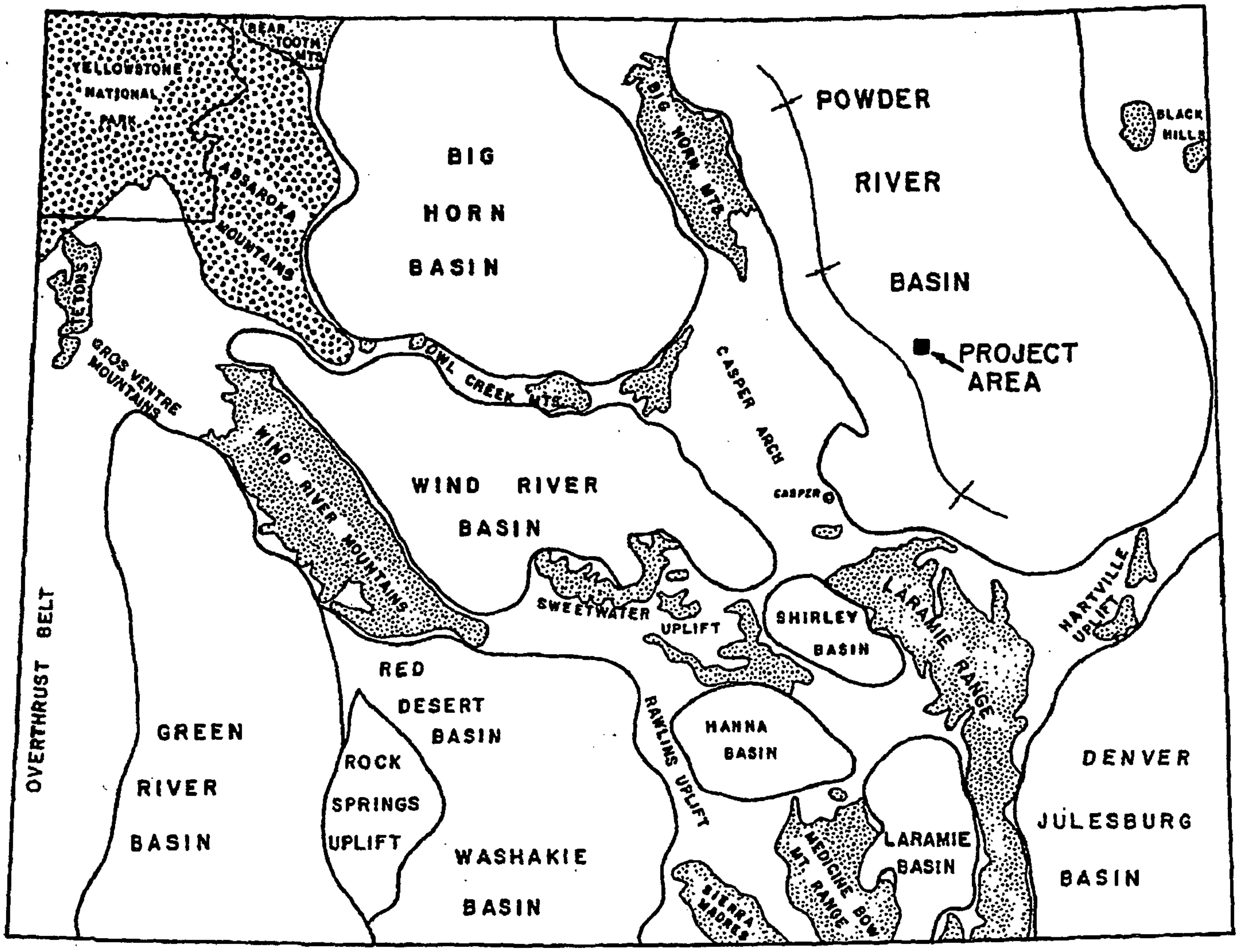
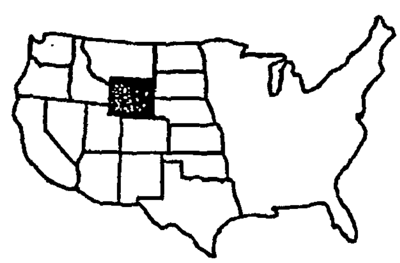


PRECAMBRIAN ROCK

TERTIARY VOLCANICS

SYNCLINAL AXIS



SCALE: 1"=50 MILES

0 50 MILES 100 MILES

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NICHOLS RANCH ISR PROJECT

FIGURE 2-12

STRUCTURAL MAP OF WYOMING

By: S.M.F.	Date: OCT. 11, 2007
Datum: N/A	Revision Date:
Scale: 1"=50 MILES	Contour Interval: N/A

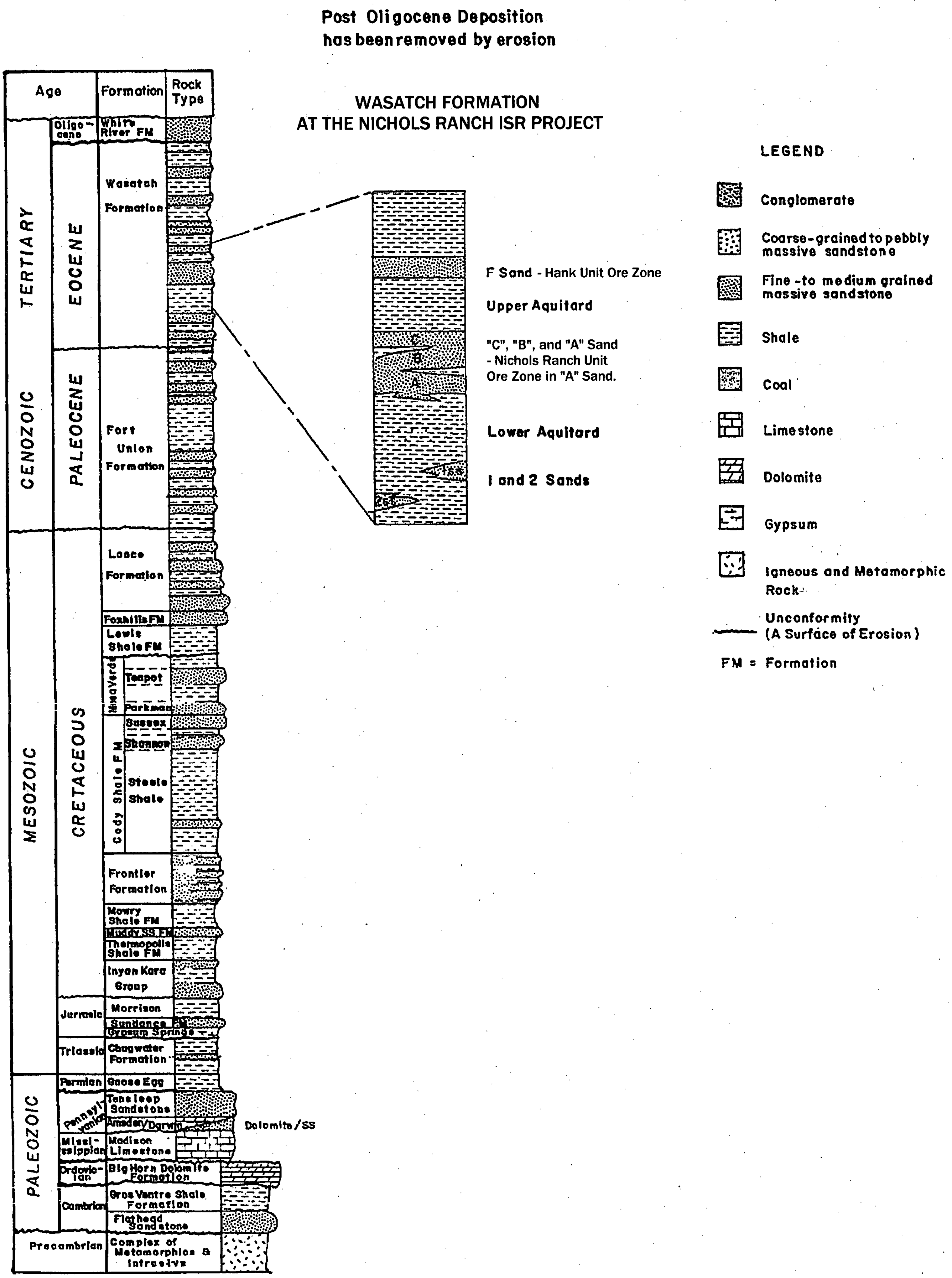

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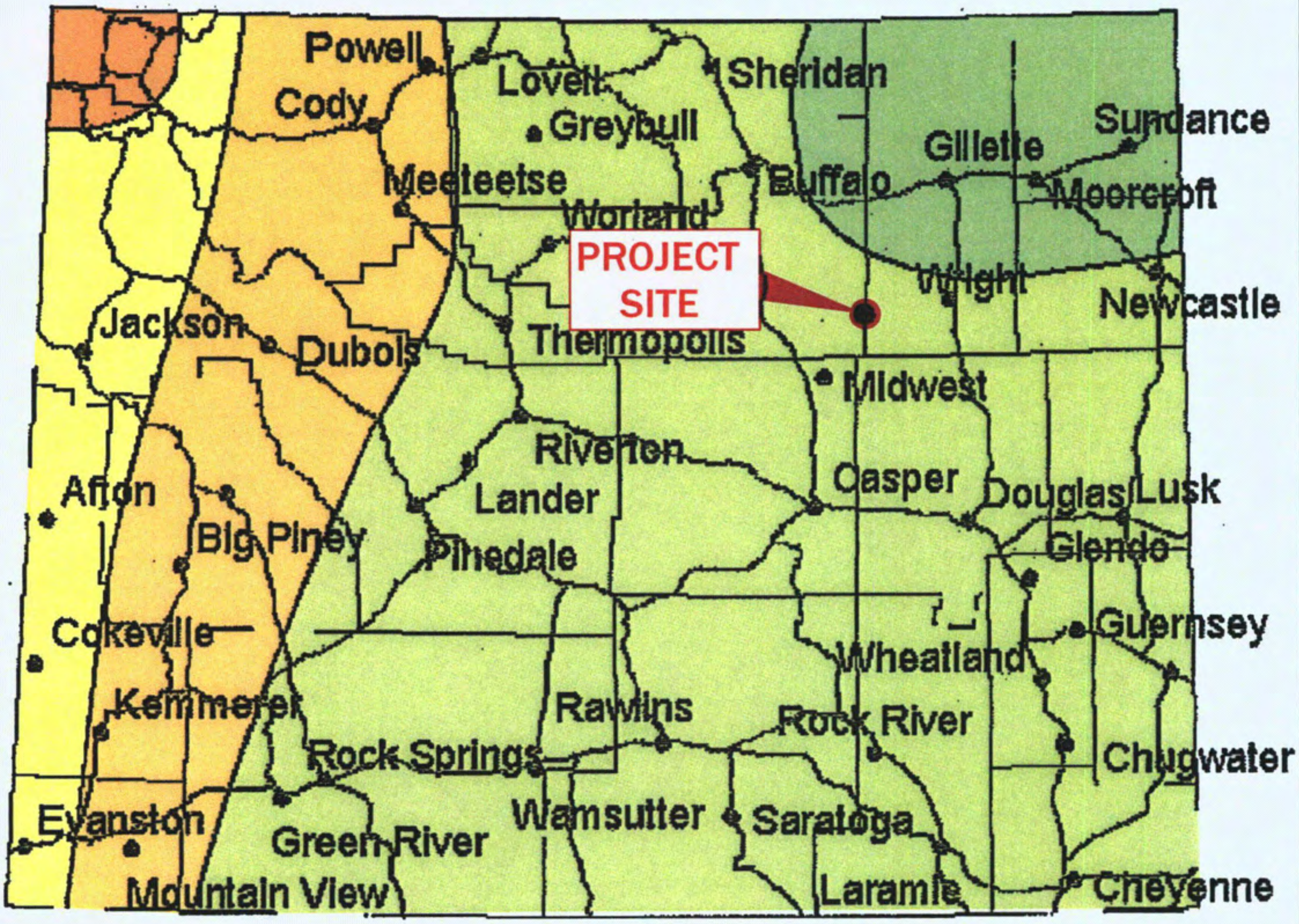
FIGURE 2-13
STRATIGRAPHIC COLUMN

By: S.M.F.	Date: OCT. 12, 2007
Datum: N/A	Revision Date:
Scale: NOT TO SCALE	Contour Interval: N/A



