	0.1	1.1	0.2	ND	
SW	0-6	1.45	1.0	0.2	1.0	0.2	1.1	0.6
SB-4	0-12	2.7	ND		1.0	0.1	0.5	0.1
	12-24	3.95	ND		1.0	0.1	0.6	0.1
	24-36	2.34	ND		0.8	0.1	0.4	0.1
SB-5	0-12	1.00	ND		0.7	0.1	0.4	0.1
	12-24	1.35	1.6	0.4	0.6	0.1	0.4	0.1
	24-36	1.91	0.7	0.3	0.7	0.1	0.2	0.1
SB-6	0-12	1.29	ND		0.8	0.2	0.5	0.1
	12-24	1.8	0.5	0.4	1.6	0.2	0.4	0.1
	24-36	2.05	0.4	0.4	0.8	0.2	0.5	0.1
SB-7	0-12	1.01	ND		0.8	0.1	0.3	0.1
	12-24	1.45	ND		0.9	0.2	0.4	0.1
	24-36	1.73	ND		0.9	0.2	0.6	0.1
SB-8	0-12	1.88	ND		1.1	0.2	0.7	0.1
	12-24	2.23	ND		1.0	0.1	0.7	0.1
	24-36	2.59	ND		1.0	0.1	0.5	0.1

Table 6-1 (Continued)

Sample Site		Uranium mg/kg*	Pb-210 pCi/g	Precision Plus/Minus	Ra-226 pCi/g	Precision Plus/Minus	Th-230 pCi/g	Precision Plus/Minus
Surface Soil:								
Minimum		**0.97**	**0.1**		**0.3**		**0.1**	
Maximum		**4.72**	**1.1**		**26.4**		**1.1**	
Average		**1.69**	**0.7**		**0.9**		**0.6**	
Standard Deviation		**0.52**	**0.3**		**0.4**		**0.2**	
Subsurface Soil:								
Minimum		**1.00**	**0.4**		**0.6**		**0.2**	
Maximum		**3.95**	**1.6**		**1.6**		**0.7**	
Average	**0-12**	**1.55**	**ND**		**0.9**		**0.5**	
	12-24	**2.00**	**0.4**		**1.0**		**0.5**	
	24-36	**2.00**	**0.2**		**0.8**		**0.5**	

Notes:
R-1: Nearest Residence. R-1 through R-4: Rn-222 and Gamma Monitoring Locations.
*Reporting Limit: 0.50.
SS: Surface Soil.
SB: Subsurface Soil.
LAS: License Area Sample.
ND: Not Detected
See Exhibit D11-1 for sample site locations.
**U and Ra-226 values for LAS-5 appear to be anomalies and were not used in the statistics.

Table 6-2 Radiological Background in Sediment - Nichols Ranch Unit.

Sample Site	Uranium mg/kg*	Pb-210 pCi/g	Precision Plus/Minus	Ra-226 pCi/g	Precision Plus/Minus	Th-230 pCi/g	Precision Plus/Minus
SD-1	2.1	ND		16.2	3.0	0.5	0.1
SD-2	2.02	ND		0.6	0.1	0.5	0.1
SD-3	1.84	0.7	0.3	0.7	0.1	0.5	0.1
SD-4	1.77	ND		0.7	0.1	0.4	0.1
SD-5	1.96	2.0	0.4	1.0	0.2	0.4	0.1
SD-6	0.95	ND		0.5	0.1	0.2	0.1
SD-7	3.07	0.5	0.4	1.0	0.2	0.6	0.1
SD-8	2.67	1.8	0.4	32.2	4.2	1.0	0.2
SD-9	3.03	ND		23.5	3.6	0.6	0.1
SD-10	4.02	ND		19.4	3.3	0.9	0.1
Minimum	**0.95**	**ND**		**0.5**		**0.2**	
Maximum	**4.02**	**2.0**		**32.2**		**1.0**	
Average	**2.34**	**1.3**		**9.6**		**0.6**	
Standard Deviation	**0.87**	**0.8**		**12.1**		**0.2**	

Notes:
SD: Sediment.
*Reporting Limit: 0.50.
ND: Not Detected.
See Exhibit D11-1 for sample site locations.

6.1.1.4 Hank Unit Results

Table 6-3 Radiological Background in Surface and Subsurface Soil - Hank Unit provides a summary of the analyses for each sample point as well as some basic statistical measures (minimum, maximum, average and standard deviation). With just a few exceptions, the values in the table are within the expected ranges. Briefly, the average value for Ra-226 is 1.1 pCi/g, and this nearly matches the reference radium concentration of 1 pCi/g in normal soil (NCRP Report No. 78). Similarly, values for U, Th-230 and Pb-210 also fall within expected background ranges. One site, LAS-2, had the highest values for uranium (8.4 mg/kg), Pb-210 (1.2 pCi/g), Ra-226 (3.8 pCi/g) and Th-230 (2.5 pCi/g).

Table 6-3 Radiological Background in Surface and Subsurface Soil - Hank 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
R-1	0-6	1.26	3.9	0.4	1.3	0.2	0.9	0.2
R-2	0-6	1.71	ND		0.5	0.1	ND	
R-3	0-6	1.04	ND		0.4	0.1	ND	
R-4	0-6	2.77	0.3	0.2	0.3	0.1	ND	
R-5	0-6	2.46	ND		1.0	0.2	ND	
SS-6	0-6				1.5	0.1		
SS-7	0-6	2.19	ND		1.7	0.2	1.2	0.6
SS-8	0-6				1.2	0.1		
SS-9	0-6				1.1	0.1		
SS-10	0-6				2.1	0.1		
SS-11	0-6				1.1	0.1		
SS-12	0-6				1.0	0.1		
SS-13	0-6				0.9	0.1		
SS-14	0-6				1.3	0.1		
SS-15	0-6				1.1	0.1		
SS-16	0-6	1.37	ND		1.3	0.2	ND	
SS-17	0-6				1.3	0.1		
SS-18	0-6				0.8	0.1		
SS-19	0-6				0.9	0.1		
SS-20	0-6				1.2	0.1		
SS-21	0-6				1.1	0.2		
SS-22	0-6				1.3	0.2		
SS-23	0-6				0.9	0.2		
SS-24	0-6				1.1	0.2		
SS-25	0-6	1.81	ND		1.0	0.2	1.2	0.6
SS-26	0-6				0.7	0.1		
SS-27	0-6				0.7	0.1		
SS-28	0-6				0.9	0.2		
SS-29	0-6				1.1	0.2		
SS-30	0-6				1.2	0.2		
SS-31	0-6				0.7	0.2		
SS-32	0-6				1.2	0.2		
SS-33	0-6				0.9	0.2		
SS-34	0-6	2.10	ND		1.3	0.2	1.2	0.5
SS-35	0-6				1.1	0.2		
LAS-1	0-6	1.60	0.5	0.1	0.9	0.1	0.3	0.1
LAS-2**	0-6	8.40	1.2	0.1	3.8	0.1	2.5	0.1
LAS-3	0-6	1.40	ND		0.8	0.1	0.4	0.1
LAS-4	0-6	1.00	ND		0.8	0.1	0.2	0.1
LAS-5	0-6	1.60	0.6	0.1	1.1	0.1	0.5	0.1
LAS-6	0-6	1.50	ND		0.9	0.1	0.4	0.1
LAS-7	0-6	1.00	0.3	0.1	0.6	0.1	0.3	0.1
LAS-8	0-6	1.10	ND		0.6	0.1	0.5	0.1

Table 6-3 (Continued)

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
LAS-9	0-6	1.39	ND		1.3	0.2	0.7	0.2
LAS-10	0-6	1.47	ND		1.2	0.2	0.7	0.2
LAS-11	0-6	2.35	ND		1.0	0.2	0.5	0.2
LAS-12	0-6	2.40	ND		1.3	0.1	0.6	0.1
LAS-13	0-6	1.90	ND		1.2	0.1	0.8	0.1
LAS-14	0-6	1.50	0.3	0.1	1.0	0.1	0.5	0.1
SB-4	0-12	2.30	0.9	0.1	1.6	0.1	0.9	0.1
	12-24	2.00	0.7	0.1	1.1	0.1	0.5	0.1
	24-36	1.70	ND		0.8	0.1	0.4	0.1
SB-5	0-12	1.30	ND		0.9	0.1	0.5	0.1
	12-24	ND	0.7	0.1	1.1	0.1	0.4	0.1
	24-36	1.80	0.6	0.1	1.1	0.1	0.4	0.1
SB-6	0-12	1.60	0.3	0.1	1.2	0.1	0.5	0.1
	12-24	1.40	0.2	0.1	1.2	0.1	0.7	0.1
	24-36	1.60	ND		1.2		0.7	0.1
SB-7	0-12	3.11	ND		0.9	0.1	0.4	0.1
	12-24	2.33	ND		0.9	0.2	0.6	0.1
	24-36	3.62	ND		1.1	0.2	0.7	0.2
SB-8	0-12	1.43	ND		1.3	0.2	0.4	0.1
	12-24	1.42	ND		1.2	0.2	0.4	0.1
	24-36	1.60	ND		0.8	0.2	0.6	0.2
SB-9	0-12	1.13	ND		0.9	0.2	0.5	0.3
	12-24	1.30	ND		0.8	0.2	0.2	0.1
	24-36	1.43	ND		1.0	0.2	0.6	0.3
Plant Site								
Center	0-12	1.35	ND		1.0	0.2	0.5	0.1
	12-24	1.28	ND		0.9	0.2	0.7	0.1
	24-36	1.57	0.7	0.04	0.9	0.2	0.5	0.1
NW	0-6	1.83	ND		1.0	0.2	ND	
NE	0-6	2.18			1.0	0.2	0.9	0.5
SE	0-6	1.82	ND		1.2	0.2	ND	
SW	0-6	1.67	0.3	0.2	1.0	0.2	ND	

Table 6-3 (Continued)

Surface Soil:					
Minimum		**1.00**	**0.3**	**0.3**	**0.2**
Maximum		**8.40**	**0.6**	**2.1**	**1.2**
Average		**1.73**	**0.4**	**1.0**	**0.6**
Standard Deviation		**0.48**	**0.1**	**0.3**	**0.3**
Subsurface Soil:					
Minimum				**0.8**	**0.2**
Maximum				**1.6**	**0.9**
Average	**0-12**	**1.75**	**0.2**	**1.1**	**0.5**
	12-24	**1.39**	**0.2**	**1.0**	**0.5**
	24-36	**1.90**	**0.2**	**0.8**	**0.6**

Notes:
R-1: Nearest Residence. R-1, 2, 3, 4 and 5: Rn-222 and Gamma Monitoring Locations.
*Reporting Limit: 0.50.
SS: Surface Soil.
SB: Subsurface Soil.
LAS: License Area Sample.
ND: Not Detected
See Exhibit D11-2 for sample site locations.
**Values for LAS-2 appear to be anomalies and were not used in the statistics.

Radiological background levels were measured at 26 different sediment sample sites at the Hank Unit. Table 6-4 Radiological Background in Sediment - Hank Unit summarizes the individual values and provides basic statistical information (minimum, maximum, average and standard deviation). Sample site SD-25 has a Pb-210 value (2.5 pCi/g) that is a few times higher than normal background but the rest of the sites are typical of what one would normally expect to find.

Table 6-4 Radiological Background in Sediment - Hank 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
SD-1		2.8	ND		1.3	0.2	0.7	0.1
SD-2		3.5	ND		1.1	0.2	0.5	0.1
SD-3		2.5	0.4	0.2	1.0	0.2	0.6	0.1
SD-4		1.3	0.5	0.2	1.1	0.2	0.6	0.1
SD-5		1.8	1.8	0.3	1.0	0.2	0.6	0.1
SD-6		1.8	0.7	0.2	1.6	0.2	0.8	0.1
SD-7		2.6	ND		1.4	0.2	0.8	0.1
SD-8		3.1	0.6	0.1	1.4	0.2	0.7	0.1
SD-9		2.7	0.9	0.1	1.6	0.2	1.0	0.2
SD-10		2.6	0.6	0.1	0.8	0.2	0.5	0.1
SD-11		2.5	ND		1.1	0.2	0.5	0.1
SD-12		2.1	ND		1.2	0.2	0.7	0.1
SD-13		1.91	ND		0.9	0.2	0.5	0.2
SD-14		2.80	ND		1.4	0.2	0.6	0.2
SD-15		22	ND		2.2	0.2	0.6	0.2
SD-16		2.52	ND		1.0	0.2	0.3	0.1
SD-17		1.98	ND		1.0	0.2	0.5	0.1
SD-18		3.46	ND		1.2	0.2	0.9	0.2
SD-19		2.23	ND		0.9	0.2	0.3	0.1
SD-20		1.85	ND		0.8	0.2	0.2	0.1
SD-21		2.17	ND		1.2	0.2	0.4	0.1
SD-22		3.74	ND		1.9	0.2	1.1	0.2
SD-23		1.91	ND		1.3	0.2	1.0	0.2
SD-24		2.08	ND		0.9	0.2	0.3	0.1
SD-25		1.18	2.5	0.5	1.0	0.2	0.6	0.1
SD-26		1.79	ND		1.0	0.2	0.4	0.2
Minimum		**1.18**	**ND**		**0.8**		**0.2**	
Maximum		**3.74**	**2.5**		**2.2**		**1.1**	
Average		**2.38**	**1.0**		**1.2**		**0.6**	
Standard Deviation		**0.65**	**0.7**		**0.3**		**0.2**	

Notes:
SD: Sediment.
*Reporting Limit: 0.50.
ND: Not Detected.
See Exhibit D11-2 for sample locations.