LEGEND

ZONE 0

ZONE 1

ZONE 2

ZONE 3

ZONE 4

NOT TO SCALE

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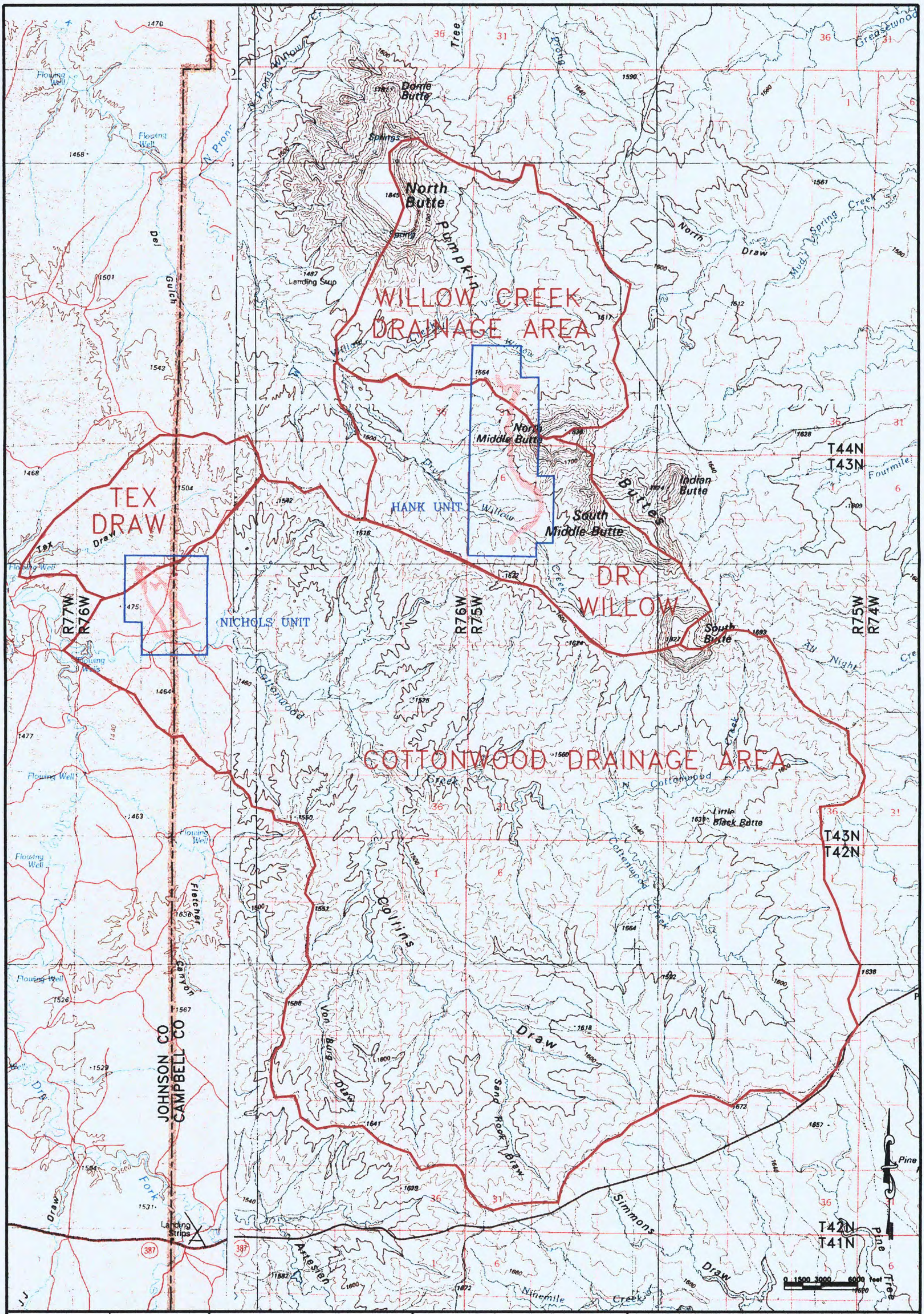
FIGURE 2-14

SEISMIC ZONE MAP OF WYOMING

By: S.M.F.	Date: OCT. 11, 2007
Datum: N/A	Revision Date:
Scale: 1"=50 MILES	Contour Interval: N/A



By: lgrh	Date: 10/16/07
Contour Interval	Revision Date:

DWG: C:\PROJECTS\2007-14\DRAINAGE AREA\DRAINAGE-LH

LEGEND: WELLFIELD
Drainage area divide
Permit Boundary
Land surface contours in meters

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FIGURE 2-15. SURFACE DRAINAGE AREAS

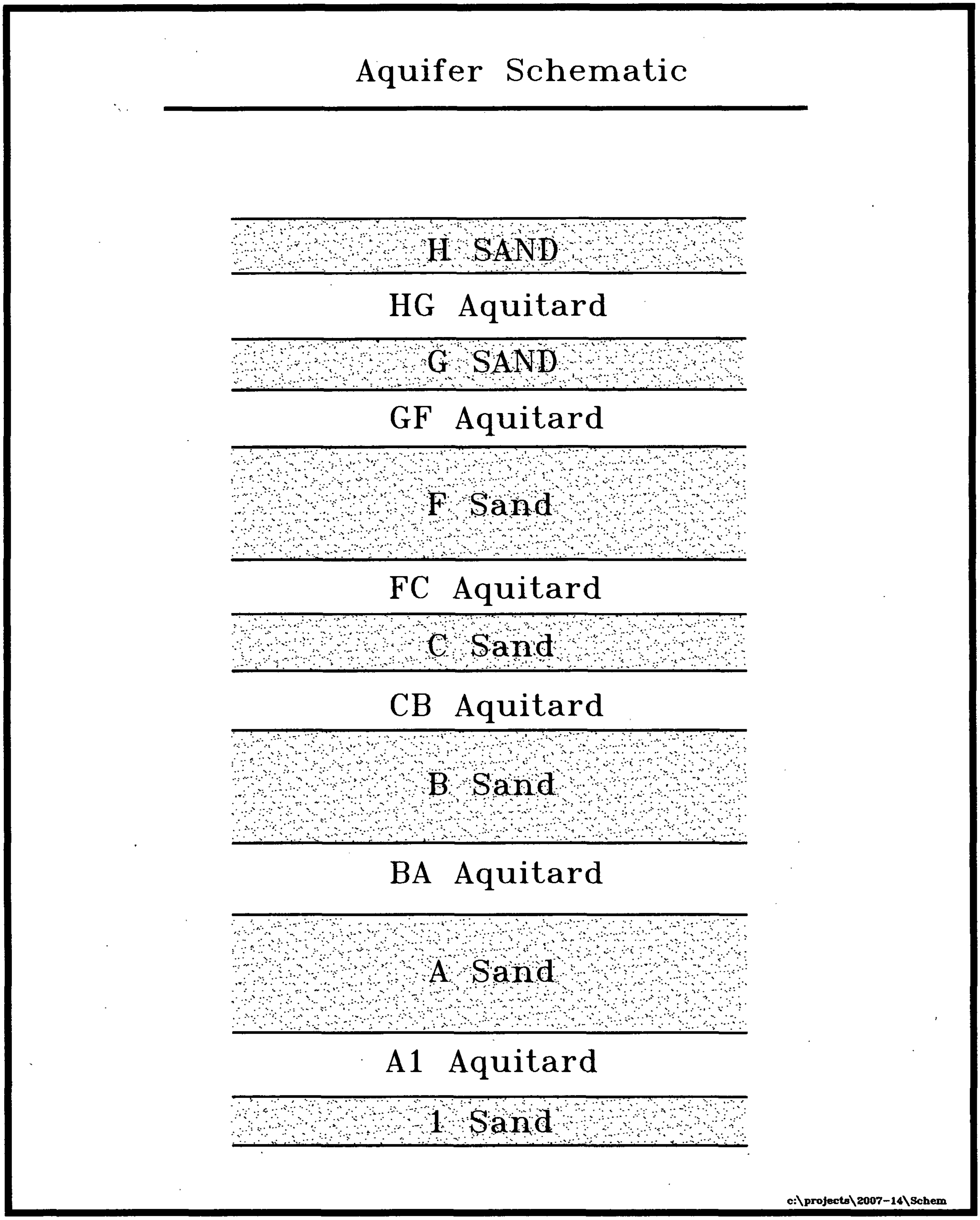
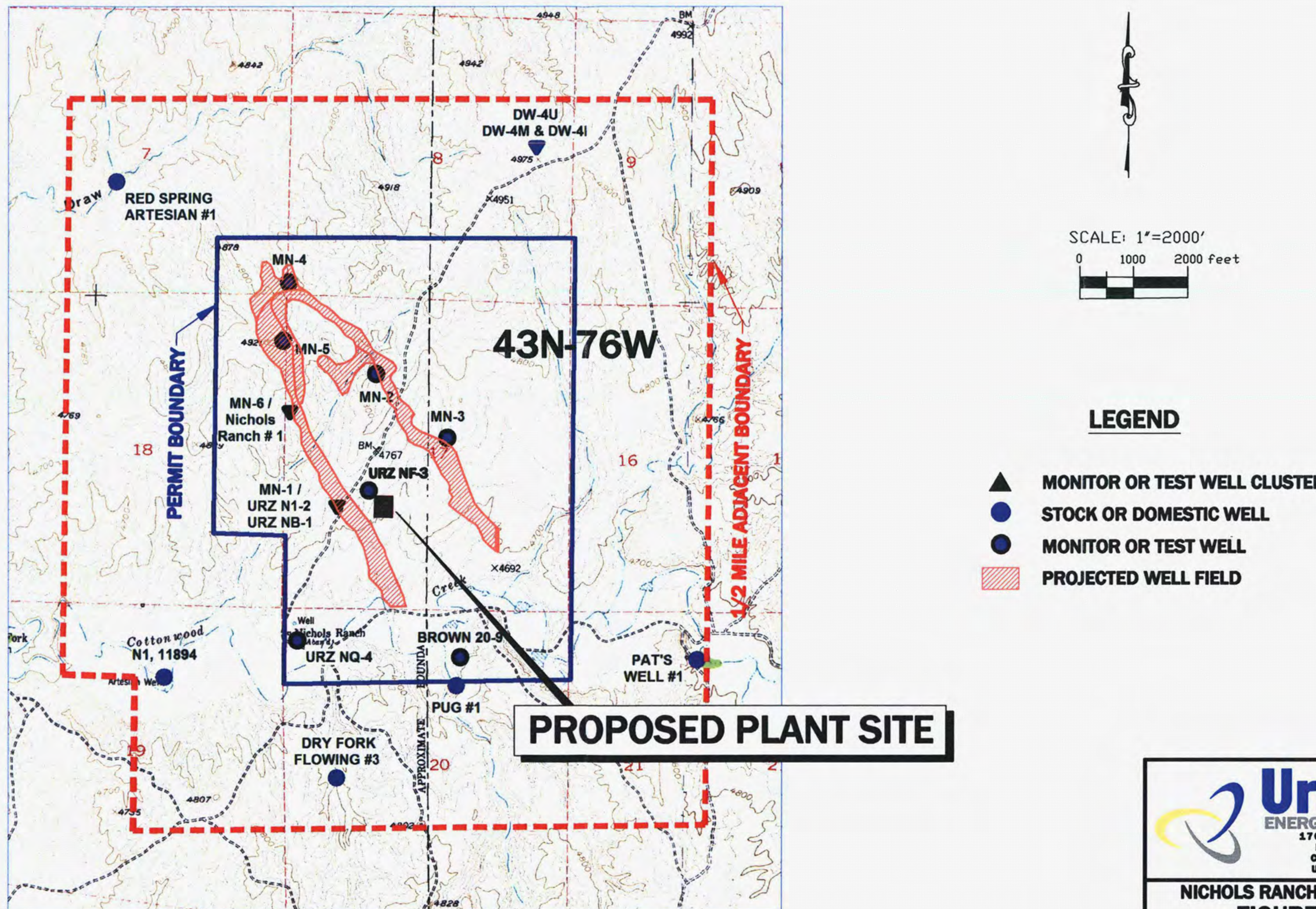


FIGURE 2-16. TYPICAL AQUIFER AND AQUITARD SEQUENCE AT THE NICHOLS RANCH PERMIT



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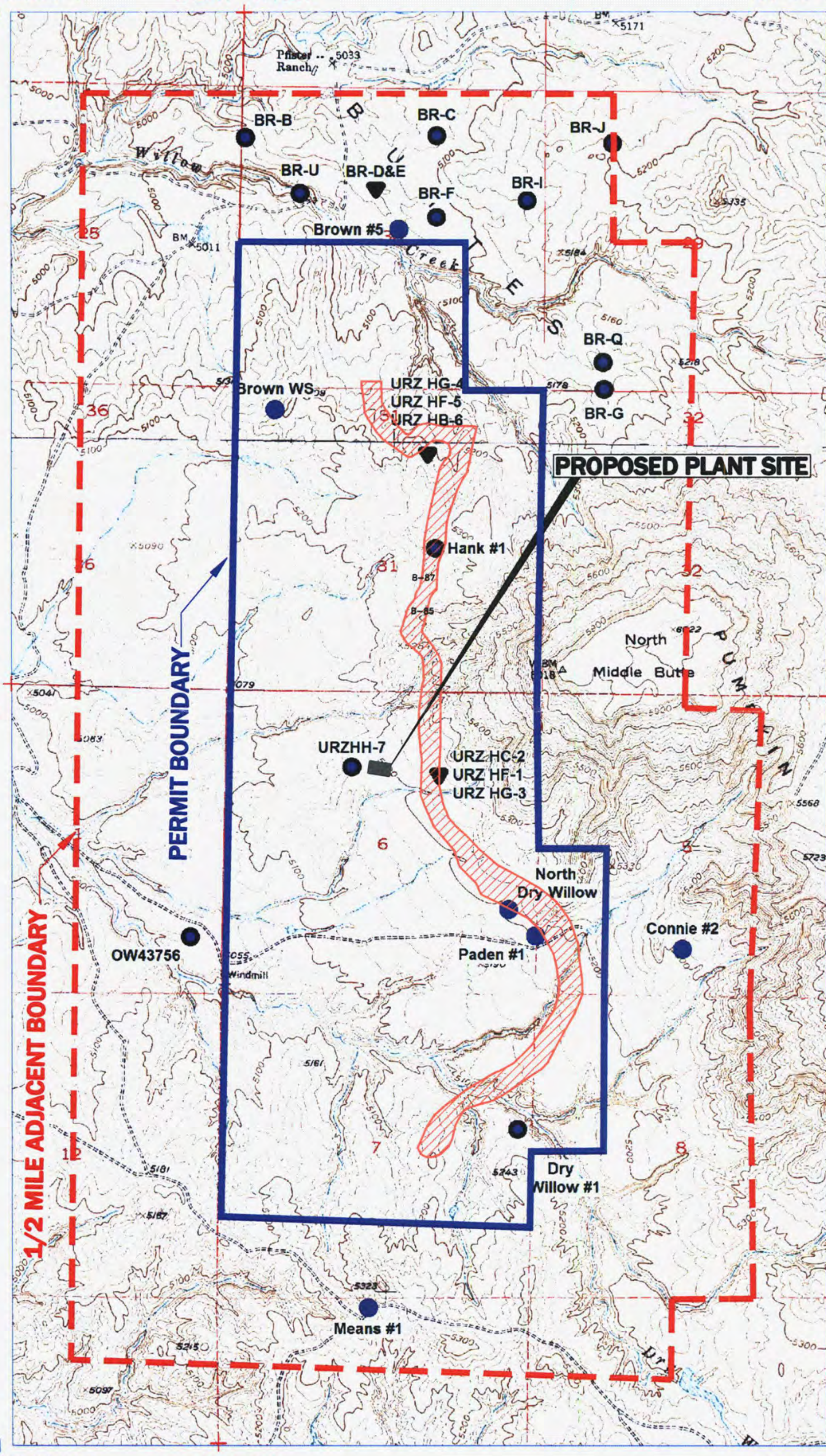
NICHOLS RANCH ISR PROJECT
FIGURE 2-17
NICHOLS RANCH UNIT
WATER WELLS

By: S.M.F.	Date: 10/12/2007
Dateum: Nad 27 UTM 13	Revision Date:
Scale: 1"=2000'	Contour Interval: 20 feet
	Dwg: FIGURE D6-3



LEGEND

- ▲ MONITOR OR TEST WELL CLUSTER
- ● STOCK OR DOMESTIC WELL
- ● MONITOR OR TEST WELL
- PROJECTED WELL FIELD

SCALE: 1"=2000'
1:24,000

0 2000' 4000'

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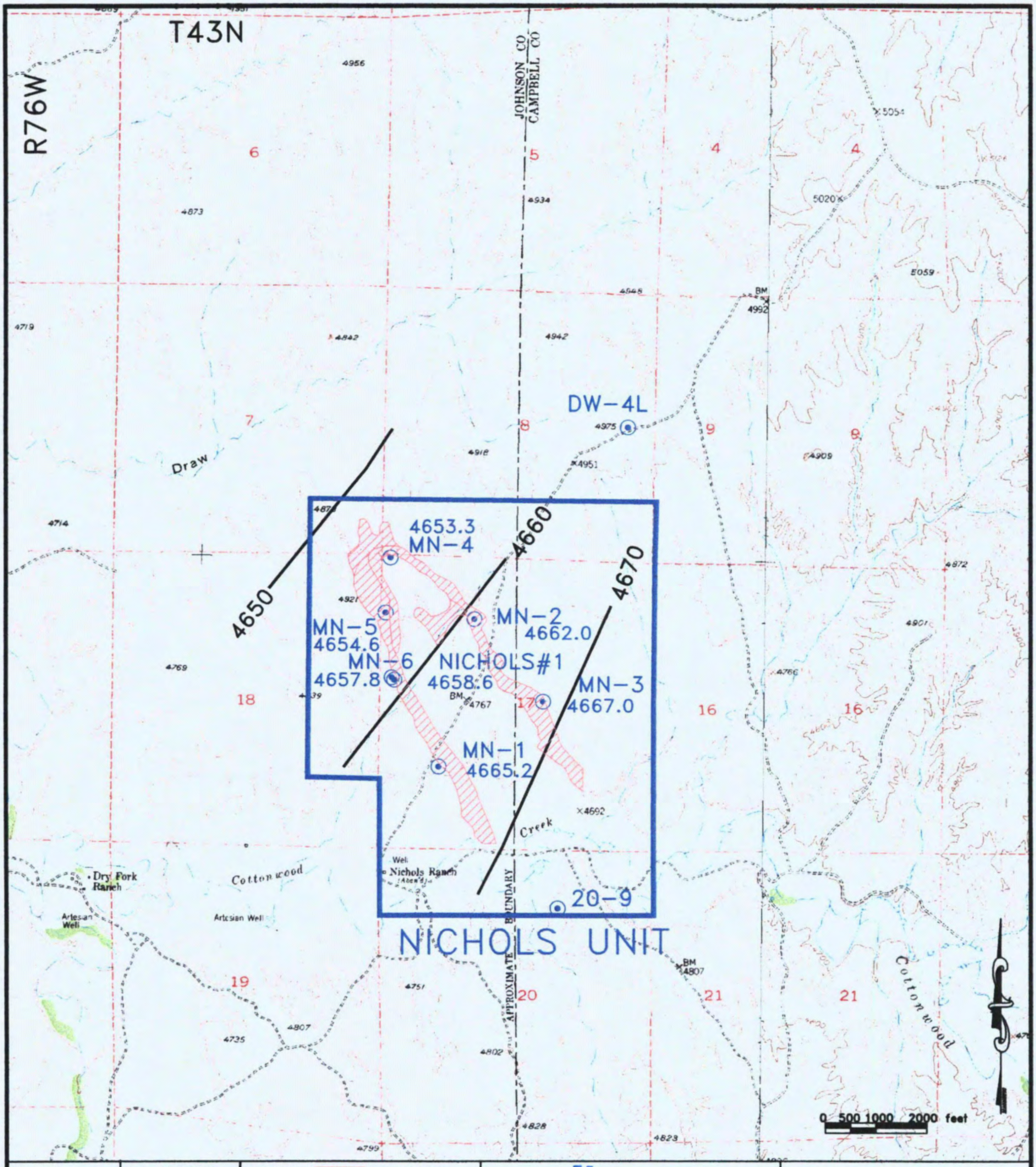
NICHOLS RANCH ISR PROJECT

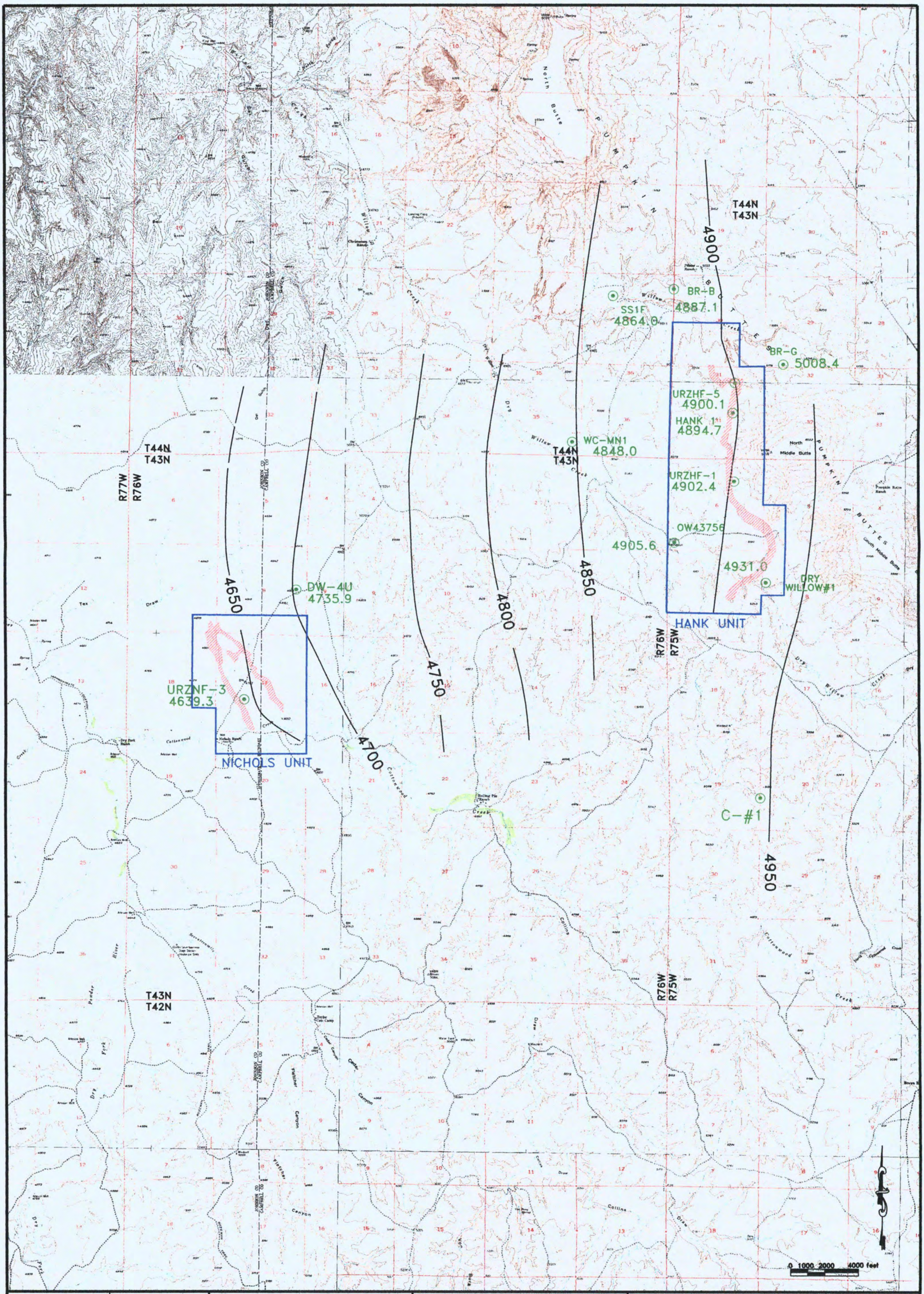
FIGURE 2-18
HANK UNIT
WATER WELLS

By: S.M.F.	Date: OCT. 2, 2007
Datum: NAD27 UTM13	Revision Date:
Scale: 1:24,000	Contour Interval: 20 feet

Dwg: FIGURE D6-4



By: lgrh	Date: 10/15/07	LEGEND: WELLFIELD MN-4 A SAND WELL	Uranerz ENERGY CORPORATION 1701 East "E" Street P.O. Box 50850 Casper, Wyoming USA 82605-0850	FIGURE 2-19. WATER-LEVEL ELEVATIONS FOR THE A SAND AQUIFER, 2007, FT-MSL
Contour Interval:	Revision Date:			
DWG: C:\PROJECTS\2007-14\SANDS lgrh				



By: lgrh	Date: 10/11/07
Contour Interval:	Revision Date:

DWG: C:\PROJECTS\2007-14\SANDS lgrh

LEGEND: WELLFIELD

URZNF-3 F SAND WELL

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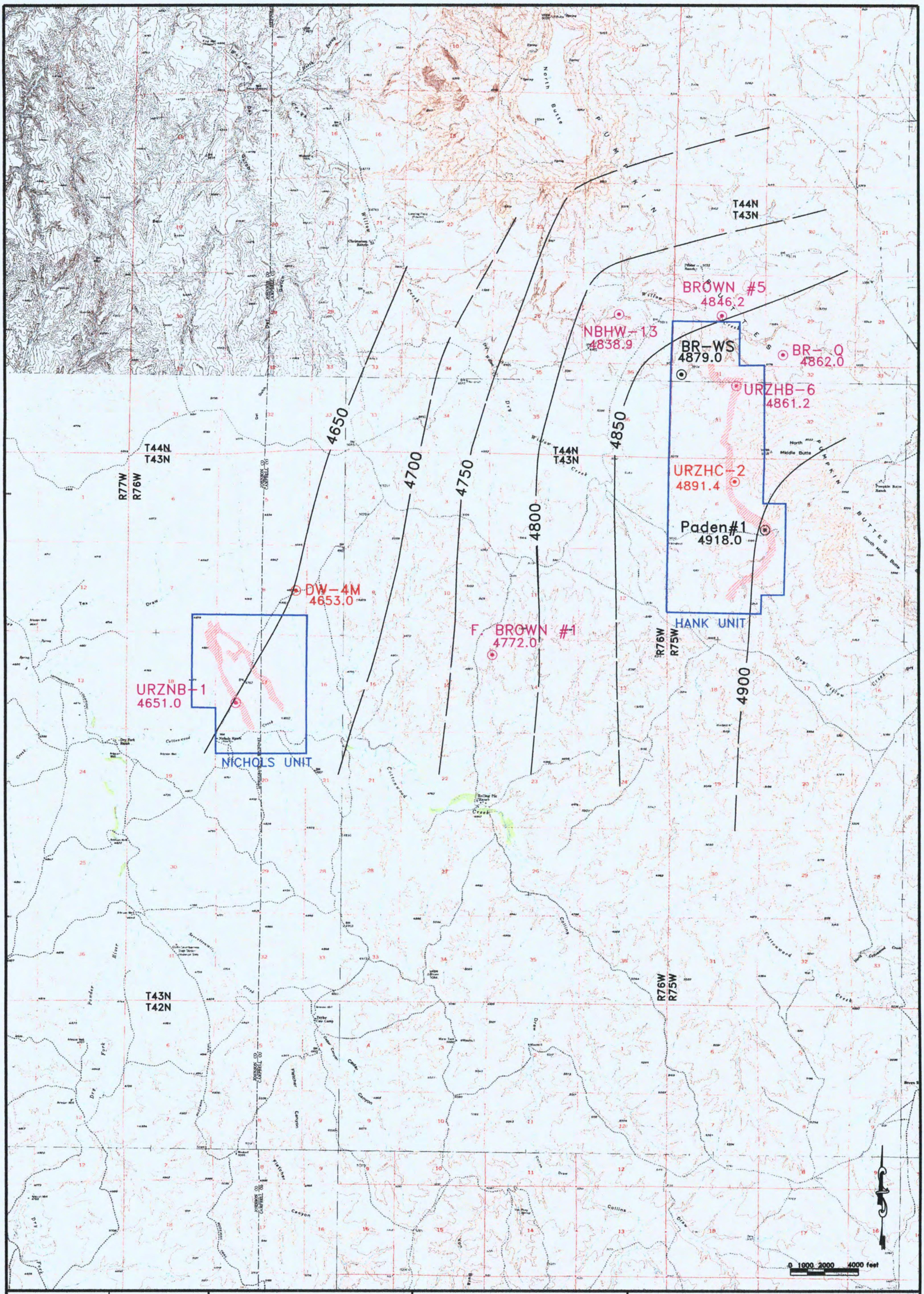
FIGURE 2-20. WATER-LEVEL ELEVATIONS FOR THE F SAND AQUIFER, 2007, FT-MSL