6.1.2 Baseline Gamma Survey

6.1.2.1 Purpose and Procedure

The purpose of a gamma survey is the same as it is for establishing other radiological levels; namely to characterize baseline conditions. Baselines serve as a backdrop against which operational impacts can be measured.

The gamma 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. Particulate sources at ISR facilities are negligible. Because of the vast difference between ISR and conventional mining and milling, a procedure was developed to measure baseline gamma levels in a more concentrated pattern in the areas where operational activities will occur. Since the operational areas are the most likely targets for potential impacts, these areas were given a higher degree of sampling. Referring back to the discussion in the soils section, it was noted that potential impacts on soils and sediments from ISR operations is attributed to accidental spills from pipeline breaks or leaks.

This aspect of potential impact played a major part in the baseline sampling pattern for soils, sediments and gamma. In addition to the large number of gamma readings taken throughout the future production area and process site, readings were also taken in the drainages passing through the license area; at the nearest residence; and near the license boundary. Exhibit D11-3 Nichols Ranch Unit - Gamma Sample Location Map and Exhibit D11-4 Hank Unit – Gamma Sample Location Map in the attached Appendix D11, show the sample sites within and near the license boundary.

6.1.2.2 Survey Methodology

A Ludlum Model 19 μR Survey Meter was the instrument used in the gamma survey. The calibration date on the meter for the June 2007 survey was June 8, 2007. As described in the soils section of the application, a sample site map was developed prior to conducting the survey. Gamma measurements were recorded by holding the meter at waist level and slowly passing it over each soil/sediment sample point and over the area proximate to the sample location.

6.1.2.3 Nichols Ranch Unit Results

Table 6-5 summarizes the gamma readings and cross-references the gamma sites with the soil and sediment sample locations. A total of 57 gamma measurements were taken over an area of approximately 116 acres. The 116 acre-area consisted of the future production areas (113 acres) and the plant site (3 acres). On a per acre basis, the density of the survey was 1 reading per 2 acres.

As can be readily seen from Table 6-5, gamma readings are for the most part tightly grouped between 12 to 13 μR/hr. The average, minimum and maximum values are not unusual for this part of the U.S. To illustrate, the values recorded at the Nichols Ranch Unit are very much in line with earlier surveys completed at nearby North Butte. In brief, the detailed gamma survey completed at the North Butte ISL project site in 1979 was compared to a verification survey conducted by Uranerz in 1992. The mean gamma reading in the verification study was 11.7 μR/hr and the range was 11 to 13 μR/hr. These values were consistent with the North Butte survey. When compared to the average natural background range for the U.S. (8 to 15 μR/hr), it can be seen that the Nichols project site falls near the high end of the average.

There are a few sites with slightly elevated gamma levels of 15 μ R/hr. Some of the 15 μ R/hr values correspond with some of the soil and sediments sites that had elevated levels of Ra-226. For example, SS-21 has a radium value of 2.4 pCi/g; SD-8 radium is 32 pCi/g; and SD-9 radium is 23.5 pCi/g.

Table 6-5 Nichols Ranch Unit Gamma/Soil and Sediment Sample Locations.

Sample Site	μR/hr	Gamma Site
R-1 Dry Fork Ranch	13	G-54
R-2	14	G-55
R-3	12	G-56
R-4	13	G-57
SS-6 Nichols URZ	15	G-45
SS-7 Nichols URZ	15	G-40
SS-8 Nichols URZ	12	G-36
SS-9 Nichols URZ	12	G-32
SS-10 Nichols URZ	13	G-20
SS-11 Nichols URZ	13	G-17
SS-12 Nichols URZ	14	G-14
SS-13 Nichols URZ	13	G-12
SS-14 Nichols URZ	13	G-11
SS-15 Nichols URZ	13	G-8
SS-16 Nichols URZ	13	G-7
SS-17 Nichols URZ	13	G-5
SS-18 Nichols URZ	13	G-4
SS-19 Nichols URZ	14	G-1
SS-20 Nichols URZ	12	G-2
SS-21 Nichols URZ	15	G-6
SS-22 Nichols URZ	13	G-9
SS-23 Nichols URZ	12	G-13
SS-24 Nichols URZ	11	G-16
SS-25 Nichols URZ	12	G-18
SS-26 Nichols URZ	13	G-24
SS-27 Nichols URZ	13	G-33
SS-28 Nichols URZ	12	G-37
SS-29 Nichols URZ	14	G-41
SS-30 Nichols URZ	13	G-47
LAS-1 Nichols URZ	12	G-21
LAS-2 Nichols URZ	11	G-23
LAS-3 Nichols URZ	13	G-35
LAS-4 Nichols URZ	13	G-44
LAS-5 Nichols URZ	13	G-51
LAS-6 Nichols URZ	13	G-46
LAS-7 Nichols URZ	14	G-38
LAS-8 Nichols URZ	13	G-25

Table 6-5 (Continued)

Sample Site		Gamma Site
SB-4 Nichols URZ	12	G-3
SB-5 Nichols URZ	11	G-26
SB-6 Nichols URZ	12	G-43
SB-7 Nichols URZ	13	G-42
SB-8 Nichols URZ	13	G-22
Plant Site:		
Center	13	G-29
Northwest	13	G-27
Northeast	13	G-28
Southeast	13	G-31
Southwest	13	G-30
Minimum	**11**	
Maximum	**15**	
Average	**13**	
Standard Deviation	**1**	
SD-1 Nichols URZ	13	G-53
SD-2 Nichols URZ	13	G-10
SD-3 Nichols URZ	12	G-15
SD-4 Nichols URZ	13	G-19
SD-5 Nichols URZ	13	G-39
SD-6 Nichols URZ	11	G-34
SD-7 Nichols URZ	14	G-48
SD-8 Nichols URZ	15	G-49
SD-9 Nichols URZ	15	G-50
SD-10 Nichols URZ	13	G-52
Minimum	**11**	
Maximum	**15**	
Average	**13**	
Standard Deviation	**1**	

Notes:
R-1through R-4 are the locations of the baseline Rn-222 and Gamma monitors.
SS: Surface Soil Site.
SB: Subsurface Soil Site.
SD: Sediment Sample Site.
LAS: License Area Sample.
See Exhibits D11-1 and D11-3 for sample site locations.

Although it is well known that gamma readings taken with a general survey-type meter do not have a high degree of correspondence with chemically measured radium content, a higher-than-background gamma reading (usually 2.5 to 3 times background) can serve as a first level screening test for detecting sites that might have elevated levels of radionuclides. In summary, the density of the survey and its consistent values provide reasonable assurance that a representative baseline was established.

6.1.2.4 Hank Unit Results

Table 6-6 summarizes the gamma readings and cross-references the gamma sites with the soil and sediment sample locations. A total of 86 gamma readings were recorded across the site (see Exhibit D11-4). Although the survey was designed to thoroughly characterize baseline conditions in the areas where activities will occur (production areas and process facility site), it also provided background levels for sites at the license boundary, nearest residence and numerous stream courses passing through and near the site. Based on the approximate 156 acres in the production areas and the 3-acre process facility site, the resulting survey density is one reading per two acres.

Table 6-6 Hank Unit Gamma/Soil and Sediment Sample Locations.

Sample Site	μR/hr	Gamma Site
R-1 Pfister Ranch Hank URZ	13	G-82
R-2	13	G-83
R-3	12	G-84
R-4	11	G-85
R-5	14	G-86
SS-6 Hank URZ	15	G-5
SS-7 Hank URZ	15	G-7
SS-8 Hank URZ	12	G-9
SS-9 Hank URZ	12	G-10
SS-10 Hank URZ	14	G-11
SS-11 Hank URZ	13	G-14
SS-12 Hank URZ	13	G-15
SS-13 Hank URZ	13	G-20
SS-14 Hank URZ	13	G-21
SS-15 Hank URZ	13	G-23
SS-16 Hank URZ	13	G-28
SS-17 Hank URZ	12	G-32
SS-18 Hank URZ	13	G-40
SS-19 Hank URZ	13	G-41
SS-20 Hank URZ	14	G-44
SS-21 Hank URZ	14	G-48
SS-22 Hank URZ	14	G-50
SS-23 Hank URZ	12	G-52
SS-24 Hank URZ	14	G-53
SS-25 Hank URZ	12	G-81
SS-26 Hank URZ	13	G-57
SS-27 Hank URZ	12	G-61
SS-28 Hank URZ	13	G-62
SS-29 Hank URZ	14	G-64
SS-30 Hank URZ	13	G-66
SS-31 Hank URZ	13	G-67
SS-32 Hank URZ	14	G-68
SS-33 Hank URZ	15	G-71
SS-34 Hank URZ	13	G-75
SS-35 Hank URZ	13	G-76
LAS-1 Hank URZ	14	G-17
LAS-2 Hank URZ	18	G-25
LAS-3 Hank URZ	13	G-18
LAS-4 Hank URZ	12	G-24
LAS-5 Hank URZ	13	G-30
LAS-6 Hank URZ	13	G-31

Table 6-6 (Continued)

Sample Site	μR/hr	Gamma Site
LAS-7 Hank URZ	11	G-46
LAS-8 Hank URZ	12	G-42
LAS-9 Hank URZ	14	G-59
LAS-10 Hank URZ	13	G-47
LAS-11 Hank URZ	15	G-55
LAS-12 Hank URZ	13	G-43
LAS-13 Hank URZ	14	G-34
LAS-14 Hank URZ	14	G-29
SB-4	16	G-6
SB-5	12	G-16
SB-6	13	G-33
SB-7	14	G-51
SB-8	12	G-65
SB-9	13	G-77
Plant Site:		
Center	13	G-37
Northwest	15	G-35
Northeast	13	G-36
Southeast	13	G-39
Southwest	13	G-38
Minimum	**11**	
Maximum	**18**	
Average	**13**	
Standard Deviation	**1**	
SD-1 Hank URZ	14	G-1
SD-2 Hank URZ	16	G-3
SD-3 Hank URZ	14	G-2
SD-4 Hank URZ	11	G-4
SD-5 Hank URZ	13	G-12
SD-6 Hank URZ	13	G-13
SD-7 Hank URZ	15	G-8
SD-8 Hank URZ	15	G-19
SD-9 Hank URZ	14	G-22
SD-10 Hank URZ	14	G-27
SD-11 Hank URZ	15	G-26
SD-12 Hank URZ	14	G-80
SD-13 Hank URZ	16	G-49
SD-14 Hank URZ	13	G-45
SD-15 Hank URZ	18	G-54
SD-16 Hank URZ	17	G-58

Table 6-6 (Continued)

Sample Site	μR/hr	Gamma Site
SD17 Hank URZ	15	G-60
SD-18 Hank URZ	17	G-56
SD-19 Hank URZ	16	G-63
SD-20 Hank URZ	15	G-70
SD-21 Hank URZ	17	G-72
SD-22 Hank URZ	16	G-73
SD-23 Hank URZ	14	G-69
SD-24 Hank URZ	14	G-74
SD-25 Hank URZ	13	G-79
SD-26 Hank URZ	13	G-78
Minimum	**11**	
Maximum	**18**	
Average	**15**	
Standard Deviation	**2**	

Notes:
R-1 through R-5 are the locations of the baseline Rn-222 and Gamma monitors.
SS: Surface Soil Site.
SB: Subsurface Soil Site.
SD: Sediment Sample Site.
LAS: License Area Site.
See Exhibits D11-2 and D11-4 for sample site locations.