By: lgrh	Date: 10/11/07
Contour Intervdl:	Revision Date:

DWG: C:\PROJECTS\2007-14\SANDS lgrh

LEGEND: WELLFIELD
- URZHC-2 C SAND WELL
- BR-Q B SAND WELL
- PADEN#1 MULTI-AQUIFER, STOCK WELL

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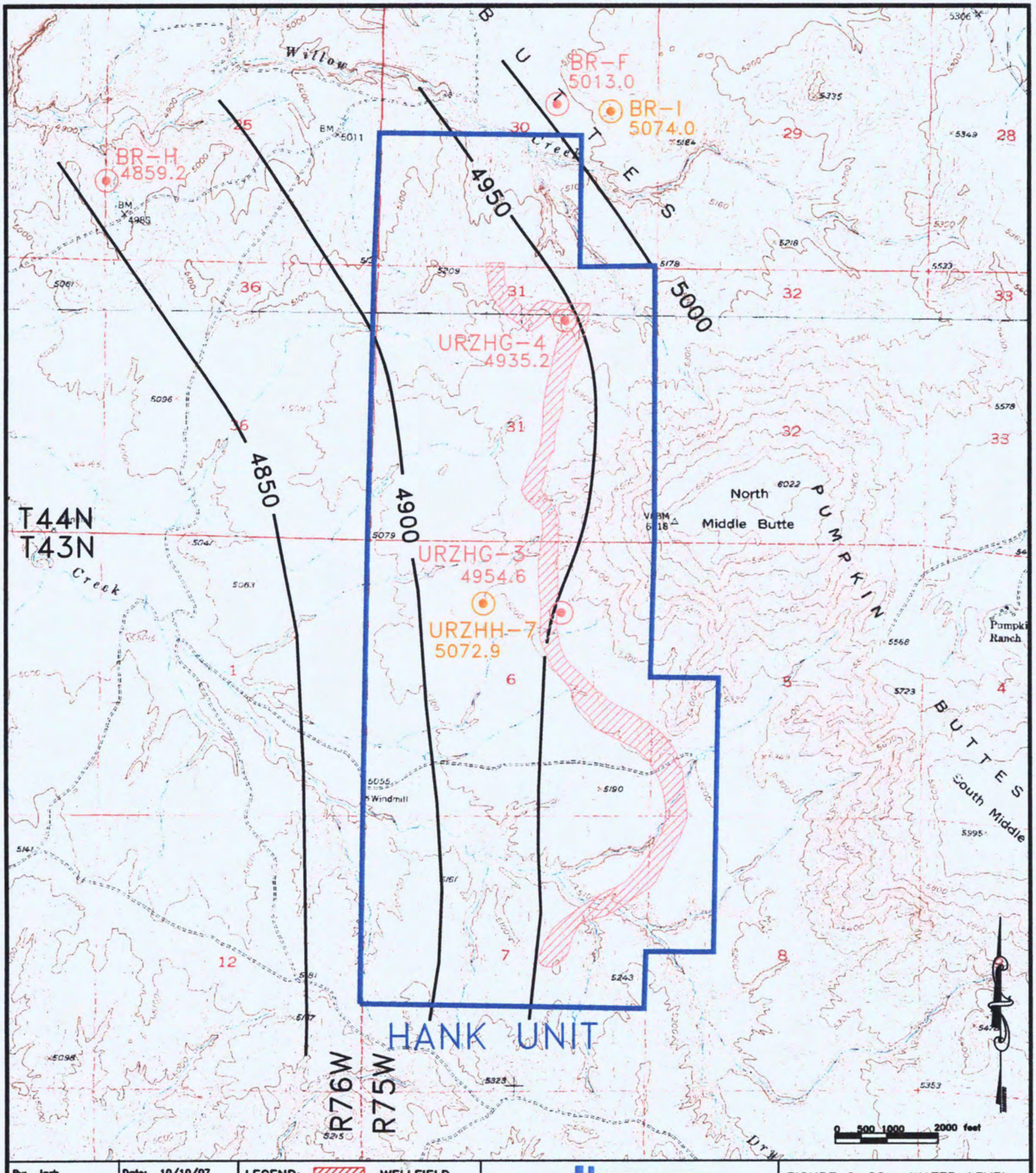
FIGURE 2-21. WATER-LEVEL ELEVATIONS FOR THE B & C SAND AQUIFERS, 2007, FT-MSL



By: lgrh	Date: 10/10/07
Contour Interval:	Revision Date:
DWG: C:\PROJECTS\2007-14\SANDS lgrh	

LEGEND: WELLFIELD
BR-F G SAND WELL
BR-I H SAND WELL

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FIGURE 2-22. WATER-LEVEL ELEVATIONS FOR THE G & H SAND AQUIFERS, 2007, FT-MSL

3.0 DESCRIPTION OF THE FACILITIES

The Nichols Ranch In-Situ Recovery (ISR) Project is divided into two units, the Nichols Ranch Unit and the Hank Unit. The Nichols Ranch Unit encompasses approximately 1,120 acres of land, and the Hank Unit area encompasses approximately 2,250 acres of land. The project units will contain all of the proposed operations. The major surface facilities include the central processing plant, satellite plant, wellfields, and deep disposal wells. The injection and production proposed wellfield and disturbance area for Nichols Ranch Unit will contain approximately 113 acres, and Hank Unit will contain approximately 155 acres. The deep disposal wells will be designed for at least 100 gpm flow rate each and have a maximum injection pressure less than the fracture pressure of the formation.

3.1 IN SITU RECOVERY PROCESS AND EQUIPMENT

Uranerz plans to 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 75 West, Sections 5, 6, 7 and 8) 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-Highland mine in the southern Powder River Basin and is the same method used by COGEMA (AREVA) at the nearby Christensen Ranch site.

The ore zones at the Nichols Ranch Unit and the Hank Unit will be divided into individual production areas where injection and recovery wells will be installed. As typical with the above mentioned commercial operations, the wells will be arranged in 4-spot, 5-spot or 7-spot patterns. In some situations, a line-drive pattern or staggered line-drive pattern may be employed. Horizontal and vertical excursion monitor wells will be installed at each wellfield as dictated by geologic and hydro-geologic parameters, and as approved by the Wyoming Department of Environmental Quality - Land Quality Division and the United States Nuclear Regulatory Commission. The facilities will be constructed according to acceptable engineering practices.

3.2 SITE FACILITIES LAYOUT

The Nichols Ranch Unit will consist of a complete processing plant including auxiliary facilities such as office, change room, laboratory, maintenance and deep disposal well. The processing plant will have the capability of concentrating the wellfield recovery solution obtained from wells installed in the Nichols Ranch Unit ore zone. Figure 3-1 (see map pocket) is a site facility diagram of the Nichols Ranch Unit. This figure shows the location of the major surface facilities.

In addition, the Nichols Ranch Unit processing facility will have excess installed capacity to process uranium loaded resin or yellowcake slurry from the Hank Unit Satellite plant. The accumulated uranium values from both ore zones will then be processed into a dry yellowcake concentrate, packaged in approved 55 gallon steel drums, and trucked off site for conveyance to the licensed uranium conversion facility of choice. At the Hank Unit there will be a plant building, maintenance building, and deep disposal well. A site facility diagram showing the major surface buildings for the Hank Unit is presented in Figure 3-2 (see map pocket).

3.2.1 Nichols Ranch Unit – Central Processing Plant

At the Nichols Ranch Unit processing facility, most of the process equipment will be housed in an approximate 150 x 250 ft metal building with eave heights less than 50 ft. The major process equipment is shown in Figure 3-3 (see map pocket), with some of the bulk chemical storage tanks located outside of the process building. The major equipment inside the process building will be the ion exchange circuit, the lixiviant make-up circuit, the elution/ precipitation circuit, and the yellowcake drying facility. During restoration, the water treatment system for aquifer restoration will also be located in the process building.

The yellowcake drying and drumming facilities will be located at one end of the process building. Due to the height of the dust abatement equipment, the building's eave height is approximately 40 ft at this end. A yellowcake storage area will be located adjacent to the yellowcake drying and packaging area. This will be an enclosed, heated area approximately

60 x 60 ft. By storing the drummed yellowcake within an enclosed area, employee safety will be improved (no snow or ice to work around) and the packaged product will be secured under locked conditions.

An office building, now planned to be approximately 150 x 60 ft, will be located adjacent to the process building. The office will be near the process building to allow use of a centralized lunch room and restroom facilities. In addition to office spaces for professional staff; a central security monitoring room, computer server room and the on-site laboratory will be located in the office building.

A second auxiliary building (maintenance building) will house the vehicle, electrical, and rotating equipment maintenance area, as well as provide an area for additional office spaces for field and operating personnel. The first aid area may be located in the maintenance building.

3.2.2 Hank Unit – Satellite Facility

The Hank Unit Satellite facility will consist of an ion exchange circuit and lixiviant make-up circuit, bleed treatment and disposal well. Most of the process equipment will be housed in an approximate 80 x 160 ft metal building with eave heights less than 40 ft. The process equipment layout is shown in Figure 3-4 (see map pocket) with some of the bulk chemical storage tanks located outside of the process building. Carbon dioxide will be added to the lixiviant as the fluid exits the Hank Unit satellite facility and returns to the header houses where oxygen and/or sodium bicarbonate could be added prior to injection into the wellfield.

3.2.3 Process Description

3.2.3.1 Uranium Recovery

The proposed uranium in-situ recovery (ISR) process has been successfully tested at the Ruth R & D project and at a commercial scale at other uranium ISR extraction properties in Wyoming including the nearby Christensen Ranch Mine. This process, involving the dissolution of the water soluble uranium compound from the mineralized host rock at neutral pH ranges, consists of two steps. First, the uranium is oxidized from the tetravalent to the hexavalent state with an oxidant such as oxygen or hydrogen peroxide. Second, a chemical compound such as a baking soda ($NaHCO_3$) is used to complex the uranium in the solution if needed. The uranium rich solution (typically 20 mg/l to 250 mg/l, but may be higher or lower) is transferred from the production wells to the processing facility nearby for uranium concentration with ion exchange resin. Figure 3-5 (see map pocket) shows a general flow process schematic.

3.2.3.2 Lixiviant Composition

The lixiviant for the in-situ uranium recovery process is a dilute carbonate/ bicarbonate aqueous solution that is fortified with an oxidizing agent. During the injection of lixiviant, oxygen or hydrogen peroxide will be added to oxidize the uranium underground. A small amount of chlorine or sodium hypochlorite, approximately 3 mg/l as chlorine, may be added to the injection solution to prevent bacterial plugging of the injection wells. Carbon dioxide is provided to lower the pH to about neutral. Additionally, carbon dioxide dissolved in water provides another source of the carbonate/ bicarbonate ions. Finally, sodium carbonate/ bicarbonate may be used to adjust the carbonate/ bicarbonate concentration.

The barren solution that leaves the uranium ion exchange system will be refortified with chemicals prior to the re-injection into the ore zone aquifer. The process continues until the economics become unfavorable.

3.2.3.3 Process Plant Circuits

The proposed Nichols Ranch Unit processing plant will have three major solution circuits: 1) the recovery/ extraction circuit, 2) the elution circuit, and typically 3) a yellowcake slurry production circuit. The system is designed to recycle and reuse most of the solutions inside each circuit. A small bleed will be taken from each circuit to prevent buildup of undesirable ions. This bleed solution will be routed to the deep disposal well.

The recovery/extraction circuit includes the flow of lixiviant from the wellfield to the sand filters, or directly to the ion exchange columns and back to the wellfield. The uranium, that is liberated underground, is extracted in the ion exchange system of the process plant. The bleed from the circuit is permanently removed from the lixiviant flow to create a "cone of depression" in the wellfield's static water level and ensure that the lixiviant is contained by the inward movement of groundwater within the designated recovery area. The bleed is disposed of by means of injection into Class I – Non Hazardous approved deep disposal wells. The volume of the concentrated bleed is approximately 0.5% to 1.5% of the circulating lixiviant flow for the Nichols Ranch Unit and 2.5% to 3.5% for the Hank Unit.

The Nichols Ranch Unit elution circuit is designed to release the uranium from the loaded ion exchange resin by applying an aqueous solution of salt and sodium carbonate or sodium bicarbonate to the loaded ion exchange resin. The uranium concentration in the eluate will be built up at a controlled concentration range of between 20 to 40 grams per liter. This uranium rich eluate is ready for the de-carbonation process that occurs in the uranium precipitation circuit.

The yellowcake production circuit starts when the eluate is treated with acid to destroy the carbonate portion of the dissolved uranium complex. In addition to adding the acid slowly, a common defoamer may be used to reduce the foaming activity. The precipitation reagents, hydrogen peroxide and sodium hydroxide, or ammonia are added to the eluate to precipitate uranium yellowcake. The yellowcake slurry is then filtered, washed, dried, and drummed.

A bleed from the elution and the yellowcake precipitation circuits is used to control the concentration of undesirable ions such as sulfates. The chemical strength is refortified during each cycle.

3.2.4 Chemical Reactions

3.2.4.1 Underground Recovery

Oxidation of tetravalent uranium is achieved by using oxygen or hydrogen peroxide. For economic reasons, oxygen is widely used in commercial applications. Uranerz will utilize oxygen as the primary oxidant; however, hydrogen peroxide may be used if needed to increase the oxidation potential in the lixiviant.

The end product of the carbonate/bicarbonate complexing process can be identified as uranyl-dicarbonate, $[UO_2(CO_3)_2]^{2-}$ (UDC), at neutral pH ranges and as uranyl-tricabonate, $[UO_2(CO_3)_3]^{4-}$ (UTC), at more alkaline pH ranges.

The chemical reactions for the alkaline recovery process are listed as follows:

Oxidation:

$$UO_2 + ½\ O_2 = UO_3$$
$$UO_2 + H_2O_2 = UO_3 + H_2O$$

Complexing:

$$UO_3 + 2HCO_3- = [UO_2(CO_3)_2]^{2-} + H_2O$$
$$UO_3 + 2HCO_3- + CO_3- = [UO_2(CO_3)_3]^{4-} + H_2O$$

3.2.4.2 Ion Exchange

A strong base resin will be used for the ion exchange of either the uranyl-dicarbonate complex, $[UO_2(CO_3)_2]^{2-}$ (UDC), or the uranyl-tricarbonate complex, $[UO_2(CO_3)_3]^{4-}$ (UTC), in the process plant.

The chemical reactions are listed as follows:

$$[UO_2(CO_3)_2]^{2-} + R^{2+} = R[UO_2(CO_3)_2]$$
$$[UO_2(CO_3)_3]^{4-} + 2R^{2+} = R_2[UO_2(CO_3)_3]$$

R denotes the active site on the ion exchange resin.

The barren lixiviant will be reconstituted to the proper bicarbonate strength if needed prior to wellfield injection. Sesqui-carbonate, soda ash, and/or carbon dioxide will be used, if needed, to maintain proper sodium bicarbonate strength. Carbon dioxide may also be used to adjust the pH.

3.2.4.3 Elution Process and Resin Handling

The resin is ready for elution when it is fully loaded with uranium. The elution process reverses the loading reactions for the ion exchange resin and strips the uranium from the resin. The eluant will be an aqueous solution containing salt and sodium carbonate and/or sodium bicarbonate.

The chemical reactions are listed as follows:

$$R\,[UO_2(CO_3)_2] = [UO_2(CO_3)_2]^{2-} + R^{2+}$$
$$R_2[UO_2(CO_3)_3] = [UO_2(CO_3)_3]^{4-} + 2R^{2+}$$

The elution circuit at the Nichols Ranch Unit facility will be designed to also accept and elute uranium loaded resin from other satellite operations. A DOT approved trailer will be used to transport the resin to and from satellite facilities. The resin will be hydraulically removed from the trailer and screened to remove formation sand and other debris. Once screened, the resin will flow by gravity into a dedicated elution vessel where the resin will be contacted with eluant.

3.2.4.4 Yellowcake Production

Yellowcake will be produced from the rich eluates that are processed at the Nichols Ranch Unit. The eluate from the elution circuit will be de-carbonated by lowering the pH below 2 with acid. The yellowcake product will be precipitated with hydrogen peroxide and a base such as sodium hydroxide or ammonia.

De-carbonation:

$$[UO_2(CO_3)_2]^{2-} + 4H^+ = UO_2^{2+} + 2CO_2 + 2H_2O$$
$$[UO_2(CO_3)_3]^{4-} + 6H^+ = UO_2^{2+} + 3CO_2 + 3H_2O$$

Precipitation: $UO_2^{2+} + H_2O_2 + 4H_2O = UO_4{\cdot}4H_2O + 2H^+$

The precipitated yellowcake slurry will be transferred to a filter where excess liquid will be removed. Following a fresh water wash step that will flush the dissolved chlorides, the resulting product cake will be transferred to the yellowcake dryer which further reduces the moisture content, yielding the final dried free flowing product.

The yellowcake drier will operate under a vacuum. The use of vacuum conditions lowers the temperature at which the yellowcake solids are dried (typically 165 F to 190 F). At these temperatures, water soluble uranium oxides and other compounds are not formed. In addition, the vacuum draws solids and water vapor toward the system's interior preventing unwanted dust releases. This type of dryer is the same design that has been successfully used by Power Resources Inc. (PRI) at the Smith-Highland mine in the southern Powder River Basin.

3.2.5 Flow and Material Balance

The ion exchange system for the Nichols Ranch Unit is designed to accommodate flow rates up to 3,500 GPM. In order to contain the lixiviant within the designated wellfield recovery area, a small portion of the barren solution is withdrawn from the ion exchange circuit. The amount of bleed is estimated to be in the average range of 1% of the overall flow rate or equivalent to about 35 GPM.

The ion exchange system for the Hank Unit is designed for flow rates up to 2,500 GPM. The average bleed rate for Hank Unit is estimated to be 3% or equivalent to about 75 GPM. The bleed rate estimates are discussed in detail in Section 3.4.8 of this Chapter.

The bleed solution is to be used to rinse and clean-up freshly eluted resin, make-up fresh eluant in the elution circuit, back wash sand filters, and wash yellowcake if necessary. A flow and material balance for the two Units is presented nominally in Figure 3-6 (see map pocket). The flow shown is an example capacity for the facilities and does not represent any design or regulatory limits. A water balance is shown in Figure 3-7 (see map pocket).

3.2.6 Sources of Plant Liquid Effluents and Disposal Methods

Liquid effluents are expected to be generated from well development water, pumping test water, process bleed, process solutions, wash-down water, and restoration water. The water generated during well development and pumping tests is expected to satisfy WDEQ-WDQ Class IV (Livestock) standards at a minimum and has minimal potential radiological impact on soils or surface water. No alternate handling or disposal method is required allowing water to be pumped onto the ground.

The process bleed and wash down water will be transferred to a deep disposal well. This deep disposal well will be equivalent in design and depth to existing deep disposal wells at similar *in situ* uranium recovery sites. This deep disposal well will be permitted through the WDEQ and operated according to permit requirements.

The restoration water will be treated by reverse osmosis or other purification technology. The treated restoration water will be re-injected into the process with the restoration water bleed transferred to the deep disposal well.

Uranerz plans to use two Type I – Non Hazardous deep disposal wells. One of the deep disposal wells will be located at the Nichols Ranch Unit and one will be located at the Hank Unit. As required, the disposal wells will be completed in approved formations. A typical deep disposal well is depicted in Figure 3-8 (see map pocket).

For the Nichols Ranch Unit there are three types of liquid effluent that will constitute the bleed that can be up to 35 GPM: 1) the wellfield bleed, 2) the elution circuit bleed, and 3) the general plant waste (resin wash, filter backwash, etc). A small quantity of water, about 1 to 2 GPM, may be introduced from a permitted water well for plant wash down and yellowcake wash.

Nichols Ranch Unit 1% Bleed

Production Only

Deep Disposal Well (DDW) Flow	+100	GPM
Production Flow to DDW	(-)40	GPM
Other	(-)1-2	GPM
Remaining Balance	+58	GPM

Production and Restoration

Deep Disposal Well (DDW) Flow	+100	GPM
Production Flow to DDW	(-)40	GPM
Restoration Flow to DDW	(-)57	GPM
Other	(-)1-2	GPM
Remaining Balance	+1	GPM

Restoration Only

Deep Disposal Well (DDW) Flow	+100	GPM
Restoration Flow to DDW	(-)90	GPM
Other	(-)1-2	GPM
Remaining Balance	+8	GPM

Hank Unit 3% Bleed

Production Only

Deep Disposal Well (DDW) Flow	+100	GPM
Production Flow to DDW	(-)75	GPM
Other	(-)1-2	GPM
Remaining Balance	+23	GPM

Production and Restoration

Deep Disposal Well (DDW) Flow	+100	GPM
Production Flow to DDW	(-)75	GPM
Restoration Flow to DDW	(-)22	GPM
Other	(-)1-2	GPM
Remaining Balance	+1	GPM

Restoration Only

Deep Disposal Well (DDW) Flow	+100	GPM
Restoration Flow to DDW	(-)90	GPM
Other	(-)1-2	GPM
Remaining Balance	+8	GPM

For the restoration operation, reverse osmosis or other purification technologies will be used to treat the recovery solution from the spent production areas. The groundwater restoration plan is discussed in detail in Chapter 6.0. For a typical restoration schedule, the anticipated liquid effluent flow rates are:

Pore Volume	Gross Water Withdrawn	Net Water Consumption
1st	50 GPM	50 GPM
2nd to 5th	200 GPM	50 GPM
6th	50 GPM	50 GPM

The average annual net water consumption from the ore zone aquifer during restoration activities is anticipated to be approximately 50 GPM.

The potential effluents that will need to be controlled for the Nichols Ranch ISR Project include radon, radioactive particulates in air, and radionuclides in liquid streams. The effluent control for gaseous and airborn particulates and liquid and solid wastes are discussed in detail in Chapter 4.0. For solid waste Uranerz will obtain an agreement with a licensed and approved 11e.(2) by product disposal facility. Uranerz will notify the NRC in writing within 7 days if the agreement expires or is terminated, and Uranerz will submit a new agreement for NRC approval within 90 days of the expiration of the termination. Uranerz plans to have readily available the most current safety equipment and personal protective equipment at the Nichols Ranch Unit and Hank Unit.

3.3 CHEMICAL STORAGE FACILITIES

Uranerz plans to use chemicals to extract uranium, process waste water, and restore groundwater. The Nichols Ranch Unit and the Hank Unit will store chemicals that are both hazardous and non hazardous. The different types of chemicals will be stored in separate locations. Any bulk hazardous materials that could impact the radiological safety of the facility will be isolated and stored in accordance with regulatory agency requirements. Chemicals that are considered nonhazardous and will not affect radiological safety can be stored inside the main buildings. A list of possible chemicals to be used at the facilities include: hydrochloric acid, hydrogen peroxide, sodium chloride, sodium hydroxide, sodium hypochlorite, ammonia, oxygen, carbon dioxide, sodium carbonate, and sodium bicarbonate. Material Safety Data Sheets (MSDS) for each of the chemicals will be reviewed for facility safety and for radiological effects and the sheets will be located at the Nichols Ranch Unit and the Hank Unit.

3.3.1 Process Related Chemicals

Chemicals that are considered hazardous and have the potential to effect radiological safety are ammonia (pH adjustment), hydrogen peroxide (uranium precipitation and oxidant in lixiviant), and hydrochloric acid (pH adjustment). These chemicals will be located outside of the main processing building. They will be separated from inside the process area until their addition point. The outside storage location may have a concrete curbed secondary containment basin for the tanks.

Oxygen (oxidant in lixiviant), sodium hydroxide (pH adjustment), sodium hypochlorite, carbon dioxide (carbonate complexing), sodium carbonate/bicarbonate (carbonate complexing and resin regeneration), and sodium chloride (resin regeneration) are the other bulk chemicals used for processing the uranium. The carbon dioxide is typically stored outside and is added to the lixiviant before the flow leaves the ion exchange facilities. Oxygen can also be stored centrally so that it can be added to the injection stream in each header house or if necessary the oxygen can be added down hole with individual spargers. The sodium hydroxide, sodium carbonate/bicarbonate, and sodium chloride will be stored inside the main processing plant near the point of addition.

Chemicals that could be located at the Nichols Ranch Unit include: hydrochloric acid, hydrogen peroxide, sodium chloride, sodium hydroxide, sodium hypochlorite, ammonia, oxygen, carbon dioxide, sodium carbonate, and sodium bicarbonate. Chemicals that could be located at the Hank Unit include: oxygen, sodium bicarbonate and carbon dioxide. During groundwater restoration activities, hydrochloric acid may be located at the Hank Unit. The hydrochloric acid will be located in a secondary containment basin. Sodium carbonate and/or sodium bicarbonate could be located at the Hank Unit for leaching. Figures 3-1 and 3-2 (see map pocket) show the storage locations of chemicals for the Nichols Ranch Unit and the Hank Unit, respectively.

Standards for transporting, handling, storing, and managing hazardous chemicals have been developed by regulatory agencies. In reviewing the on site chemicals, anhydrous ammonia is likely to be the most hazardous chemical with the greatest impact to chemical safety. Uranerz may use sodium hydroxide or ammonia. If ammonia is used, the ammonia system at the Nichols Ranch Unit will be reviewed and follow accepted Environmental Protection Agency (EPA) regulations for on site quantities. To prevent unintentional releases of hazardous chemicals and limit potential impacts to the public and environment, the Risk Management Program (RMP) regulations require facilities to comply with certain actions. The actions include accidental release modeling, documentation of safety information, hazard reviews, operating procedures, safety training, and emergency response preparedness. Uranerz will comply with the RMP regulations if on-site quantities of anhydrous ammonia require such actions.

3.3.2 Nonprocess Related Chemicals

Chemicals that are nonprocess related materials are stored at the Nichols Ranch Unit and the Hank Unit. The materials include gasoline, diesel and propane. Since these materials are considered flammable and/or combustible, the bulk quantities are stored outside of the main buildings. The storage tanks are located above ground and within secondary containment basins in compliance with local code.

3.4 WELLFIELDS

3.4.1 Ore Zone

The ore zones for the Nichols Ranch Unit are 300-700 ft below the surface and occur in two long narrow trends meeting at the nose. The nose is the northwest corner of the ore zone where the two narrow trends meet to form the tip of the geochemical front. The Hank Unit's ore zones are approximately 200-600 ft below the surface. The depths of the two units depend on the topography, the changes in the levels of the formation and the stratigraphic horizon. The host sand for the Nichols Ranch Unit is designated as the A Sand and the Hank Unit host sand is designated as the F Sand. The average grade of the two units is above 0.1%, the average thickness is above seven feet, and the combined areal distribution is near 100 acres.

3.4.2 Wellfield Areas

Wellfields are designated areas above the ore zone that are sized to reach the desired production goals. The ore zone is the geological sandstone unit where the leaching solutions are injected and recovered in an in situ recovery wellfield and it is bounded between impermeable aquatards. Production areas are the individual areas that will be mined in the wellfield. The injection and recovery wells are completed in the ore zone intervals of the production sand. Horizontal monitor wells are located in a ring around the wellfields. Vertical monitor wells for overlaying and underlying aquifers are installed accordingly for one monitor well for every 4 acres of wellfield area. The distance between the monitor wells in the same aquifer shall not exceed 1,000 ft, and all monitor wells are installed within the production area unit. The final locations of the horizontal and vertical monitor wells will be submitted in the Production Area Pump Test Document as described in Section 5.7.8. This is because the actual locations might need to be changed because of topography, access, etc. The screened intervals for the excursion monitor wells are across the entire production zone.