As can be seen from Table 6-6, gamma readings do not vary significantly across the area. However, there are a few sites with elevated gamma (16 to 18 μ R/hr levels). Comparing the elevated gamma levels with the soil and sediment analyses show some correspondence. Sample site LAS-2, for example, has the highest gamma level of 18 μ R/hr and it also has the highest U (8.4 mg/kg), Pb-210 (1.2 pCi/g), Ra-226 (3.8 pCi/g) and Th-230 (2.5 pCi/g) values.

As shown below, the minimum, maximum and average values recorded at the Hank Unit compare favorably with those measured at the Nichols Ranch Unit.

	Nichols Ranch Unit (μR/hr)	Hank Unit (μR/hr)
Minimum	11	11
Maximum	15	18
Average	13	13

Between the Hank Unit and the Nichols Ranch Unit, there are 143 gamma sample points. With a combined area of 275 acres (production areas and plant site areas), the overall survey density is one sample per two acres. This density, coupled with the close agreement between the measurements taken at both sites, provides a good baseline for gamma levels.

6.1.3 Baseline Radon-222 and Direct Gamma Exposure Rates

6.1.3.1 Purpose and Procedure

As noted in the discussion on soil and sediment baseline sampling, ISR operations do not generate significant levels of particulates, but 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

The detectors that were used in the one-year monitoring program were Landauer Extra Sensitive Outdoor Rn-222 Detectors and X-9 Gamma Dosimeters. Prior to installing the detectors, the prevailing wind direction was obtained from the National Climatic Data Center for Gillette. The data covered a period from 1996 through 2005. Data from this period was compared to data from Casper and to a data collected between 1978 and 1979 by AeroVironment for Cleveland Cliffs Iron Company (CCI), who operated a meteorological station near North Butte (Pathfinder Mines Corporation, 1988). CCI's baseline data was used in support of their NRC license application for the North Butte ISL Project. A comparison of the databases showed that Casper has a stronger southwest/west-southwest/south-southwest component, while North Butte and Gillette have a component from the south/southwest/southeast.

The detectors were deployed and retrieved at the same time for each location. Exposure time was on a quarterly basis. Detector locations included: (1) the nearest residence or structure that could be occupied; (2) locations at or near the license boundary; and (3) a control point to reflect background (upwind of the site). Exhibits D11-3 and D11-4 show the locations of the Rn-222 and gamma dosimeters.

Given that the prevailing wind direction is from the south, two monitoring stations were placed in the northern parts of both sites (see previously referenced Exhibits D11-3 and D11-4. In contrast, control detectors were placed in the extreme southern parts of the license areas. During operations, the downwind monitors will reflect the maximum change from baseline while the control detectors will measure the minimum change. In addition to these placements, two monitors were placed near the license boundary on the east and west side of the Hank Unit and one was placed at a nearest residence (Dry Fork Ranch), which is approximately 1.3 mi to the southwest of the process facility location.

6.1.3.3 Nichols Ranch Unit Results

The one-year monitoring results are given in Table 6-7. A comparison of the values shows background levels to be within the expected range. When compared to historical radon levels measured over a one year period (1988-1989) at the nearby North Butte Project site, it can be seen that values at Nichols are not surprisingly different. North Butte's annualized average was 0.8 pCi/l compared to Nichols' 1.2 pCi/l average. Because radon levels are known to vary

Table 6-7 Ambient Radon-222 Levels - Nichols Ranch Unit.

		Fourth Quarter (10/06 to 1/07) pCi/l	First Quarter (1/07 to 3/07) pCi/l	Second Quarter (4/07 to 7/07) pCi/l	Third Quarter (7/07 to 10/07) pCi/l
R-1	Nearest Residence	1.2	0.7	0.9	1.1
R-2	Upwind Control	0.9	0.8	1.1	1.7
R-3	Downwind Boundary	0.6	27.7*	2.3	1.4
R-4	Downwind Boundary	0.7	0.8	1.9	1.4
Site Averages		0.9	0.8	1.6	1.4

1. *The adhesive that holds the detector within the protective housing failed and the detector was found on the ground. The anomalous value was not used in the average.
2. The annualized average for all sites combined is 1.2 pC/l.
3. The annualized average measured between 1988 and 1989 at the nearby North Butte; Project was 0.8 pCi/l.
4. The U.S. average outdoor Rn-222 level is 0.4 pCi/l (U.S. EPA).

widely from place to place, the difference between 0.8 pCi/l and 1.2 pCi/l is not significant. It must also be remembered that some of difference between the two annual averages can be attributed to the detectors. Significant improvements have been made in this area over the past 10 years. As noted above, Extra Sensitive detectors were used in the monitoring program at the Nichols and Hank Units. Differences in the prevailing weather conditions at the two sites would also play a role in the background concentrations.

Both sites have ambient radon levels that are much above the U.S. average. According to EPA, the U.S. outdoor average radon concentration is 0.4 pCi/l. The higher-than-background levels are not surprising given that with the exception of two counties, Weston and Platte, indoor radon levels in Wyoming are at or above the EPA Action Level of 4 pCi/l (EPA 2007). The indoor average for the U.S. is 1.3 pCi/l--this puts Wyoming at 3 times the average.

Background gamma exposure rates from the one year monitoring program are summarized in Table 6-8. The averages range from 35 mrem to 48 mrem. When compared to the gamma survey results from the North Butte Project mentioned earlier, the values are similar. The North

Table 6-8 Background Gamma Exposure Rate - Nichols Ranch Unit.

		Fourth Quarter (10/06 to 1/07) mrems	First Quarter (1/07 to 3/07) mrems	Second Quarter (4/07 to 7/07) mrems	Third Quarter (7/07 to 10/07) mrems
R-1	Nearest Residence (Dry Fork Ranch)	34.7	41.1	49.3	37.4
R-2	Downwind Boundary (Northwest)	36.4	41.9	48.2	38.0
R-3	Boundary (Northeast)	35.2	49.4	41.1	39.1
R-4	Upwind Control (South)	33.6	57.6	52.8 (LP)	44.0
Site Averages		35.0	47.5	47.9	39.6

Notes: LP: Low energy photon.

Butte quarterly averages ranged from 32.3 mrem to 39.7 mrem. To put these values into perspective, the following exposure rates are given.

- 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.

6.1.3.4 Hank Unit Results

Not unexpectedly, Rn-222 levels measured at the Hank Unit match up well with those just discussed for the Nichols Ranch Unit. The one high value (9.2 pCi/l) was caused by the detector being on the ground for some unknown period of time. This value was not used in calculating the average shown on Table 6-9. Background gamma exposure rates from the one year monitoring program are summarized in Table 6-10. The averages range from 34.4 mrem to 55 mrem. Once again these results are very similar to the Nichols Ranch Unit results and those of the historic North Butte results.

Table 6-9 Ambient Radon-222 Levels - Hank Unit.

		Fourth Quarter (10/06 to 1/07) pCi/l	First Quarter (1/07 to 3/07) pCi/l	Second Quarter (4/07 to 7/07) pCi/l	Third Quarter (7/07 to 10/07) pCi/l
R-1	Nearest Residence	1.2	1.2	1.4	2.2
R-2	Downwind Boundary	0.4	0.6	0.7	3.4
R-3	Boundary	0.5	0.3	0.9	1.4
R-4	Upwind Control	0.3	9.2*	1.0	1.0
R-5	Boundary	0.4	0.5	0.8	1.7
Site Averages		0.6	0.6	1.0	1.9

Notes:
1. *The adhesive that holds the detector within the protective housing failed and the detector was found on the ground. The anomalous value was not used in the average.
2. The annualized average for all sites combined is 1.0 pC/l.
3. The annualized average measured between 1988 and 1989 at the nearby North Butte; Project was 0.8 pCi/l.
4. The U.S. average outdoor Rn-222 level is 0.4 pCi/l (U.S. EPA).

Table 6-10 Background Gamma Exposure Rate - Hank Unit.

		Fourth Quarter (10/06 to 1/07) mrems	First Quarter (1/07 to 3/07) mrems	Second Quarter (4/07 to 7/07) mrems	Third Quarter (7/07 to 10/07) mrems
R-1	Nearest Residence (Pfister Ranch)	33.5	39.0	45.1	H
R-2	Downwind Boundary (North)	33.5	50.0 (LP)	49.9	H
R-3	Boundary (Northwest)	33.5	40.5	53.9	44.0
R-4	Upwind Control (South)	34.1	114.5 (LP)	51.8	39.1
R-5	Boundary (Southeast)	37.5	31.3	52.0	41.4
Site Averages		34.4	55.0	50.5	41.5

Notes: LP = Low energy photon
H = Not read

6.1.4 Flora and Fauna

6.1.4.1 Purpose and Procedure

The purpose of establishing baseline radiological conditions prior to initiating operations is to have a reference for comparing potential impacts. When designing a pre-operational baseline sampling program, the operational features of the activity should be kept in mind. In other words, particular attention should be given to the pathways through which contaminants could enter the environment. In developing the baseline sampling program, pathways were considered in conjunction with guidance given in Regulatory Guide 4.14.

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 in Sections 6.1.1 and Section 7.3 of Chapter 7 of this report, pathways for radiological contaminants to enter the environment from modern ISR operations have been markedly reduced or virtually 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 build up 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 25 years.

The baseline sampling program was modified somewhat 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 through the evolution of ISR, that pathways to flora and fauna and hence to human populations are not significant. The reasons supporting this assertion were given above and are discussed in other sections of this application.

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 part of a RML application. Measured baseline values can be compared to values during actual operations to validate the minimal to no-impact prediction of the MILDOS model. Additionally, having baseline data to compare with values recorded during operations, underscores the fact that modern ISR activities do not have a significant impact on human health and the environment. Following is a description of the baseline sampling program that was performed at the Nichols Ranch Unit and the Hank Unit.

6.1.4.2 Methods

Regulatory Guide 4.14 suggests that vegetation, crops, livestock and fish samples should be collected and analyzed for Ra-226 and Pb-210. According to the field reconnaissance, no permanent surface water exists at or immediately adjacent to the sites. Given the absence of water, fish too are absent. The sites were surveyed for the presence a crop-growing areas and none was 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 ISR operations. To reiterate, ISR operations do not cause significant build up of radionuclides in soil or vegetation and therefore a significant pathway for exposure does not exist. 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.

Given this setting, baseline sampling included samples from grazing areas and vegetation from the nearest residences and Rn-222/gamma monitoring locations. Grab samples were collected in mid-August. While collecting the samples, care was taken to clip the vegetation approximately one inch above the ground to avoid mixing with surface soil. Samples were placed in large plastic bags and transported to the laboratory with 24 hours of collection. All samples were analyzed for Ra-226, Pb-210, Po-210, Th-230, Uranium, Arsenic and Selenium.

6.1.4.3 Nichols Ranch Unit Results

Table 6-11 summarizes the radiological and nonradiological (arsenic and selenium) background concentrations found in the samples. Although there is the usual variation in concentrations for the radiometric parameters, the values are within normal background ranges. The same generalization can be made for the arsenic and selenium values.

6.1.4.4 Hank Unit Results

Background values for the Hank Unit are given in Table 6-12. A comparison of the concentrations with those reported for the Nichols Ranch Unit shows a great deal of consistency. In brief, the values are not unusual for baseline conditions.

Table 6-11 Radiological and Nonradiological Background Levels in Vegetation Nichols Ranch Unit.

Sample Location	Radiological Elements				
	Ra-226 (μCi/kg)	Pb-210 (μCi/kg)	Po-210 (μCi/kg)	Th-230 (μCi/kg)	Uranium (μCi/kg)
R-1 Dry Fork Ranch	3.7E-04	4.2E-04	9.3E-05	3.7E-06	1.1E-04
+/-	5.1E-06	2.9E-05	2.7E-05	1.8E-06	4.6E-07*
R-2 Control Upwind	8.8E-05	4.5E-04	1.5E-04	2.8E-06	6.6E-05*
+/-	6.0E-06	2.3E-05	2.3E-05	4.2E-06	3.0E-07*
R-3 Downwind NE	1.4E-04	7.5E-04	1.1E-04	3.6E-05	9.5E-05*
+/-	8.0E-06	3.0E-05	2.3E-05	4.4E-04	3.3E-07*
R-4 Downwind NW	2.7E-04	6.6E-04	9.9E-05	1.4E-04	2.4E-04*
+/-	1.1E-05	2.6E-04	2.2E-05	9.9E-06	2.8E-07*
Grazing Area	6.7E-05	4.3E-04	7.2E-05	2.4E-05	8.3E-05*
+/-	4.2E-06	1.8E-05	1.7E-05	3.6E-05	2.1E-07*

Sample Location	Non-radiological Elements			
	Arsenic (mg/kg-dry)	RL*	Selenium (mg/kg-dry)	RL*
R-1 Dry Fork Ranch	ND	0.5	ND	0.5
R-2 Control Upwind	ND	0.5	ND	0.5
R-3 Downwind NE	1.0	0.5	0.7	0.5
R-4 Downwind NW	0.7	0.5	1.3	0.5
Grazing Area	ND	0.5	1.2	0.5

Notes: *RL is the reporting limit for U.
+/- is the counting error.
ND- Not detected

Table 6-12 Radiological and Non-radiological Background Levels in Vegetation Hank Unit.

	Radiological Elements				
Sample Location	Ra-226 (µCi/kg)	Pb-210 (µCi/kg)	Po-210 (µCi/kg)	Th-230 (µCi/kg)	Uranium (µCi/kg)
R-1 Pfister Ranch	7.5E-05	4.0E-04	4.1E-05	2.3E-06	4.5E-05
+/-	5.7E-06	2.1E-05	1.3E-05	3.6E-06	2.8E-07*
R-2 Downwind	4.6E-05	5.8E-04	2.9E-05	2.0E-05	4.9E-05*
+/-	2.0E-06	2.1E-05	8.5E-06	4.5E-06	2.1E-07*
R-3 West Boundary	6.3E-05	2.5E-04	1.5E-04	6.8E-06	1.5E-05*
+/-	6.1E-06	2.1E-05	2.9E-05	2.1E-06	3.9E-07*
R-4 Control South	7.3E-05	2.6E-04	4.9E-05	2.4E-05	4.5E-05*
+/-	5.4E-06	1.8E-05	1.3E-05	4.2E-06	2.8E-07*
R-5 East Boundary	9.6E-05	5.9E-04	1.1E-04	3.5E-05	7.1E-07*
+/-	6.9E-06	2.8E-05	2.8E-05	4.9E-06	3.4E-07
Grazing Area	6.7E-05	2.5E-04	5.9E-05	8.1E-06	4.0E-05*
+/-	7.0E-06	2.4E-05	2.3E-05	2.7E-06	4.5E-07*

	Non-radiological Elements			
Sample Location	Arsenic (mg/kg-dry)	RL*	Selenium (mg/kg-dry)	RL*
R-1 Pfister Ranch	ND	0.5	0.8	0.5
R-2 Downwind	ND	0.5	0.6	0.5
R-3 West Boundary	1.0	0.5	ND	0.5
R-4 Control South	ND	0.5	ND	0.5
R-5 East Boundary	ND	0.5	1.7	0.5
Grazing Area	ND	0.5	1.0	0.5

Notes: *RL is the reporting limit for U.
+/- is the counting error.
ND - Not detected

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 Nichols Ranch ISR Project, radon flux is not an applicable radiological parameter for baseline characterization. Radon flux measurements have not been collected in support of this project and none are planned in association with future monitoring schedules.

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 Nichols Ranch ISR Project. The section also addresses the groundwater monitoring program that will 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 Nichols Ranch ISR Project was conducted for a one year time period with regional water wells sampled once a quarter and analyzed for parameters found in Table 6-13. These parameters are those that are required by the Wyoming Department of Environmental Quality in determining baseline groundwater quality. The results of the regional baseline water quality sampling are detailed in Addendum D6B of the attached Appendix D6. Additionally, Section 2.7 of the NRC Technical Report summarizes the groundwater quality information obtained during baseline groundwater sampling.

Table 6-13 Groundwater Baseline Water Quality Parameters.

Parameter*	Analytical Method
Ammonia Nitrogen as N	EPA 350.1
Nitrate + Nitrite as N	EPA 353.2
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

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

6.2.1.2 Pre-Operational Wellfield Assessment

The groundwater monitoring program for the Nichols Ranch ISR Project will begin with pre-operation wellfield testing. These tests are conducted utilizing the baseline geologic and hydrologic information that was collected and assembled for Nichols Ranch ISR Project. Appendix D5 and 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 will 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 will be installed in the ore zone at a density of one monitoring well per four acres in the proposed wellfield. These wells will be used to obtain baseline water quality data for the proposed wellfield to determine groundwater Restoration Target Values (RTV's).

Horizontal monitor wells will also be installed on the edge of the wellfield in the same zone as the ore zone. This "ring" of wells will be used to obtain baseline water quality data in the area outside of the wellfield and to ensure that recovery solutions do not migrate outside of the ore zones. Upper Control Limits (UCL's) will 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 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.

Vertical monitor wells will 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 will be used to collect baseline water data that will 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 will be determined in consultation with the regulatory agencies. In the case of the wellfield becoming very narrow where a line drive pattern may be utilized, overlying and underlying aquifer monitor wells will not be more than approximately 1,000 ft apart from one another.

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 all ready been tested.

Before conducting the Production Area Pump Test, the test plan will be submitted to the Safety and Environmental Review Panel (SERP) and WDEQ for review and comment. Standard Operating Procedures (SOP's) will also be developed that will 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 will be assembled and submitted to the WDEQ for review. Additionally the document will 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 will evaluate any safety and environmental concerns. The evaluation will also address compliance with applicable NRC requirements. The written evaluation will be located at the Uranerz Energy Corporation 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 will be used to establish the Upper Control Limits (UCL's) and the restoration target values that will be used in groundwater restoration. Standard Operating Procedures (SOP) will be developed that will 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 will 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 will be in accordance to all sampling, preservation, and analysis procedures. The number of samples collected and the parameters that the samples will be tested for are as follows:

1. Ore Zone (Production Pattern) Wells (MP Wells) – All ore zone monitoring wells in a production area will 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 will be sampled four times, with at least two weeks between sampling, during the baseline characterization. The first monitor well ring sampling will include the analyses for the parameters listed in WDEQ Guideline No. 8 including uranium parameters. The remaining three samples will be tested for the potential Upper Control Limits (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 will be sampled four times with at least two weeks between sampling events. The first and second sampling events will be analyzed for the parameters listed in Table 6-14. The third and fourth sampling events will be analyzed for the possible UCL parameters chloride, total alkalinity, and conductivity.

Table 6-14 Groundwater Parameters.

Parameter	Lower Detection Limit*
Alkalinity	0.1
Ammonium	0.05
Arsenic	1
Barium	0.1
Bicarbonate	0.1
Boron	0.1
Cadmium	0.01
Calcium	0.05
Carbonate	0.1
Chloride	0.1
Chromium	0.05
Copper	0.01
Electrical Conductivity@ 25 degrees° C	1 uohm
Fluoride	0.1
Iron	0.05
Lead	0.05
Magnesium	0.01
Manganese	0.01
Mercury	0.0005
Molybdenum	0.05
Nickel	0.05
Nitrate	0.01
pH	0-14 s.u.
Potassium	0.1
Radium-226	0.1 pCi/L
Selenium	0.001
Sodium	0.05
Sulfate	0.5
Total Dissolved Solids	1
Uranium	0.001
Vanadium	0.1

*mg/L unless specified otherwise

6.2.1.7 Statistical Assessment of Baseline Water Quality Data

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

1. Ore Zone Wells (MP Wells) – Baseline water quality will 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 will not be averaged together, but separated into sub-zones. Data within the sub-zones will then be averaged. The boundaries of the sub-zones, where required, will 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 will 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 will be averaged separately.

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

6.2.1.8 Restoration Target Values

The Restoration Target Values (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 will be determined for each sub-zone. The Restoration Target Value Parameters are listed in Table 5-1 of the NRC Technical Report.

6.2.1.9 Upper Control Limits

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 will cause the UCL's to be exceeded. If an excursion is determined to have occurred, operational changes will 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 will 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 will 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 will be expressed in mg/L.

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

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

6.2.1.11 Operational Groundwater Monitoring Program

The groundwater in a production area will 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 will 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 will be sampled twice per month at intervals of approximately 2 weeks. The samples will be analyzed for and compared against the UCL parameters of conductivity, chloride, and total alkalinity. Static water levels will 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 will be kept by Uranerz Energy Corporation and submitted to the WDEQ on a quarterly basis. These data will also be available to the NRC for review.

6.2.1.11.2 Water Quality Sampling and Analysis Procedures

Water quality samples will be obtained for the monitor wells through permanently installed submersible pumps. Initially the monitor wells will have three casing volumes discharged before sampling to ensure that the water in the well is formation water. As operations continue, the monitor wells will 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 will have its static water level recorded prior to pumping. Conductivity, pH, and temperature will 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 will be periodically reviewed to ensure that sampling and analytical procedures are adequate.

All water quality samples from the monitor wells will be analyzed at the Nichols Ranch Unit laboratory for chlorides, total alkalinity, and conductivity within 48 hours of the sample being collected. All samples will be analyzed in accordance with accepted methods. Standard Operating Procedures (SOP's) will be developed that will 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 will 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 will be taken within 48 hours. During an excursion event, all monitoring wells that are placed on excursion status will 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 will be notified by telephone or email within 24 hours. The WDEQ and NRC Project Manager will 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 will be implemented as soon as practical. The corrective actions will 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 will be suspended to further increase the amount of net water withdrawal from the excursion area. Injection will 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 will be implemented. When a significant declining trend is established, normal operations will resume with injection and/or production rates monitored such that net water withdrawals for the excursion area will continue. The declining trend will 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 Collection

Groundwater baseline sample collection was conducted based on guidance provided by the Uranerz Energy Corporation Groundwater Sampling Procedure and by the WDEQ Guideline No. 8–Hydrology. 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 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 Nichols Ranch ISR Project will include annual raptor and sage grouse surveys as required by the WDEQ. Raptor surveys will take place in late April or early May. Sage grouse surveys will take place at the same time. The purpose of the surveys will 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 Nichols Ranch ISR Project found that there are no sage grouse leks within the permit area, but 10 leks are located within 2.0 mi of the permit area. Forty raptor nests were found within the permit area of which 14 were determined to be active. All active nests were located in areas that would not be affected by wellfield or plant activities associated with the Nichols Ranch ISR Project. All active nests will be monitored for continued activity. In the unlikely event that it becomes necessary to disturb a raptor nest, a mitigation plan will be developed including consultation with the WDEQ, Wyoming Game and Fish, and the U.S. Fish and Wildlife Service. Any required permits will be obtained from the appropriate agencies.

Appendix 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 Nichols Ranch ISR Project. The locations and activity status of raptor nests are provided in Table D9-4 and illustrated on Exhibit D9-3. The results of the baseline sage grouse surveys and historic lek activity data are presented in Table D9-3. Sage grouse lek locations are illustrated on Exhibit D9-3. Also included in Appendix D9 is the documentation of contact with all applicable regulatory agencies.

6.4 ALTERNATIVES

The environmental measurements and monitoring programs that would take place for the alternatives of open pit and underground mining would be similar to those of the proposed Nichols Ranch ISR Project except the groundwater monitoring programs would focus on leak detection from tailings ponds and preventing contamination of groundwater aquifers located below the mining zones. The monitoring would also be on a larger scale for the alternatives compared to those of the proposed project, but would encompass the same measurements and monitoring.

6.5 NO ACTION ALTERNATIVE

No environmental measurements and monitoring programs would be needed with the no action alternative since no mining would take place.

7.0 COST BENEFIT ANALYSIS

7.1 GENERAL

Uranium that will be mined at the Nichols Ranch ISR Project will be used to replace the uranium consumed in the production of power from nuclear power plants. The Nichols Ranch ISR Project 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 Nichols Ranch ISR Project 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 for the Nichols Ranch ISR Project 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 added costs and strains on schools, fire and medical response, and other community services, but these costs are relatively small since most of the workforce that will used for the project will be pulled from the surrounding communities. 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 Nichols Ranch ISR Project will 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 will be confined in the process. During reclamation, any remaining solid radioactive wastes will 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 will be reclaimed, and after the project is decommissioned, will be returned back to the pre-mining use. Groundwater impacted by the Nichols Ranch ISR Project will be restored back to pre-mining conditions such that pre-mining use suitability of the groundwater is maintained.

7.4 SUMMARY

The 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 balance for the Nichols Ranch ISR Project favorable. 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 Nichols Ranch ISR Project is the desired regulatory action.

8.0 SUMMARY OF ENVIRONMENTAL CONSEQUENCES

The Nichols Ranch ISR Project will use the in situ recovery method of mining uranium. The project will be located in Johnson and Campbell Counties, Wyoming in the Pumpkin Buttes Mining District of the Powder River Basin. The location of the Nichols Ranch ISR Project is adjacent to one currently licensed and past operating uranium ISR facility, COGEMA's Christensen Ranch, and one licensed amendment area, Power Resources Inc. (PRI) North Butte.