3.4.3 Wellfield Injection and Recovery Patterns

The patterns for the injection and recovery wells follow the conventional 5-spot pattern. Depending on the ore zone shape, 7-spot or line drive patterns may be used. A typical 5-spot pattern is shown in Figure 3-9 (see map pocket) and contains 4 injection wells and 1 recovery well. The dimensions of the pattern vary depending on the ore zone, but the injection wells will likely be between 50 and 150 ft apart. In order to effectively recover the uranium and also to complete the groundwater restoration, the wells will be completed so that they can be used as either injection or recovery wells. The leaching solution will be injected into the injection wells, and the solution will be recovered through the recovery wells. To create a cone of depression in the wellfield, a greater volume of water is recovered than injected. The excess water or wellfield bleed will be disposed of in a Class I deep disposal well. With the cone of depression being created, the natural groundwater movement from the surrounding areas is toward the wellfield providing an additional control of the leaching solution.

Wellfield bleed is defined as the difference between the amount of solution injected and produced. The bleed rate is anticipated to average 1% of the total production rate for the Nichols Ranch Unit and up to 3% for the Hank Unit. Over- production can be adjusted to guarantee the horizontal ore zone monitor wells are influenced by the cone of depression from the wellfield bleed.

Depending on the oxidation requirement of the formation, the injection wells may be equipped with down-hole oxygen spargers with oxygen being metered through individual rotometers so that each well can be controlled as to the amount of oxygen concentration it receives, or a header house oxygen manifold distributor will be installed. Header houses are small buildings that contain the manifolds that connect to the individual injection and recovery wells. The header houses will contain the electrical closures, flow metering, possible oxygen rotometers, and/or sock injection filtration.

The pipelines transport the wellfield solutions to and from the ion exchange columns. The flow rates and pressures are monitored to the individual lines. Automatic valves are installed for control of the flow. High density polyethylene (HDPE), Polyvinyl chloride (PVC), and/or stainless steel piping are used in the wellfield. The piping will be designed for operating pressure of 150 psig. However, the equipment will be operated at pressures less than or equal to the designed piping and other equipment ratings. If higher operating pressures are needed, the overall system will be evaluated and materials of construction with appropriate pressure ratings will be used.

Some of the lines from the ion exchanges facilities, header houses, and individual well lines may be buried to prevent freezing. Other ISR sites in Wyoming have successfully buried pipelines to protect them from freezing.

3.4.4 Wellfield Operations – Production Areas

To plan production, develop extraction schedules, establish baseline data, comply with monitoring requirements and complete restoration, the Nichols Ranch Unit will be divided into two production areas. The Nichols Ranch Unit contains the central processing plant with two production areas, NR Production Area #1 and NR Production Area #2. As the productivity or head grade of some patterns for the NR Production Area #1 decrease below the economic limit, replacement patterns for the NR Production Area #2 will be placed into operation in order to maintain the desired flow rate and head grade to the processing plant. Eventually, all the patterns in NR Production Area #1 will reach their economic limit and all production flow in that area will cease. At that time, all production flow will be coming from NR Production Area #2, and restoration activities will commence at NR Production Area #1. Figure 3-10 (see map pocket) shows the two Production Areas for Nichols Ranch. A characteristic flow rate for each of the two Nichols Ranch Unit Production Areas will range from 1,000-3,500 gallons per minute (GPM).

The Hank Unit is a remote satellite facility with two production areas, Hank Production Area #1 and Hank Production Area #2. The Hank Production Areas will follow a similar developmental, production, and restoration schedule as outlined in the above section for the Nichols Ranch Production Areas. The two Hank Production Areas are shown in Figure 3-11 (see map pocket). A characteristic flow rate for each of the Hank Unit Production Areas will range from 1,000-2,500 (GPM).

A Gantt chart showing Nichols Ranch and Hank Production Areas is shown in Figure 3-12 (see map pocket). The chart shows the proposed plan for production, groundwater restoration, and decommissioning of each production area. However, the plan is subject to change due to extraction schedules, variations with production area recoveries, production plant issues, economic conditions, etc. The exact annual extraction schedules will be updated in the Annual report to the WDEQ. The proposed plan incorporates an adequate water balance calculations so that the deep disposal well can process the proposed production and restoration efforts at any given time.

After each production area is completed, aquifer restoration will begin as soon as practical. If a completed production area is near a unit that is currently being mined, a portion of the first production area's restoration may be delayed to limit interference with the current extraction production area. The exact production area size and location may change based on the final delineation results of the ore zone and the actual production performance of the particular ore zone.

3.4.5 Well Completion

Pilot holes for monitor, production, and injection wells are drilled through the target completion interval with a small rotary drilling unit using native mud and a small amount of commercial drilling fluid additive for viscosity control. The hole is logged, reamed, casing set, and cemented to isolate the completion interval from all other aquifers. The cement will be placed by pumping it down the casing and forcing it out the bottom of the casing and back up the casing-drill hole annulus. The drill holes will be large enough in diameter for adequate sealing and, at any given depth, at least three inches greater in nominal diameter than the diameter of the outer casing at that depth.

Typical well completion schematics for production wells (recovery and injection wells), and monitor wells are shown on Figures 3-13 (see map pocket) and 3-14 (see map pocket), respectively. The well casing will be fiberglass, PVC, or HDPE. The fiberglass casing has a standard joint length of 30 ft and is rated for at least 950 pounds per square inch operating pressure. PVC well casing is typically 4 to 6 inches in diameter and SDR·17 to SDR·26 (or equivalent). The PVC casing joints normally have a length of approximately 20 ft each. When PVC casing is used, each joint is connected by a water tight o-ring seal.

Casing centralizers, located approximately every 40 ft along the casing, are normally placed around the casing to ensure it is centered in the drill hole. Effective sealing materials shall consist of neat cement slurry and/or sand-cement grout meeting Wyoming State requirements described in Section 6, Chapter 11 of the LQD Non Coal Rules and Regulations unless a variance is obtained from the LQD Administrator. The purpose of the cement is to stabilize and strengthen the casing and plug the annulus of the hole to prevent vertical migration of solutions. If needed, the upper portion of the annulus will be cemented from the surface to stabilize the wellhead. This procedure is called "topping off". Tremie pipes can be used to top off a well.

After the well is cemented and the cement has set, the well is under reamed in the mineralized zone and completed either as an open hole or it is fitted with a screen assembly (slotted liner), which may have a sand filter pack installed between the screen and the under reamed formation. The well may then be air lifted for 30 minutes or more to remove any remaining drilling mud and/or cuttings. A submersible pump or small trailer mounted air compressor may be run in the well for final cleanup and/or sampling.

3.4.6 Well Casing Integrity

After an injection or recovery well has been completed, and before it is made operational, a Mechanical Integrity Test (MIT) of the well casing is conducted. For the integrity test, the bottom of the casing adjacent to or below the confining layer above the production zone is sealed with a plug, down hole packer, or other suitable device. The top of the casing is then sealed in a similar manner or with a sealed cap, and a pressure gauge is installed to monitor the pressure inside the casing. The pressure in the sealed casing is then increased to 125% of the maximum operating wellhead casing pressure. A well is considered satisfactory if a pressure drop of less than 10% occurs over one hour. A second procedure that uses a 5% pressure drop over 30 minutes may also be used.

If there are obvious leaks, or the pressure drops by more than 10% during the 60 minute period, or equivalent period, the seals and fittings will be reset and/or checked and another test is conducted. If the pressure drops less than 10% the well casing is considered to have demonstrated acceptable mechanical integrity.

The results of the MITs conducted during a quarter are documented on a quarterly bases to include the well designation, date of the test, method by which the MIT was completed, verification of whether the MIT was or was not established, test duration, beginning and ending pressures, and the signature of the individual responsible for conducting the test. Results of the MITs are maintained on site and are available for inspection by NRC and WDEQ personnel. In accordance with regulatory requirements the results of MITs are reported to the WDEQ on a quarterly basis for those wells that were tested. In accordance with WDEQ and EPA requirements, MITs are repeated once every five (5) years for all wells used for injection of lixiviant, or injection of fluids for restoration operations.

If a well casing does not meet the MIT criteria, the well will be placed out of service and the casing may be repaired and the well re-tested or abandoned. If a repaired well passes the MIT, it will be employed in its intended service. If an acceptable test cannot be obtained after repairs, the well will be plugged and abandoned. The WDEQ-LQD Administration will be notified in the quarterly report of wells that fail the MIT. In the quarterly report the following is required: the identification of the failed well, a description of the method of plugging or repair, a status of the corrective actions on defective wells, the results of well plugging or repair, statements that the wells were plugged according to the approved permit and that the volume of material used for plugging equals the volume of material placed in the well.

During wellfield operations, injection pressure at the injection well heads will not exceed 90% of the mechanical integrity test pressure. Injection wells will not be used for injection purposes if they do not demonstrate mechanical integrity. Additionally, a MIT will be conducted on any well to be used for injection purposes after any well repair where a down hole drill bit or under reaming tool is used. Any injection well with evidence of suspected subsurface damage will require a new MIT prior to the well being returned to service.

3.4.7 Monitoring of Wellfield Flow and Pressure

Injection well and recovery well flow rates and pressures are monitored in order that injection and recovery can be balanced for each pattern and the entire production area. Recovery flow rates will always be greater than injection rates. This flow information is also needed for assessing operational conditions and mineral royalties. The volume of fluid for each recovery and injection well is determined by monitoring individual flow meters in each production areas header houses. Recovery well volumes are determined on a daily basis. More details on the instrumentation are given in a following Section 3.5.

3.4.8 Monitor Well Ring Gradient Reversal

An analytical simulation of the gradient reversal was conducted with the use of the Theis well flow equation, and a program by Walton (1989), which is called "WELFLO". This program sums the drawdowns from numerous stresses over a grid. The critical location for the gradient reversal at Nichols Ranch Unit is to the northwest in the downgradient direction. The wellfield orientation extends in this direction and therefore, the drawdowns for the northwestern portion of the wellfield were calculated to evaluate the gradient reversal. Figure 3-15 (see map pocket) shows the location of 73 recovery wells in the northwestern end of the number one wellfield. Additional stresses were lumped together and placed at 15 locations over the remainder with the wellfield, which extends an additional length of 4,800 ft to the southeast of these 73 stresses. This accounts for the entire stress from the wellfield with distribution of the stresses over the area. The bleed rate was applied to each of the recovery wells to simulate the net withdrawal of water from the A Sand aquifer.

An average transmissivity of 350 gal/day/ft and a storage coefficient of 1.8E-4 were used to simulate the drawdowns resulting from the bleed of the Nichols Ranch Unit Production Areas. A stress of 0.155 gpm was applied to each of the 73 recovery wells shown in the northern portion of the production area. The lumped bleed rates for the remaining 15 stresses varied from 0.93 to 2.48 gpm for a total bleed of 23.7 gpm from the additional stresses. The simulation period was one year to allow definition of the gradient reversals after a significant period of operation. T he cumulative drawdown was calculated at each of the nodes. The differences between the 100 ft node drawdowns to the northwest (ground water gradient direction) are shown on Figure 3-15 (see map pocket).

This simulated bleed rate was 1% of the overall flow and the distance between adjacent nodes on the diagonal is 141 ft. In the northwest direction, a simulated head difference between adjacent nodes that is greater that 0.47 ft indicates gradient reversal toward the wellfield. The northwest corner of the model grid is approximately 1,100 ft from the northwest edge of the wellfield, and the simulated head difference between adjacent nodes in the northwest corner of the model grid is much greater than 0.47 ft. Hence, the operation of the Nichols Ranch Unit Production Areas at a bleed of 1% will result in gradient reversal to the wellfield at a distance much greater than 1,100 ft from the northwest edge of the wellfield. A horizontal monitoring ring that is located 500 ft from the perimeter of the Nichols Ranch Unit Production Areas is within the zone of gradient reversal and will be adequate for detection of potential excursions from the Production Areas. These monitoring wells will also be spaced 500 ft from each other.

The magnitude of this simulated gradient reversal shows that the maintenance of a reversal zone in the confined aquifer at the Nichols Ranch Unit is readily achievable, and adjustments in local wellfield balance can be used to quickly induce reversal in the event of excursions.

The groundwater gradient at the Hank Unit site is 0.005 ft/ft to the west. Seventy one wells in the southern end of the Hank Unit Production Area #1 were used to simulate the composite drawdown response for the Hank Units at a rate of 0.426 gpm per well. Aquifer properties used in the simulation were a transmissivity of 400 gal/day/ft and a specific yield of 0.05. A simulation period of 365 days was also used for the Hank Unit Production Areas. The Hank Unit Production Areas are planned for a 2,500 gpm production rate and a 3% bleed was used in this simulation. This resulted in a stress at the seventy one recovery wells of 0.426 gpm. An additional nine stresses were used to simulate the remaining 105 wells in the northern portion of the wellfield with varying stresses from 3.41 to 7.24 gpm for a total additional stress of 44.74 gpm for the northern wells. The total stress rate was 75 gpm.

Figure 3-16 (see map pocket)shows the results of the gradient reversal for the Hank Unit. The head change between the 100 ft nodes is shown on this figure to the left of the 71 recovery stresses. An additional drawdown of 0.5 ft is needed to create gradient reversal toward the wellfield. Horizontal monitoring ring distance for this unconfined aquifer will be adequate at a distance of 500 ft from the wellfield perimeter with a 3% bleed rate for the Hank Unit. A spacing of 500 ft between the monitoring ring wells is also proposed for the Hank Unit.