The in situ recovery mining method environmental impacts are temporary and not significant. 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 will 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) will be below the regulatory limits in 10 CFR Part 20. Any radioactive (contaminated) waste generated by the Nichols Ranch ISR Project 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 300 acres will be disturbed during the life of the project. Measures will be taken to stockpile topsoil in areas where disturbances will last the life of the project. In areas such as the wellfield, any disturbance to the soils will be temporary as the soils will 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 Nichols Ranch ISR Project 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 will be put in place to minimize environmental impacts from the Nichols Ranch ISR Project so that upon completion of the project all groundwater and lands affected by the operation will be returned to their pre-mining condition or use.

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Susan Frazier	Drafter

10.2 TRC ENVIRONMENTAL CORPORATION

TRC Environmental Corporation
605 Skyline Drive
Laramie, WY 82070

Scott Kamber	Operations Manager and Biologist
Roger Schoumacher	Environmental Program Manager
Jan Hart	Biologist
Waylon Hiler	Biologist
Scott McConnell	Biologist
Hugh Faust	Biologist
Edward Schneider	Cultural Program Manager
James A. Lowe	Associate Program Manager
Rena Merritt	Document Production
Jessica Robinson	Document Production
Tamara Linse	Document Production
Kim Dyess	Document Production
Courtney Engelhart	Document Production
Randall Blake	GIS Specialist
Mindy Uitterdyk	GIS Specialist
Betty Wills	AutoCad Specialist

10.3 CRAIG HOLMES CONSULTING

Craig W. Holmes
8107 Pommel Drive
Austin, TX 78759

Craig W. Holmes	Regulatory Consultant

10.4 OMEGA PROJECT SERVICES

Omega Project Services
P. O. Box 1290
Muskogee, OK 74402

Rob Miller	Principal and Project Manager
Craig Harlin	Principal

10.5 HYDRO-ENGINEERING, LLC

Hydro-Engineering, LLC
4685 East Magnolia
Casper, WY 82604

George Hoffman P.E.	Hydrologist
Thomas Michaels Ph.D	Hydrologist

10.6 WILDLIFE RESOURCES, LLC

Wildlife Resources, LLC
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Bighorn, WY 82833

Duffy Brown	Principal Biologist

10.7 FRONTIER ARCHEOLOGY

Frontier Archaeology
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Jim Brunette	Archaeologist

10.8 TREC INC.

TREC Inc.
1800 W. Koch
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Bozeman, MT 59715

Doug Graves P.E.	Principal and President
Matt Yovich P.E.	Principal Engineer and Vice President
Laurie Childs	Engineering Technician

10.9 ANDERSON ENVIRONMENTAL CONSULTING

Anderson Environmental Consulting
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Robert M. Anderson Principal Biologist

10.10 BKS ENVIRONMENTAL ASSOCIATES, INC.

BKS Environmental Associates, Inc.
P.O. Box 3467
Gillette, WY 82718

Brenda Schlandweiler	Soil Scientist
Jamie Eberly	Soil Scientist
Beth McGee	Soil Scientist

10.11 STRATIGRAPHIC REX, LLC

Stratigraphic Rex, LLC
2210 E. 17th
Casper, WY 82609

Melissa Connely Paleontologist

ADDENDUM 5A:

LANDOWNER ROAD DESIGN CONSTRUCTION LETTER

November 2007

ADDENDUM 5B:

NICHOLS RANCH ISR PROJECT SURETY ESTIMATE

Revised February 2009

Uranerz
ENERGY CORPORATION

Surety Estimate
First Year of Operation
Nichols Ranch In Situ Recovery Project
Uranerz Energy Corporation

Total Restoration and Reclamation Cost Estimates

No.	Cost Item	Cost
1	GROUNDWATER RESTORATION COST	$2,818,830
2a	PLANT EQUIPMENT REMOVAL AND DISPOSAL COST	$143,944
2b	BUILDING DEMOLITION AND DISPOSAL COST	$646,768
3	SOIL REMOVAL & DISPOSAL COST	$221,497
4	TOTAL WELL ABANDONMENT COST	$301,790
5	WELLFIELD EQUIPMENT REMOVAL & DISPOSAL COST	$316,393
6	TOPSOIL REPLACEMENT & REVEGETATION COST	$296,821
7	MISCELLANEOUS RECLAMATION COST	5049.22
	Subtotal Restoration and Reclamation Cost Estimate	$4,751,093
	Subtotal	$4,751,093
	Administration,Overhead and Contingency (25%)	$1,187,773
	Total	$5,938,866
	TOTAL CALCULATED IN 2007 DOLLARS	$5,938,866

Surety Estimate
First Year of Operation
Nichols Ranch ISR Project
Uranerz Energy Corporation

Worksheet 1, No. I --
GROUNDWATER RESTORATION

Cost Item	Mining Unit Nichols #1	Notes
Technical Assumptions		
Wellfield Area (Ft^2)	1,551,650	
Wellfield Area (Acres)	35.62	66.21 Ac at Nichols, 45.56 at Hank per URZ permit
Affected Ore Zone Area (Ft^2)	1,551,650	
Avg Completed Thickness (Ft)	7.27	
Factor for Flare	1.45	
Affected Volume:	16,356,717	
Porosity	0.3	
Gallons per Cubic Foot	7.48	
Gallon per Pore Volume	36,704,474	
Number of Wells in Unit(s)		
Recovery Wells	233	
Injection Wells	259	
Monitor Wells	33	
Average Well Spacing (Ft)	100	
Average Well Depth (Ft)	550	
I Groundwater Sweep		
A. Plant & Office		
Operating Assumptions:		
Flowrate (gpm)	50	
PV's Required	1.00	
Total Gallons for Treatment	36,704,474	
Total Kgals for Treatment	36,704	
Cost Assumptions:		
Power		
Avg Connected Hp	15	
Kwh's/Hp	0.75	
$/Kwh	0.05	$.02 plus demand charges per quote
Gallons per Minute	50	
Gallons per Hour	3000	
Cost per Hour	$0.56	
Cost per Kgal ($)	$0.188	
Chemicals		
Barium Chloride ($/Kgals)	$0.041	Costs from operating ISR facility experience (Cogema)
Antiscalent ($/Kgals)	$0.000	Costs from operating ISR facility experience (Cogema)
Elution ($/Kgals)	$0.099	Costs from operating ISR facility experience (Cogema)
Repair & Maintenance ($/Kgals)	$0.061	Costs from operating ISR facility experience (Cogema)
Analysis ($/Kgals)	$0.164	Costs from operating ISR facility experience (Cogema)
Total Cost per Kgal	$0.55	
Total Treatment Cost	$20,279	
Utilities		
Power ($/Month)	1,800	
Propane ($/Month)	800	
Time for Treatment		
Minutes for Treatment	734,089	
Hours for Treatment	12,235	
Days for Treatment	510	
Average Days per Month	30	
Months for Treatment	17.0	
Years for Treatment	1.42	
Utilities Cost ($)	$44,181	
TOTAL PLANT & OFFICE COST	**$64,461**	
B. WELLFIELD		
Cost Assumptions:		
Power		
Avg Flow/Pump (gpm)	1	
Avg Hp/Pump	1.5	
Avg # of Pumps Required	50	
Avg Connected Hp	75	
Kwh's/Hp	0.75	
$/Kwh	0.05	
Gallons per Minute	50	
Gallons per Hour	3000	
Costs per Hour ($)	$2.81	
Costs per Gallon ($)	$0.0009	
Costs per Kgal ($)	$0.94	
Repair & Maintenance ($/Kgals)	$0.016	
Total Cost per Kgal	$0.954	
TOTAL WELLFIELD COST	$34,998	
TOTAL GROUNDWATER SWEEP COST	**$99,458**	

Worksheet 1, No. II
GROUNDWATER RESTORATION

Cost Item	Mining Unit Nichols #1	Notes
II REVERSE OSMOSIS		
A. PLANT & OFFICE		
Operating Assumptions:		
Flowrate (gpm)	50	
PV's Required	6.00	
Total Gallons for Treatment	220,226,842	
Total Kgals for Treatment	220,227	
Feed to RO (gpm)	50	
Permeate Flow (gpm)	40	
Brine Flow (gpm)	10	
Average RO Recovery	80%	
Cost Assumptions:		
Power		
Avg Connected Hp	20	
kWh/Hp	0.75	
$/Kwh	0.05	$.02 plus demand charges per quote
Gallons per Minute	50	
Gallons per Hour	3000	
Cost per Hour ($)	$0.75	
Cost per Gallon ($)	$0.0003	
Cost per Kgal ($)	$0.25	
Chemicals		
Sulfuric Acid ($/Kgals)	$0.076	Costs from operating ISR facility experience (Cogema)
Caustic Soda ($/Kgals)	$0.111	Costs from operating ISR facility experience (Cogema)
Hydrochloric Acid ($Kgals)	$0.009	Costs from operating ISR facility experience (Cogema)
Hydrochloric Sulfide ($Kgals)	$0.304	Costs from operating ISR facility experience (Cogema)
Repair & Maintenance ($Kgals)	$0.279	Costs from operating ISR facility experience (Cogema)
Sampling & Analysis ($/Kgals)	$0.164	Costs from operating ISR facility experience (Cogema)
Total Cost per Kgal ($)	$1.19	
Total Pumping Cost ($)	$262,731	
Utilities		
Power ($/Month)	1,800	
Propane ($/Month)	800	
Time for Treatment	0	
Minutes for Treatment	4,404,537	
Hours for Treatment	73,409	
Days for Treatment	3,059	
Average Days per Month	30	
Months for Treatment	101	
Utilities Cost ($)	$261,600	
TOTAL PLANT & OFFICE COST	**$524,330**	
B. WELLFIELD		
Cost Assumptions:		
Power		
Avg Flow/Pump (gpm)	1	
Avg Hp/Pump	1.5	
Avg # of Pumps Required	72.5	
Avg Connected Hp	108.75	
Kwh's/Hp	0.75	
$/Kwh	0.05	
Gallons per Minute	72.5	
Gallons per Hour	4350	
Costs per Hour ($)	4.078125	
Costs per Gallon ($)	$0.0009	
Costs per Kgal ($)	$0.94	
Repair & Maintenance ($/Kgals)	$0.016	
Total Cost per Kgal	$0.954	
TOTAL WELLFIELD COST	**$209,986**	
TOTAL REVERSE OSMOSIS COST	**$734,317**	

Worksheet 1, No III --
GROUNDWATER RESTORATION

Cost Item	Mining Unit Nichols #1	Notes
III Deep Disposal Well		
Operating Assumptions:		
Total Disposal Requirement		
RO Brine Total Gallons	44,045,368	
RO Brine Total Kgallons	44,045	
Brine Concentration Factor	1	
Total Concentrated Brine (Gals)	44,045,368	
Months of RO Operation	17.0	
Average Monthly Reqm't (Gallons)	2,592,000	
Average Brine Flow (gpm)	60.0	
Total DDW Disposal (Gallons)	44,045,368	
Total DDW Disposal (Kgallons)	44,045	
Cost Assumptions:		
Avg Connected Hp	20	
Kwh's/Hp	0.75	
$/Kwh	0.05	$.02 plus demand charges per quote
Gallons per Minute	60.0	
Gallons per Hour	3600	
Cost per Hour ($)	$0.75	
Cost per Gallon ($)	$0.0002	
Cost per Kgal ($)	$0.21	
Chemicals		
RO Antiscalent ($/Kgals)	$0.192	Costs from operating ISR facility experience (Cogema)
WDW Antiscalent ($/Kgals)	$0.226	Costs from operating ISR facility experience (Cogema)
Sulfuric Acid ($/Kgals)	$0.280	Costs from operating ISR facility experience (Cogema)
Corrosion Inhibitor	$0.217	Costs from operating ISR facility experience (Cogema)
Algacide	$0.080	Costs from operating ISR facility experience (Cogema)
Other	$0.000	Costs from operating ISR facility experience (Cogema)
Repair & Maint. ($/Kgals)	$0.230	Costs from operating ISR facility experience (Cogema)
Total Cost per Kgal	$1.433	
TOTAL DEEP DISPOSAL WELL COST	**$63,132**	

Worksheet 1, Nos. IV & V --
GROUNDWATER RESTORATION

Cost Item	Mining Unit Nichols #1	Labor Cost Factors			Notes
IV STABILIZATION MONITORING					
Operating Assumptions:					
Time of Stabilization (mos)	17.0				
Frequency of Analysis (mos)	3				
Total Sets of Analysis	6				
Cost Assumptions:					
Power ($/Month)	$0				No add'l power required to sample
Total Power Cost	$0				
Sampling & Analysis (each set)	$3,960				12 Monitoring Wells @ $330 per event
Total Sampling & Analysis Cost ($)	$23,760				
Utilities ($/Month)	$0				No add'l utilities required to sample
Total Utilities Cost ($)	$0				
TOTAL STABILIZATION COST	$23,760				
V LABOR					
Cost Assumptions:	No.	Cost/Hour	Hours/Year	Cost	
Crew:					
1. Supervisor	1	29	2080	$60,320	
2. Operators	4	22	2080	$183,040	
3. Maintenance	2	20	2080	$83,200	
4. Vehicles	2	10	2080	$41,600	
Cost per Year				$368,160	
Time Required - Years	5.02				
TOTAL RESTORATION LABOR COST	**$1,848,163**				

Worksheet 1, Nos. VI, VII & Summary --
GROUNDWATER RESTORATION

Cost Item	Mining Unit Nichols #1	Notes
VI RESTORATION CAPITAL REQUIREMENTS		
I Deep Disposal Well(s)	1	
II Plug and Abandon DDW	$50,000	
III Reverse Osmosis Unit	$0	Already in Processing Plant
TOTAL RESTORATION CAPITAL REQUIREMENTS	**$50,000**	
VII RESTORATION OF EXCURSION WELLS		
I Shallow Sand Well(s)		
Total Wells in Excursion	0	Assume no excursions during Year 1
Cost of Clean-Up	$0	
Total Shallow Sand Cleanup	$0	
II Ore Zone Wells		
Total Wells in Excursion	0	
Cost of Clean-Up	$0	
Total Ore Zone Cleanup	$0	
III Deep Zone Wells		
Total Wells in Excursion	0	
Cost of Clean-Up	$0	
Total Deep Zone Cleanup	$0	
TOTAL WELLFIELD COST		
TOTAL EXCURSION CLEANUP COST	**$0**	
SUMMARY:		
I GROUNDWATER SWEEP	$99,458	
II REVERSE OSMOSIS	$734,317	
III WASTE DISPOSAL WELL	$63,132	
IV STABILIZATION	$23,760	
SUB TOTAL	$920,667	
V LABOR	$1,848,163	
VI CAPITAL	$50,000	
VII EXCURSION CLEANUP	$0	
TOTAL GROUNDWATER RESTORATION COST	**$2,818,830**	

Worksheet 2 a
PLANT EQUIPMENT REMOVAL AND DISPOSAL

Cost Item	Nichols Mine Unit: Office & Laboratory	Main Process Building	Maintenance Building	Resin + Sand Filter Media	External Tanks	Header Houses	Sub Total	Notes
Volume (Yds³)	40	200	45	110	25	240		
Quantity per Truck Load (Yds³)	20	20	20	20	20	20		
Number of Truck Loads	2	10	2.25	5.5	1.25	12		
I Decontamination Cost								
Decontamination Cost ($/Load)	600	600	600	600	600	600		
Percent Requiring Decontamination	20%	100%	20%	0%	50%	100%		
Total Cost	$240	$6,000	$270	$0	$375	$7,200		
II Dismantle and Loading Cost								
Cost per Truck Load ($)	$800	$800	$800	$800	$800	$800		
Total Cost	$1,600	$8,000	$1,800	$4,400	$1,000	$9,600		
III Oversize Charges								
Percent Requiring Permits	40%	40%	40%	0%	50%	40%		
Cost per Truck Load ($)	$400	$400	$400	$400	$400	$400		
Total Cost	$320	$1,600	$360	$0	$250	$1,920		
IV Transportation & Disposal								
A. Landfill								
Percent to be Shipped	90%	80%	90%	0%	100%	80%		
Distance (Miles)	50	50	50	50	50	50		
Transport Cost ($/Ton-Mile)	$0.15	$0.15	$0.15	$0.15	$0.15	$0.15		
Transportation Cost	$292	$1,296	$328	$0	$203	$1,555		
Disposal Fee per Cubic Yard	$15	$15	$15	$15	$15	$15		
Disposal Cost ($)	$540	$2,400	$608	$0	$375	$2,880		
Total Cost	$832	$3,696	$936	$0	$578	$4,435		
B. Licensed Site								
Percent to be Shipped	10%	20%	10%	100%	0%	20%		
Distance (Miles)	160	160	160	160	160	160		
Transport Cost ($/Ton-Mile)	$0.15	$0.15	$0.15	$0.15	$0.15	$0.15		
Transport Cost	$691	$6,912	$778	$19,008	$0	$8,294		
Disposal Cost ($/Ton)	$350	$350	$350	$350	$350	$350		
Quantity per Truck Load (Yds³)	20	20	20	20	20	20		
Quantity per Truck Load (Tons)	21.6	21.6	21.6	21.6	21.6	21.6		Based on avg 80lbs per cf
Disposal Cost	$1,512	$15,120	$1,701	$41,580	$0	$18,144		
Total Cost	$2,344	$18,816	$2,637	$41,580	$578	$22,579		
Total Cost	$3,175	$22,512	$3,572	$41,580	$1,155	$27,014		
TOTAL COST NICHOLS MINE	**$5,335**	**$38,112**	**$6,002**	**$45,980**	**$2,780**	**$45,734**	**$143,944**	

Worksheet 2 b --
BUILDING DEMOLITION AND DISPOSAL

Cost Item	Nichols Mine Unit: Office & Laboratory	Main Process Building	Maintenance Building	Header Houses	Sub Total	Notes
STRUCTURE DEMOLITION & DISPOSAL						
Structural Character						
Demolition Volume (Ft^3)	90,000	1,188,000	144,000	3,000		
Unit Cost of Demolition ($\$/Ft^3$)	$0.178	$0.178	$0.178	$0.178		Demolition Unit Cost per WDEQ Guideline No.12, App. K ($/ft3)
Total Demolition Cost	$16,020	$211,464	$25,632	$534		
Weight of Disposal Material in Tons	41	535	65	1		
Factor for Gutting	0.1	0.3	0.2	0.25		
Cost for Gutting ($)	$1,602	$63,439	$5,126	$134		
Quantity per Truck Load (Ton)	21.6	21.6	21.6	21.6		
Number of Truckloads	1.9	24.8	3.0	0.1		
Distance to Landfill	60	60	60	60		
Unit Cost (Ton-Mile)	$0.15	$0.15	$0.15	$0.15		
Transportation Cost	$364.50	$4,811.40	$583.20	$12.15		
Disposal Cost ($/ton)	$56.63	$56.63	$56.63	$56.63		Demolition Unit Cost per WDEQ Guideline No.12, App. K, Adjusted Cost per Unit
Disposal Cost ($)	$2,293.52	$30,274.40	$3,669.62	$76.45		
TOTAL STRUCTURE DEMO & DISPOSAL	**$20,280**	**$309,989**	**$35,011**	**$756**	**$366,036**	
CONCRETE DECONTAMINATION, DEMO & DISPOSAL						
Area	9000	29700	8000	3000		
Average Thickness (Ft)	0.5	0.5	0.5	0.5		
Volume (Ft^3)	4500	14850	4000	11880		
Weight of Disposal Concrete Assuming 145lbs/cubic foot	652,500	2,153,250	580,000	1,722,600		
Weight of Disposal in Tons	326	1077	290	861		
Percent Requiring Decontamination	0%	100%	0%	10%		
Volume Decontaminated (Ft^2)	0	14,850	0	1,188		
Decontamination ($\$/Ft^2$)	$0.2845	$0.2845	$0.2845	$0.2845		Decontamination by Steam Cleaning (137.5 ft2/hr) ECHOS Unit Cost Book
Decontamination Cost	$0	$4,225	$0	$338		
Demolition ($\$/Ft^2$)	$3.40	$3.40	$3.40	$3.40		Demolition Unit Cost per WDEQ Guideline No.12, App. K, Adjusted Cost per Unit
Demolition Cost	$30,600	$100,980	$27,200	$10,200		
Transportation & Disposal						
A. Onsite Disposal						
Percent to be Disposed Onsite	100%	75%	100%	100%		
Transportation Cost	$0	$0	$0	$0		
Disposal Cost per Cubic Yard ($)	$5.00	$5.00	$5.00	$5.00		Demolition Unit Cost per WDEQ Guideline No.12, App. K, Adjusted Cost per Unit
Disposal Cost ($)	$833	$2,750	$741	$2,200		
B. Licensed Site						
Percent to be Shipped	0%	25%	0%	0%		
Distance (Miles)	160	160	160	160		
Unit Cost (Ton-Mile)	$0.15	$0.15	$0.15	$0.15		
Transportation Cost ($)	$0	$6,460	$0	$0		
Disposal Cost ($/Ton)	$350	$350	$350	$350		
Disposal Cost ($)	$0	$94,205	$0	$0		
TOTAL TRANSPORT & DISPOSAL COST	**$31,433**	**$208,619**	**$27,941**	**$12,738**	**$280,731**	
TOTAL BUILDING DEMO & DISPOSAL COST	**$51,713**	**$518,608**	**$62,952**	**$13,494**	**$646,768**	

Worksheet 3 b --
SOIL REMOVAL & DISPOSAL

Cost Item	Nichols Mine Unit					Notes
	Office & Laboratory	Main Process Building	Maintenance Building	Header Houses	Sub Total	
SOIL EXCAVATION, TRANSPORT & DISPOSAL						
Removal Under Building Footprints						
Excavation, Front End Loader	$45	$150	$40	$15		$81.81/hr per WDEQ Guideline12 and 150 cy/hr
Quantity to be Shipped (Ft^3)	2,250	7,425	2,000	750		Assume removal of 3" of Contaminated Soil under Primary Areas, Disposal at a Licensed facility (ft3)
Weight in Tons	112.5	371.25	100	37.5		
Distance (Miles)	160	160	160	160		
Transportation Unit Cost (Ton/Mile)	$0.150	$0.150	$0.150	$0.150		
Transportation Cost	$2,700	$8,910	$2,400	$900		
Disposal Fee ($/Ton)	$350	$350	$350	$350		
Disposal Cost ($)	$39,375	$129,938	$35,000	$13,125	$217,438	
Removal NPDES Pts.						
Quantity to be Shipped (Ft^3)	0	0	0	0		Zero discharge facility
Weight in Tons	0	0	0	0		
Distance (Miles)	160	160	160	160		
Transportation Cost Ton/Mile ($)	$0.015	$0.015	$0.015	$0.015		
Transportation Cost	$0	$0	$0	$0		
Disposal Fee ($/Ton)	$350	$350	$350	$350		
Disposal Cost ($)	$0	$0	$0	$0		
Total NPDES Removal Cost	$0	$0	$0	$0	$0	
TOTAL SOILS EXC., TRANSPORT & DISPOSAL	**$39,375**	**$129,938**	**$35,000**	**$13,125**	**$217,438**	
RADIATION SURVEY						
Area Required (Acres)	0.21	0.68	0.18	0.07		
Survey Cost ($/Acre)	$600	$600	$600	$600		
Number of Structures	1	1	1	12		
Cost per Structure ($)	$225	$225	$225	$225		
TOTAL RAD SURVEY COST	**$349**	**$634**	**$335**	**$2,741**	**$4,060**	
TOTAL SOIL REMOVAL & DISPOSAL COST	**$39,724**	**$130,572**	**$35,335**	**$15,866**	**$221,497**	

Worksheet 4 --
Well Abandonment

Cost Item	Mining Unit Nichols #1	Notes
Number of Wells	515	Includes injection, recovery and monitor wells.
Average Depth (ft)	550	
Average Diameter (inch)	5	
Area of Annulus (ft^2)	0.1364	
Materials		
Bentonite Chips Required (Ft^3/Well)	40.9	300 feet of clay above water
Bags of Chips Required/Well	55	
Cost per Bag ($)	$6.45	
Cost/Well Bentonite Chips ($)	$355	
Gravel Fill Required (Ft^3/Well)	34.1	Avg depth less 300 feet filled w/ gravel
Cost of Gravel/Yd^3 ($)	$20	
Cost/Well Gravel Fill ($)	$25	
Cement Cone/Markers Req'd/Well	1	
Cost of Cement Cones Markers ($)	$6	
Total Materials Cost per Well	$386	
Labor		
Hours Required per Well	2	
Labor Cost per Hour	$70	
Total Labor Cost per Well ($)	140	
Equipment Rental		
Hours Required per Well	1	
Backhoe w/Operator Cost/Hr ($)	$60	
Total Equipment Cost per Well ($)	$60	
Total Cost per Well ($)	$586	
TOTAL WELL ABANDONMENT COST ($)	**$301,790**	