An additional simulation was conducted on the gradient reversals for the Hank Unit. The second simulation was the same as presented above except that the net extraction from the nine southern recovery wells in the production area were increased by a total of 5 gpm, which increases the overall wellfield bleed from 3% to 3.2%. The individual bleed rate for these nine wells was 0.982 gpm instead of the 0.462 gpm used in the first Hank Unit simulation. This small localized increase in the bleed rate caused the reversal to increase by greater than 60% at a distance of 500 ft from the production area. The second simulation shows that small local adjustments in the bleed rate can be used to expand the local zone of reversal and prevent or retrieve an excursion in a particular area for the Hank Unit.

This analysis provides the impacts that in situ recovery operations might have on surrounding groundwater. The surface pathways that might transport extraction solutions offsite include the Cottonwood Drainage and Tex Draw for the Nichols Ranch Unit and the Dry Willow and Willow Creek Drainage for the Hank Unit. The expected post-extraction impacts on geochemical properties and water quality are discussed in the Restoration Chapter, Chapter 6.0. The flood and flood velocities are provided in Appendix D6-1.

3.5 PLANT EQUIPMENT, INSTRUMENTATION, AND CONTROL

The plant equipment at the proposed facilities will consist of standard design, construction, and materials for uranium in-situ recovery extraction. Uranerz plans to install automated devices within the plant circuits to assist the operators with their coverage and reduce the number of operators required for successful coverage. Most of the automated devices will be pre-programmed to control operating parameters and the process information will be recorded. The automated systems will include alarms and shutoffs to prevent overflow and overpressure situations and provide centralized monitoring of the process variables.

The central processing plant, satellite plant, production circuits, wellfields, header houses, lines from the wellfield to the plant, and the deep disposal well will have instrumentation. The control system will have continuous monitoring, and alarms that are set when operating parameters are outside of the specified operating ranges. The alarms signal the operators to proceed with corrective actions until the parameter is back within specific ranges. Extreme tank levels or pressures will activate automatic shutdown of equipment for that area. The header houses, pipelines, and deep disposal wells are the sources of greatest risk for large spills and will have high and low pressure, and flow alarms for automatic shutdown of related equipment.

The total plant flow, total waste flow leaving the plant, and tank levels will be monitored. There will also be a low vacuum alarm for the dyer that will indicate either corrective action or automatic shut down. Manufacture's recommendations for the operating and maintenance of the dryer will be followed and recorded according to 10 CFR Part 40, Appendix A, Criterion 8. The critical systems will be equipped with back up systems that are automatically activated in a power failure or operating failure. The wellfield flows and pressures may be continually recorded, but at a minimum once a day recordings. The pressures will be kept under casing and formation rupture pressures.

The Uranerz Standard Operating Procedures (SOP) will address alarm responses, automatic shutdowns, and start up after automatic shutdowns. The SOP at both the Nichols Ranch Unit and Hank Unit facilities are designed to minimize the risks of uncontrolled releases of leaching fluids, chemicals, and plant fluids, and provide the maximum safety and protection to the environment and personnel.

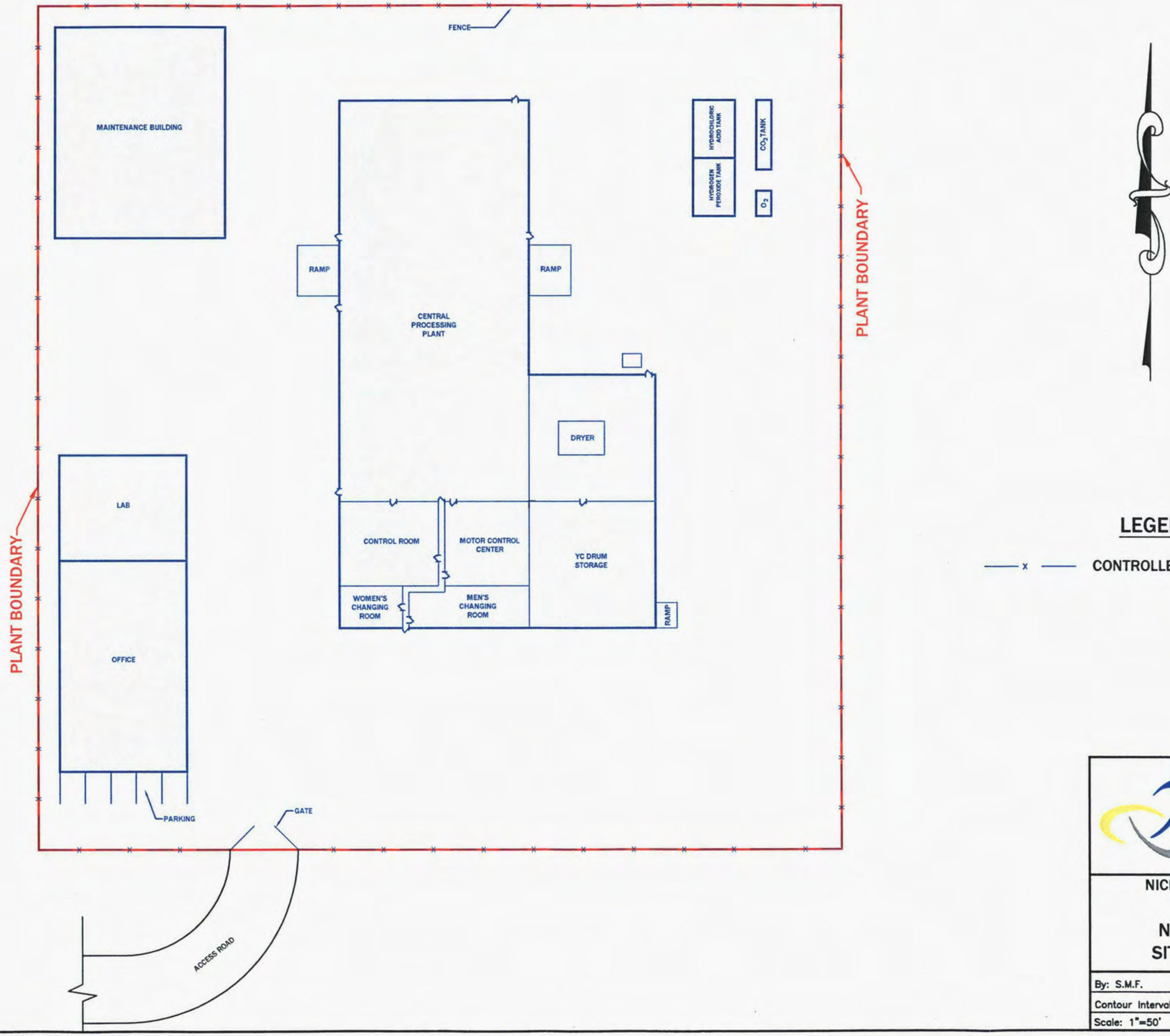
In the event that a spill occurs in the wellfield or process plants, measures will be taken to safely and quickly contain the spill and mitigate the impacts of any released material. Proper notification of plant and corporate management will be made along with properly contacting the NRC and State if applicable.

Spills are likely to occur from leaking pipelines and fittings. If a pipeline leak or spill occurs in the plants, the spill or leak will be contained within the building with all spilled material collected in the plant sump. This material will either be pumped backed into the process or sent to the deep disposal well.

Wellfield spills will be contained as soon as possible. The area of the spill will be surveyed to identify any contaminated areas and then cleaned up and removed for disposal according to NRC and State regulations.

If any process vessels or tanks that contain or have contained radioactive materials have to be entered for any reason such as cleaning, inspection, or repairs, a radiation work permit (RWP) will be issued detailing the requirements for special air sampling, protective equipment, and increased exposure surveillance.

To notify operating personnel of potential issues with process and wellfield operations, instrumentation such as flow meters and pressure indicators will be used. If any process condition falls out of the normal operating range, audible and visual alarms will sound notifying employees of potential plant problems. The alarm notification will aid in reducing the severity of any potential spills that might occur.



LEGEND

—— x —— CONTROLLED ACCESS AREA FENCE

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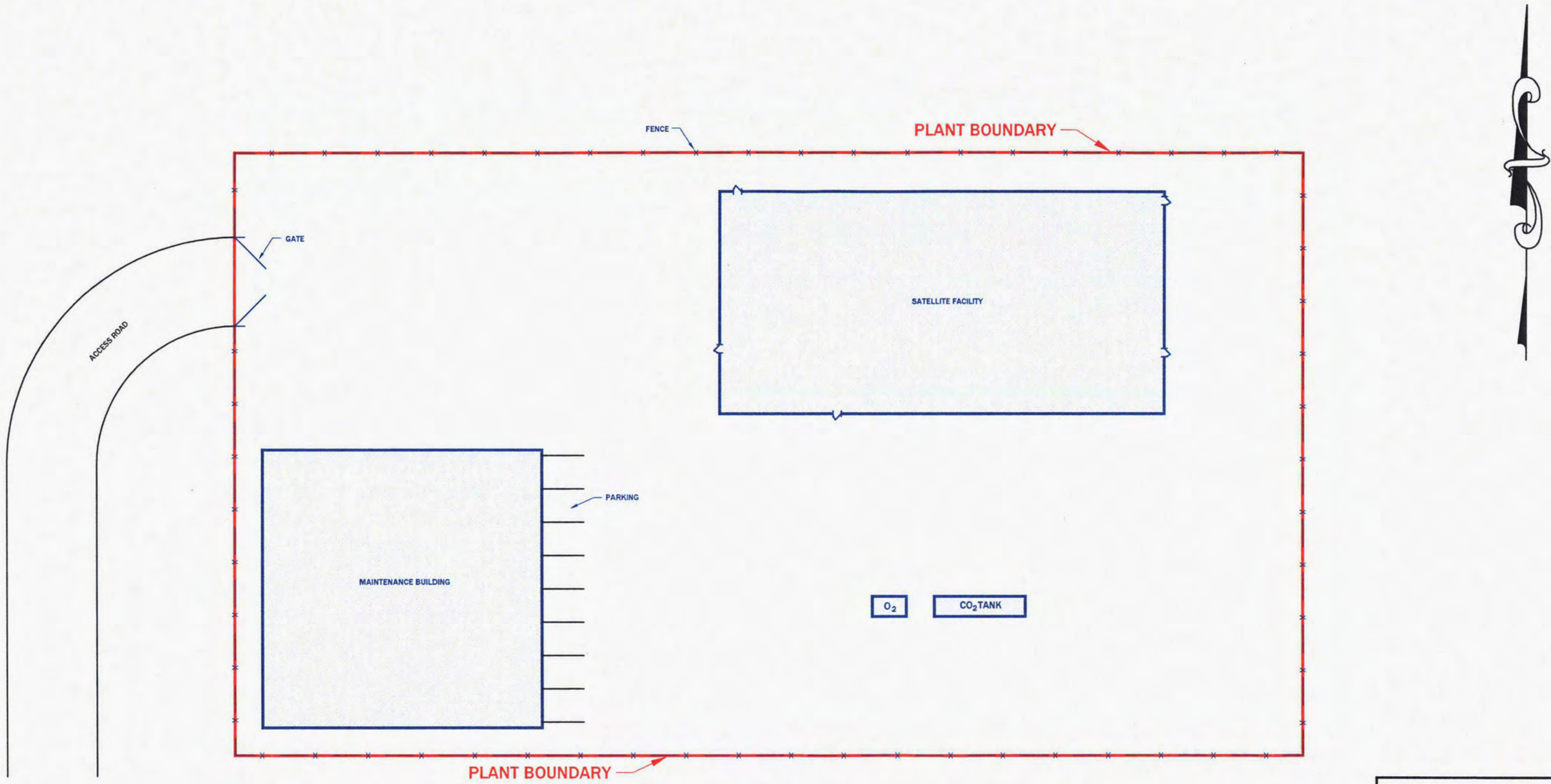
FIGURE 3-1
NICHOLS RANCH UNIT
SITE FACILITY DIAGRAM

By: S.M.F.	Date: OCTOBER 17, 2007
Contour Interval: N/A	Revision Date:
Scale: 1"=50'	Datum: NAD 27 UTM 13



LEGEND

—— x —— CONTROLLED ACCESS AREA FENCE

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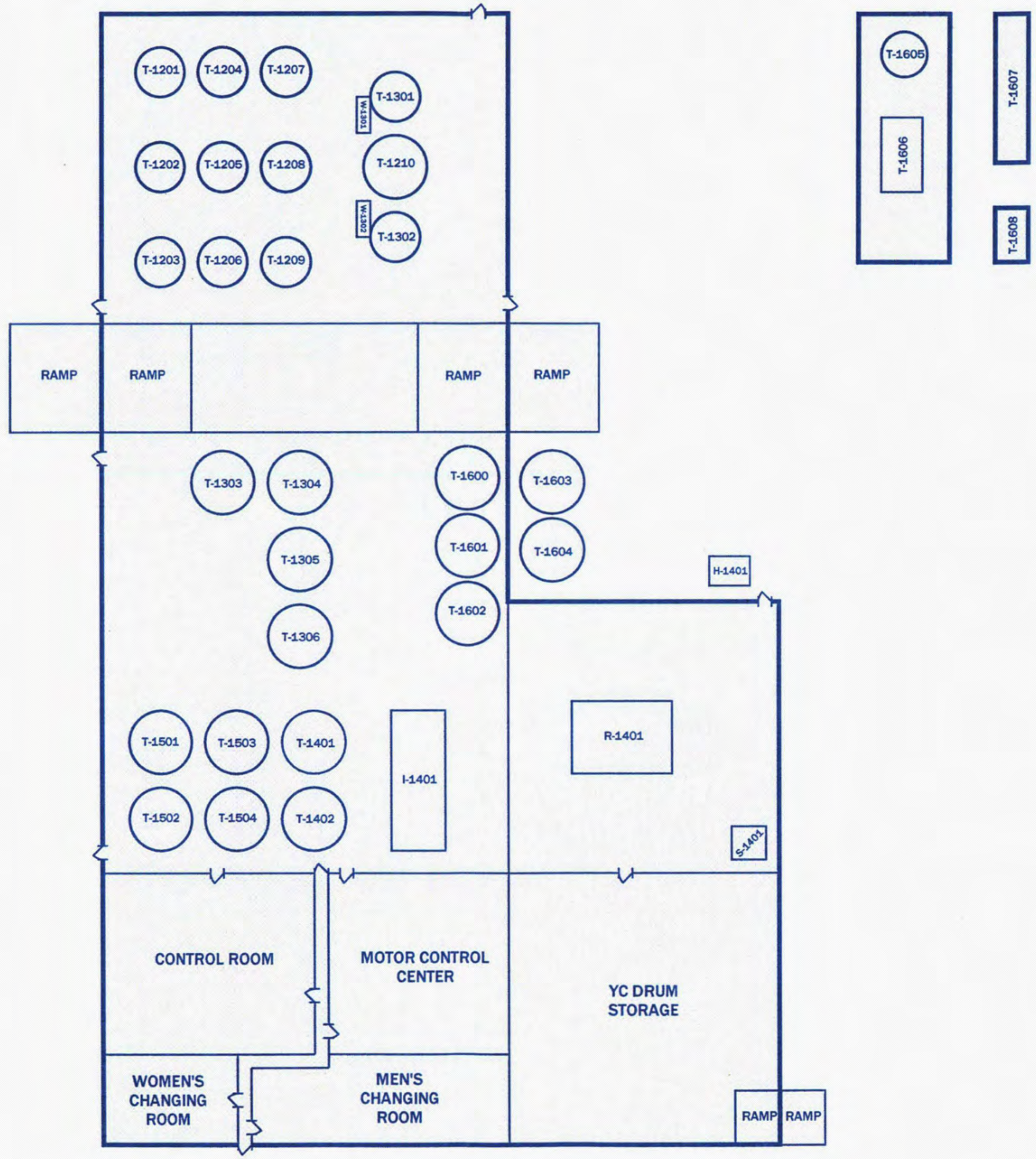
FIGURE 3-2
HANK UNIT SITE FACILITY DIAGRAM