Surety Estimate
First Year of Operation
Nichols Ranch ISR Project
Uranerz Energy Corporation

Worksheet 5, No. I --
WELLFIELD EQUIPMENT REMOVAL & DISPOSAL

Cost Item	Mining Unit Nichols #1	Notes
I Wellfield Piping		
A. Removal		
Total Number of Wells	482	Includes total injection and recovery wells
Feeder lines from HH to Injection wells 1" HDPE (Ft)	71,560	From Preliminary Design
Pregnant solution feeder lines from production wells to HH 1" HDPE (Ft)	50,427	From Preliminary Design
Total Quantity of 1" HDPE Piping (Ft)	121,987	
Plastic Volume (Ft^3)	400.05	Thickness Based on WL Plastics Corp PSI 160 (R1=.05479', R2=.04425')
Chipped Volume Assuming 30% Void Space (Ft^3)	520.07	
Disposal Weight (tons)	20.80	Year 1 buildout only to include Nichols 1
Quantity per Truck Load (Tons)	21.6	Based on 20 cy per truckload and 80lbs per cf
Total Number of Truck Loads	1	
Total Length of Feeder line Trench (ft)	40,765	Includes Shared Trenches
Pipeline Removal Unit Cost ($/ft of trench)	$2.25	Quote - Jordan Construction
Total Cost for Trunkline Removal ($)	$91,720	
Total Cost - Removal	$91,720	
B. Survey & Decontamination		
Percent Requiring Decontamination	0	No survey or decon needed. Total volume to low level disposal
Loads for Decontamination	0	
Cost for Decontamination ($/Load)	$600	
Cost for Decontamination ($)	$0	
C. Transport & Disposal		
1.) Landfill		
a. Transportation		
Percent to be Shipped	0%	
Loads to be Shipped	0	
Distance (Miles)	50	
Transportation Cost (Ton/Mile) ($)	$0.15	
Transportation Cost ($)	$0	
b. Disposal		
Disposal Fee per Yd^3	$15	
Yds^3 per Load	20	
Disposal Cost ($)	$0	
Total Cost - Landfill	$0	
2.) Licensed Site		
a. Transportation		
Percent to be Shipped	100%	
Loads to be Shipped	1	
Tons to be Shipped	20.80	
Distance (Miles)	160	
Transportation Ton/Mile ($)	$0.150	
Transportation Cost ($)	$499	
b. Disposal		
Disposal Fee per ton	$350	
Disposal Cost ($)	7,281	
Total Cost - Licensed Site	7,780	
Total Cost - Transport & Disposal	7,780	
Total Cost - WF Piping Removal & Disposal	**99,500**	

Worksheet 5, No. II
WELLFIELD EQUIPMENT REMOVAL & DISPOSAL

Cost Item	Mining Unit Nichols #1	Notes
II Production Well Pumps		
A. Pump and Tubing Removal		
Number of Production Wells	233	
Cost of Removal ($/well)	$40	
Cost of Removal ($)	$9,320	
Number of Pumps per Truck Load	180	
Number of Truck Loads (Pumps)	1.29	
Weight of Pumps	21.29	Assume 20 T per truck
B. Survey & Decontamination (Pumps)		
Percent Requiring Decontamination	50%	
Loads for Decontamination	0.65	
Cost for Decontamination ($/Load)	$600	
Cost for Decontamination ($)	$388	
C. Tubing Volume Reduction & Loading		
Length per Well (Ft)	300	
Total Quantity (Ft^3)	229.2	Thickness Based on WL Plastics Corp PSI 160 (R1=.05479', R2=.04425')
Chipped Volume Assuming 30% Void Space (Ft^3)	298.0	
Cost of Removal ($/Ft)	$0.03	
Cost of Removal ($)	$9.00	
Quantity per Truck Load (Ft^3)	540	
Number of Truck Loads	0.42	
D. Transport & Disposal		
1.) Landfill		
a. Transportation		
Percent to be Shipped (Pumps)	50%	
Loads to be Shipped	0.6	
Distance (Miles)	50	
Transportation Ton/Mile ($)	$0.15	
Transportation Cost ($)	$105	
b. Disposal		
Disposal Fee per Yd^3	$15	
Yds^3 per Load	20	
Disposal Cost ($)	$194	
Total Cost - Landfill	$299	
2.) Licensed Site		
a. Transportation		
Percent to be Shipped (Pumps)	50%	
Percent to be Shipped (Tubing)	100%	
Loads to be Shipped	1.07	
Distance (Miles)	50	
Transportation Ton/Mile ($)	$0.15	
Transportation Cost ($)	$174	
b. Disposal		
Disposal Cost per Ft^3	$15	
Disposal Fee per Yd^3	20	
Quantity Per Truck Load (Yds^3)	$322	
Disposal Cost ($)	$495	
Total Cost - Licensed Site	$669	
Total Cost - Transport & Disposal	$968	
Total Cost - Pump Removal & Disposal	**$10,685**	

Surety Estimate
First Year of Operation
Nichols Ranch ISR Project
Uranerz Energy Corporation

Worksheet 5, No. III
WELLFIELD EQUIPMENT REMOVAL & DISPOSAL

Cost Item	Mining Unit Nichols #1	Notes
III Buried Trunkline		
A. Removal		
Trunk lines from Resin Plant to HH 8" HDPE Pipe (Ft)	38,473	
Pregnant solution trunk lines form HH to Resin Plant 8" HDPE Pipe (Ft)	38,473	
Total Quantity of 8" HDPE Piping (Ft)	76,946	
Plastic Volume (Ft^3)	51,906	Thickness Based on WL Plastics Corp PSI 160 (R1=.7188', R2=.5494')
Chipped Volume Assuming 30% Void Space (Ft^3)	67,478	
Disposal Tons	320	8.315lb/ft per WL Plastics
Quantity per Truck Load (Tons)	21.6	
Total Number of Truck Loads	15	
Total Length of Trunkline Trench (ft)	38,473	
Pipeline Removal Unit Cost ($/ft of trench)	$2.25	Quote Jordan Construction
Total Cost for Trunkline Removal ($)	$86,564	
B. Survey & Decontamination		
Percent Requiring Decontamination	0	No survey or decon needed. Total volume to low level disposal
Loads for Decontamination	0	
Cost for Decontamination ($/Load)	$600	
Cost for Survey & Decontamination ($)	$0	
C. Transportation & Disposal		
1.) Landfill		
a. Transportation		
Percent to be Shipped	0%	
Loads to be Shipped	0	
Distance (Miles)	50	
Transportation Cost (Ton/Mile) ($)	$0.15	
Transportation Cost ($)	$0	
b. Disposal		
Disposal Fee per Yd^3	$15	
Yds^3 per Load	20	
Disposal Cost ($)	$0	
Total Cost - Landfill	$0	
2.) Licensed Site		
a. Transportation		
Percent to be Shipped	100%	
Loads to be Shipped	15	
Tons to be Shipped	319.90	
Distance (Miles)	160	
Transportation Ton/Mile ($)	$0.150	
Transportation Cost ($)	$7,678	
b. Disposal		
Disposal Fee per ton	$350	
Disposal Cost ($)	$111,966	
Total Cost - Licensed Site	$119,644	
Total Cost Transportation & Disposal	**$119,644**	
Total Cost - Buried Trunkline Removal & Disposal	**$206,208**	
TOTAL WELLFIELD EQUIPMENT REMOVAL & DISPOSAL COST	**$316,393**	

Surety Estimate
First Year of Operation
Nichols Ranch ISR Project
Uranerz Energy Corporation

Worksheet 6, No. I
TOPSOIL REPLACEMENT & REVEGETATION

	Mining Unit	
Cost Item	Nichols #1	**Notes**
I Process Plant and Office Building		
A. Topsoil Handling & Grading		
Affected Area (Acres)	5.2	Plant site is 475' by 475'
Average Affected Thickness (Ins)	12	
Topsoil Volume (Yds^3)	8,356	
Unit Cost	$5	Price from Dragstrip Soil Cover Project MT
Sub Total - Topsoil	$41,782	
B. Radiation Survey & Soil Analysis		
Unit Cost ($/Ac)	$600	
Sub Total - Survey & Analysis	$3,108	
C. Revegation		
Fertilizer ($/Ac)	$232.00	Price from Dragstrip Soil Cover Project MT
Seeding Prep & Seeding ($/Ac)	$227.00	Price from Dragstrip Soil Cover Project MT
Mulching & Crimping ($/Ac)	$100.00	Price from Dragstrip Soil Cover Project MT
Sub Total Cost/Acre	$559.00	
Sub Total Revegation	$2,895	
TOTAL PLANT AND OFFICE BUILDING TOPSOIL REPLACEMENT & REVEG COST	**$47,786**	

Surety Estimate
First Year of Operation
Nichols Ranch ISR Project
Uranerz Energy Corporation

Worksheet 6, Nos. II & III
TOPSOIL REPLACEMENT & REVEGETATION

Cost Item	Mining Unit Nichols #1	Notes
II Wellfields		
A. Topsoil Handling & Grading		
Affected Area (Acres)	22	Equals trench length times 12 feet wide
Average Affected Thickness (Inch)	12	
Topsoil Volume (Yds^3)	35,217	
Unit Cost - Haul/Place/Grading ($/cy)	$5.00	Price from Dragstrip Soil Cover Project MT
Sub Total - Topsoil	$176,083	
B. Radiation Survey & Soil Analysis		
Unit Cost ($/Ac)	$600	
Sub Total - Survey & Analysis	$13,097	
C. Spill Cleanup		
Affected Area (Acres)	0	
Affected Area (Ft^2)	0	
Affected Area Thickness (Ft)	0.25	
Affected Volume (Ft^3)	0	
Quantity per Truckload (Ft^3)	540	
Quantity to be Shipped (Loads)	0	
Distance (Miles)	160	
Transportation Cost (Ton/Mile) ($)	$0.15	
Transportation Cost ($)	$0	
Handling Cost ($/Load)	$200	
Handling Cost ($)	$0	
Disposal Fee ($/Ton)	$350	
Disposal Cost ($)	$0	
Sub Total - Spill Cleanup	$0	
D. Revegation		
Fertilizer ($/Ac)	$232.00	Price from Dragstrip Soil Cover Project MT
Seeding Prep & Seeding ($/Ac)	$227.00	Price from Dragstrip Soil Cover Project MT
Mulching & Crimping ($/Ac)	$100.00	Price from Dragstrip Soil Cover Project MT
Sub Total Cost/Acre	$559.00	
Sub Total Revegation	$12,202	
Sub Total - Wellfields	$201,383	
TOTAL WELLFIELDS COST	**$201,383**	
III Roads		
A. Topsoil Handling & Grading		
Affected Area (Acres)	5.17	3750 feet by 60 feet wide
Average Affected Thickness (Ins)	12	
Topsoil Volume (Yds^3)	8,333	
Unit Cost - Haul/Place/Grading ($/cy)	$5.00	Price from Dragstrip Soil Cover Project MT
Sub Total - Topsoil	$41,667	
B. Radiation Survey & Soil Analysis		
Unit Cost ($/Ac)	$600	
Sub Total - Survey & Analysis	$3,099	
C. Revegation		
Fertilizer ($/Ac)	$232	Price from Dragstrip Soil Cover Project MT
Seeding Prep & Seeding ($/Ac)	$227	Price from Dragstrip Soil Cover Project MT
Mulching & Crimping ($/Ac)	$100	Price from Dragstrip Soil Cover Project MT
Sub Total Cost/Acre	$559	
Sub Total Revegation	$2,887	
Sub Total - Roads	$47,653	
TOTAL ROADS COST	**$47,653.24**	

Worksheet 6, Nos IV & V
TOPSOIL REPLACEMENT & REVEGETATION

Cost Item	Mining Unit Nichols #1	Notes
IV Other		
A. Topsoil Handling & Grading		
Affected Area (Acres)	0	
Average Affected Thickness (Ins)	3	
Topsoil Volume (Yds^3)	0	
Unit Cost - Haul/Place/Grading ($/Ac)	$5.00	Price from Dragstrip Soil Cover Project MT
Sub Total - Topsoil	$0	
B. Radiation Survey & Soil Analysis		
Unit Cost ($/Ac)	$600	
Sub Total - Survey & Analysis	$0	
C. Revegation		
Fertilizer ($/Ac)	$232.00	Price from Dragstrip Soil Cover Project MT
Seeding Prep & Seeding ($/Ac)	$227.00	Price from Dragstrip Soil Cover Project MT
Mulching & Crimping ($/Ac)	$100.00	Price from Dragstrip Soil Cover Project MT
Sub Total Cost/Acre	$559.00	
Sub Total Revegation	$0	
Sub Total - Other	$0	
TOTAL OTHER COST	**$0**	
V Remedial Action		
A. Topsoil Handling & Grading		
Affected Area (Acres)	0	Assume no excursions/spills
Average Affected Thickness (Ins)	3	
Topsoil Volume (Yds^3)	0	
Unit Cost - Haul/Place/Grading ($/cy)	$5.00	Price from Dragstrip Soil Cover Project MT
Sub Total - Topsoil	$0	
B. Radiation Survey & Soil Analysis		
Unit Cost ($/Ac)	$600	
Sub Total - Survey & Analysis	$0	
C. Revegation		
Fertilizer ($/Ac)	$232.00	Price from Dragstrip Soil Cover Project MT
Seeding Prep & Seeding ($/Ac)	$227.00	Price from Dragstrip Soil Cover Project MT
Mulching & Crimping ($/Ac)	$100.00	Price from Dragstrip Soil Cover Project MT
Sub Total Cost/Acre	$559.00	
Sub Total Revegation	$0	
TOTAL REMEDIAL ACTION	**$0**	
TOTAL TOPSOIL REPLACEMENT & REVEGETATION COST (Total of 7I through 7V)	**$296,821**	

Worksheet 7, Nos I - VII
MISCELLANEOUS RECLAMATION

	Cost Item	Mining Unit Nichols #1	Notes
I	**Fence Removal & Disposal**		
	Quantity (Ft)	8,558	
	Cost of Removal/Disposal ($/Ft)	$0.59	Demolition Unit Cost per WDEQ Guideline No.12, App. H
	Cost of Removal/Disposal ($)	$5,049	
II	**Powerline Removal & Disposal**		
	Quantity (Ft)	160,460	Power to Wells, header houses. Other power already in place by CBM companies
	Cost of Removal/Disposal ($/Ft)	$0	Lines buried in pipe trenches. Excavation costs covered on Sheets 6I and 6III. Assume salvage of wire at no cost.
	Cost of Removal/Disposal ($)	$0	
III	**Powerpole Removal & Disposal**		
	Quantity	0	Overhead powerpoles and lines will remain in place for future gas production
	Cost of Removal/Disposal ($/Each)	0	
	Cost of Removal/Disposal ($)	$0.00	
IV	**Transformer Removal & Disposal**		
	Quantity	0	
	Cost of Removal/Disposal ($/Each)	0	Tri-County Electric will remove at no cost, WDEQ Guideline No.12, App. H
	Cost of Removal/Disposal ($)	0	
V	**Culvert Removal & Disposal**		
	Quantity (Ft)	0	None
	Cost of Removal/Disposal ($/Ft)	$4.56	($91.24/20') WDEQ Guideline No.12, App. J
	Cost of Removal/Disposal ($)	$0.00	
VI	**Guardrail Removal**		
	Quantity (Ft)	0	None
	Cost of Removal/Disposal ($/Ft)	$6.50	
	Cost of Removal/Disposal ($)	$0	
VII	**Low Water Stream Crossing**		
	Quantity	0	None
	Cost of Removal/Disposal ($/Each)	$8,000	
	Cost of Removal/Disposal ($)	$0	
	TOTAL MISCELLANEOUS COST	**$5,049**	

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D-06

D10.2.0 SURVEY METHODS

On-site inspections of the project area for potential jurisdictional wetlands and WUS were conducted throughout the 2006 growing season using procedures outlined in COE (1987). Prior to fieldwork, background information was obtained from National Wetland Inventory (NWI) maps, U.S. Geological Survey (USGS) topographic maps, and aerial photographs. Information from the NWI maps is presented in Figures D10-1 and D10-2. These sources were used to identify areas likely to contain wetlands and other WUS. All potential wetland and WUS sites identified on the NWI or USGS maps were visited to determine if a wetland or WUS were present. If at least the wetland indicator was present, the site was evaluated further to determine if a wetland was present. Other areas not designated as wetlands on the NWI map were investigated if standing water or other primary or secondary hydrology indicators were present or if areas of hydrophytic vegetation were observed.

During the on-site inspection, geomorphic and hydrologic characteristics of the site were investigated to determine if primary wetland hydrology indicators were present, including inundation, saturation, water marks, sediment deposits, drainage patterns, and drift lines. Secondary indicators (e.g., oxidized root channels) were searched for only if no primary indicators were identified.

Dominant plant species were identified at each potential wetland site to determine if hydrophytic vegetation was present. Plant species were either identified on-site or taken to the Rocky Mountain Herbarium at the University of Wyoming in Laramie and identified. An ocular estimate of percent cover was used to determine dominant species at each wetland site. *The National List of Plant Species that Occur in Wetlands: North Plains* (*Region 4*) (Reed 1988) was used to determine the indicator status of dominant plants within each community, and plant species were classified as obligate wetland (OBL), facultative wetland (FACW), facultative (FAC), facultative upland (FACU), upland (UPL) species, or insufficient information is available to determine an indicator species (NI).

D10.3.0 RESULTS

D10.3.1 INTRODUCTION

The survey of potential jurisdictional wetlands and WUS was completed in June and July 2006 in accordance with the survey methods presented in Section D10.2. The survey was conducted by Ms. Jan Hart of TRC Environmental Corporation, Laramie, Wyoming. Ms. Hart is a COE-certified wetland delineator, has received formal wetland training from the Wetland Training Institute in 1998, and has been conducting jurisdictional wetland surveys since 1998.

NWI map information for each unit of the project area is presented on Figures D10-1 and D10-2. All potential wetland or WUS areas identified on the NWI maps were visited; however, not all NWI wetlands fit the COE criteria (i.e. the presence of either primary or secondary indicators of wetland hydrology, hydric soils or hydrophytic vegetation). Photographs of wetland Sites 1-3 and WUS are presented in Addendum D10A. No photograph is available for wetland Site 4. Wetland delineation forms were completed for each site determined to be a wetland and are presented in Addendum D10B.

D10.3.2 RESULTS FOR NICHOLS RANCH UNIT

D10.3.2.1 Wetlands

Four jurisdictional wetland sites were delineated in the Nichols Ranch Unit of the project area (refer to Table D10-1 and Figure D10-3). Sites 1, 2, and 3 are linear palustrine type wetlands located in a drainage to Cottonwood Creek. Site 4 is below an overflowing stock tank located in the Cottonwood drainage. Sites 1, 3, and 4 were inundated, and water is supplied to these sites from groundwater (i.e., springs). Sites 1 and 3 were created prior to 1950 and are the result of excavation to the water table, thereby creating small ponds (personal communication March 1, 2007, with Patricia Clark, T-Chair Ranch). Site 2 has signs of inundation (i.e., water marks and salt deposits). Vegetation at all four wetland sites is composed of hydrophytic species such as cattail, four-square bulrush, Baltic rush, rabbitfoot grass, barnyard grass, and foxtail barley.

Table D10-1 Wetland Sites, Nichols Ranch ISR Project Area, 2007.

Site Number	NWI Designation[1]	Field Determination	Wetland Acres in Project Area	Wetland Acres Affected
1	PEMC	Wetland	0.498	0
2	PEMF	Wetland	0.117	0
3	PEMC	Wetland	0.487	0
4	--	Wetland	0.102	0
Total			1.20	0

[1] PEMC = Palustrine emergent seasonally flooded; PEMF = Palustrine emergent semipermanently flooded.

Soils at all four wetland sites were determined to be hydric. None of the jurisdictional wetland sites in the Nichols Ranch Unit will be disturbed by mining activities.

D10.3.2.2 WUS

Approximately 21,722 linear ft of WUS occur in the Nichols Ranch Unit, and all WUS were dry at the time of the site visits (refer to Table D10-1 and Figure D10-3). In the Nichols Ranch Unit, drainage is to the southwest to Cottonwood Creek via small ephemeral moderately to deeply incised (1- to 15-ft banks) channels that range from 1 to 15 ft wide. WUS Segment 25 (refer to Figure D10-3) is deeply incised with 20- to 30-ft high banks. Within the Nichols Ranch Unit, Cottonwood Creek has been altered with a system of irrigation ditches and spreader dikes have been constructed to supply water to the area for hay production; therefore, there is no typical pool-riffle riverine system in the Nichols Ranch Unit. The spreader dikes are referred to in a 1927 description of the ranch (personal communication, March 1, 2007, with Patricia Clark, T-Chair Ranch).

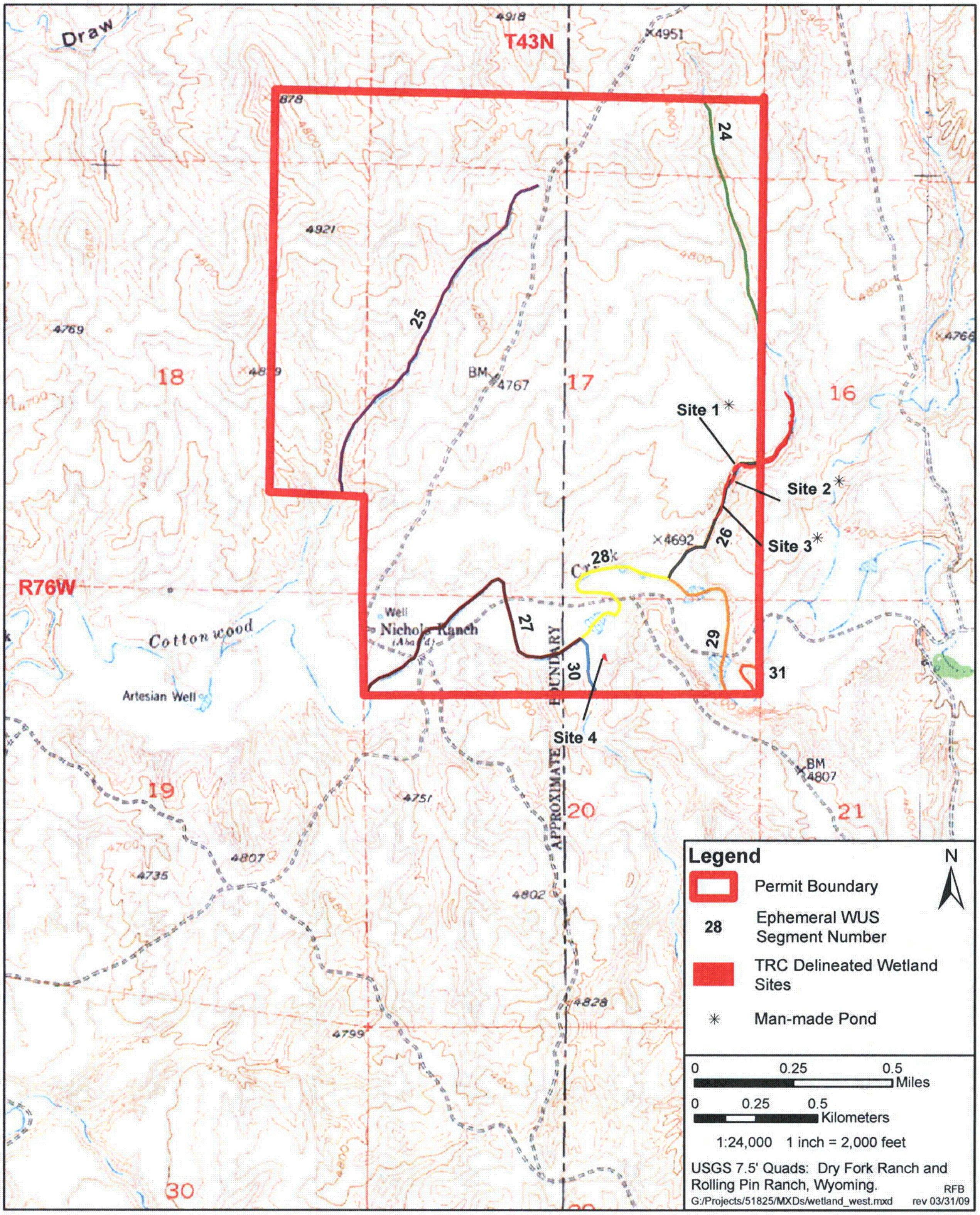

Figure D10-3 WUS Locations and Wetland Sites Delineated on the Nichols Ranch Unit, 2007.