By: S.M.F.	Date: OCTOBER 18, 2007
Contour Interval: N/A	Revision Date:
Scale: 1"=40'	Datum: NAD27 UTM 13



LEGEND

WELL FIELD = 1100'S
IX = 1200'S
ELUTION = 1300'S
YELLOWCAKE = 1400'S
WASTE = 1500'S
CHEMICALS = 1600'S
TANKS = T
SCREENS = W
FILTERS = I
DRYERS = R
HEATERS = S
COOLING TOWERS = H
PUMPS = P

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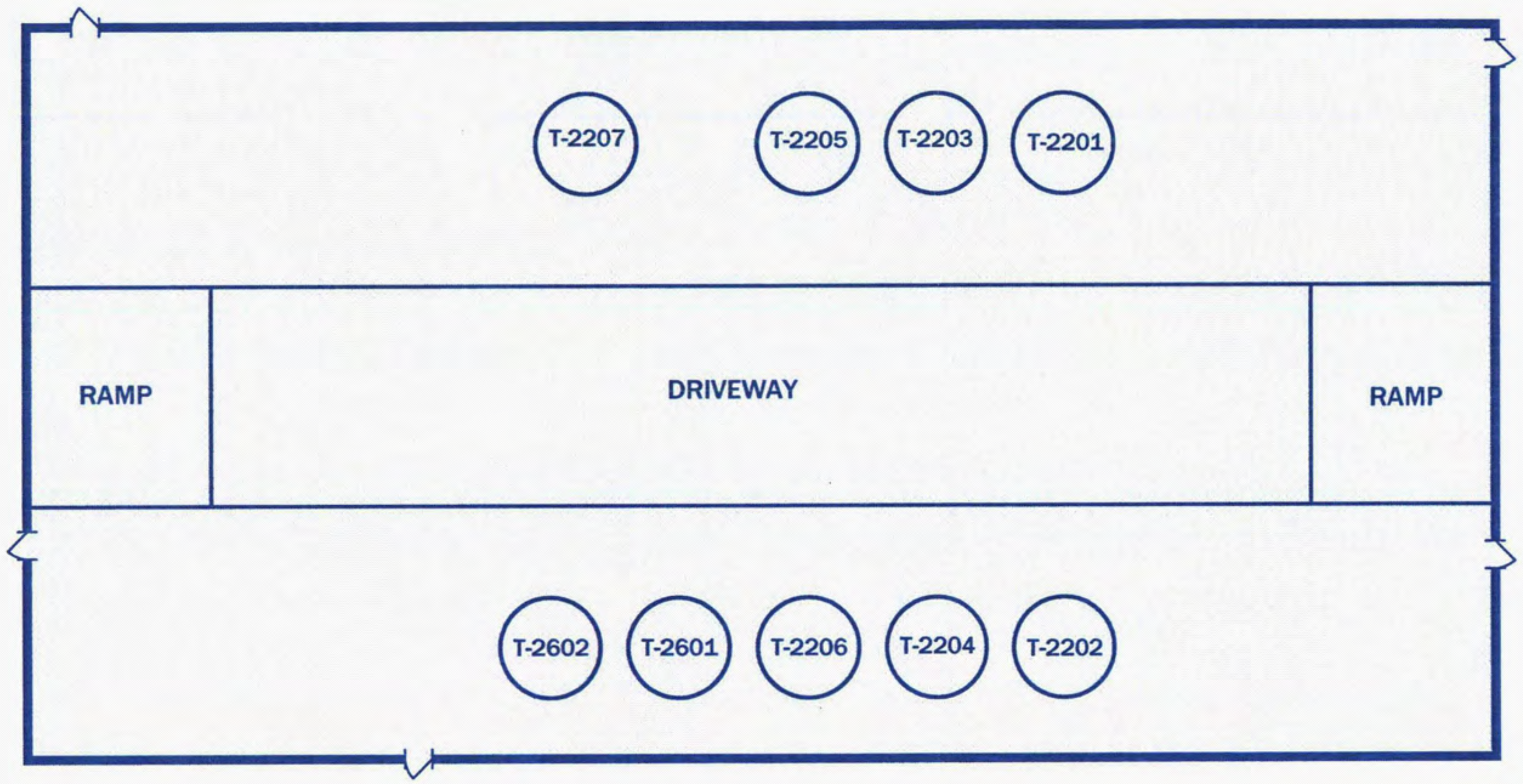
FIGURE 3-3

NICHOLS RANCH UNIT
PROCESS FLOW DIAGRAM

By: S.M.F.	Date: OCTOBER 18, 2007
Contour Interval: N/A	Revision Date:
Scale: 1"=30'	Datum: NAD27 UTM 13



LEGEND

WELL FIELD = 2100'S
IX = 2200'S
CHEMICALS = 2600'S
TANKS = T
PUMPS = P

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FIGURE 3-4

HANK UNIT PROCESS FLOW DIAGRAM

By: S.M.F.	Date: OCTOBER 18, 2007
Contour Interval: N/A	Revision Date:
Scale: 1"=20'	Datum: NAD27 UTM13

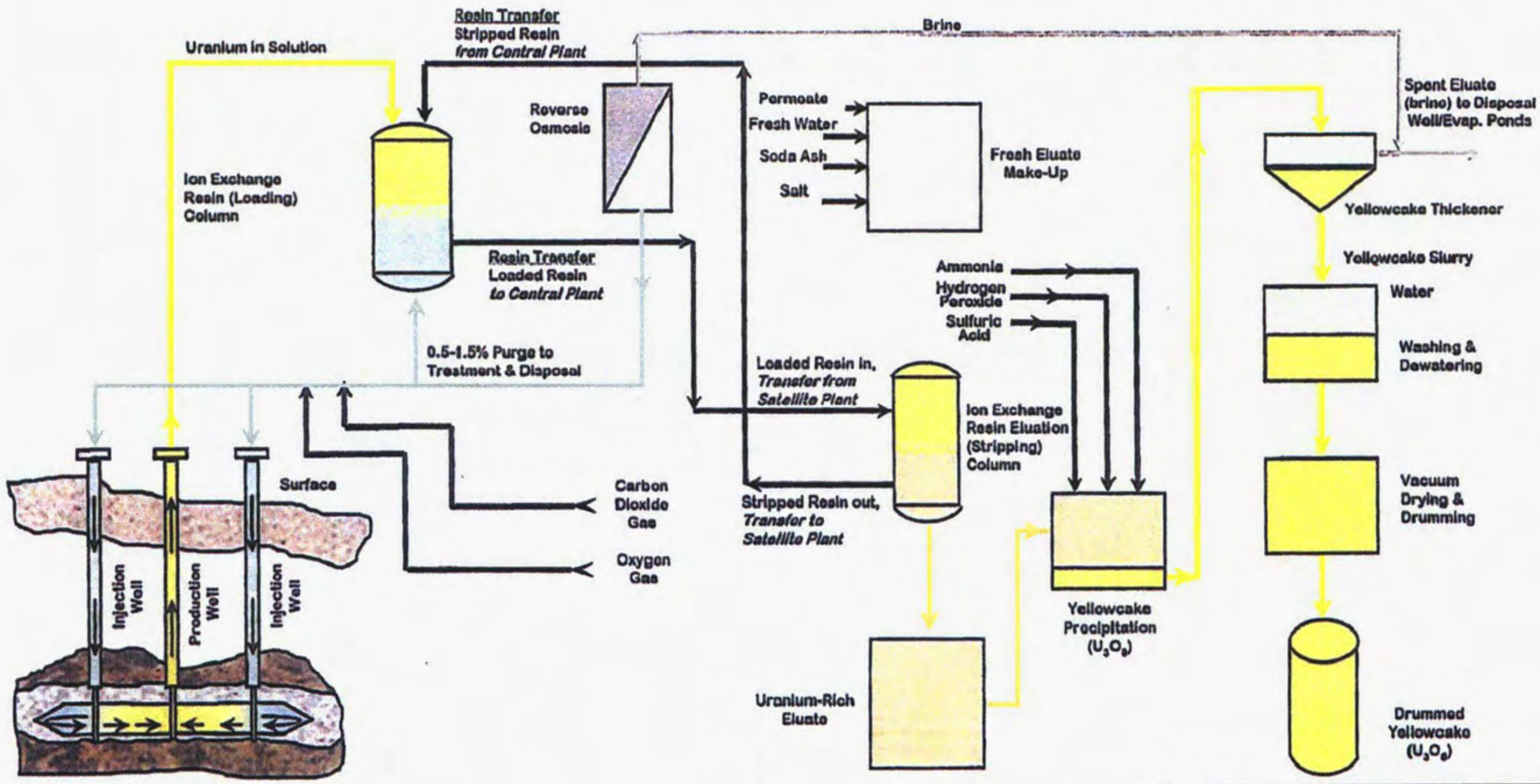

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FIGURE 3-5
GENERAL FLOW PROCESS SCHEMATIC

By: S.M.F.	Date: OCT. 17, 2007
Datum: N/A	Revision Date:
Scale: N/A	Contour Interval: N/A

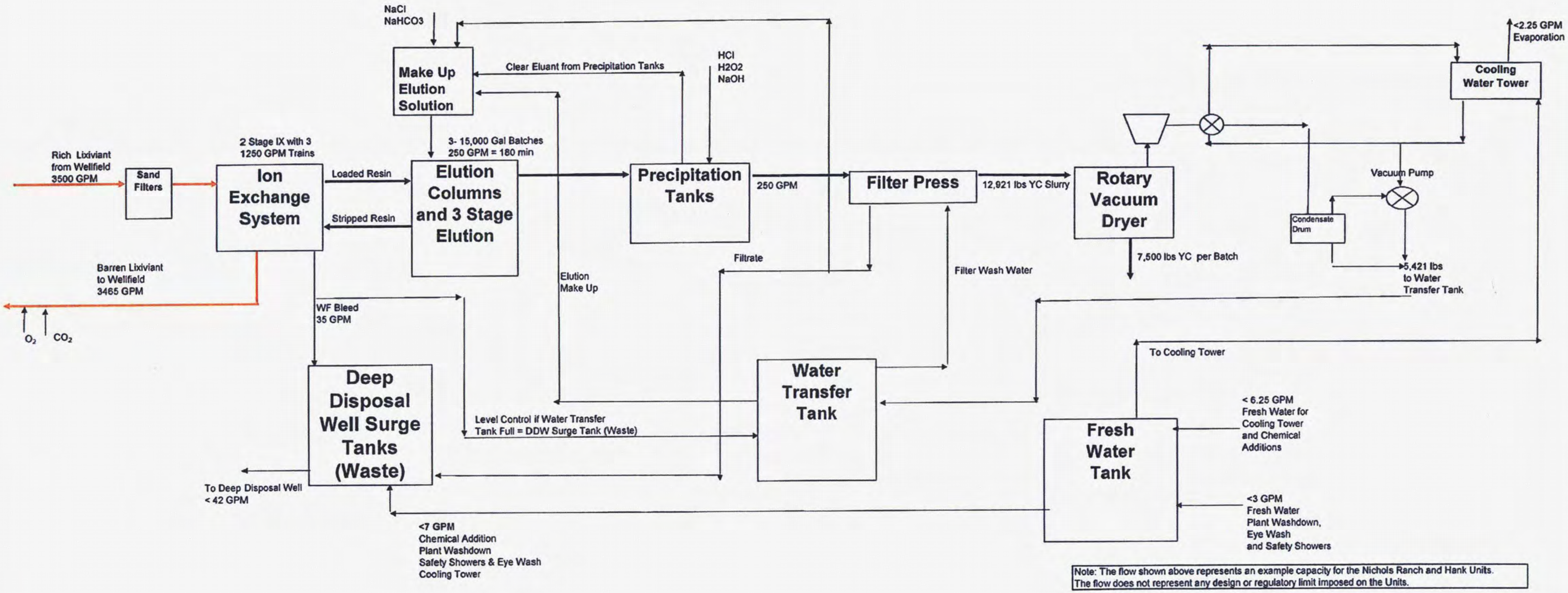

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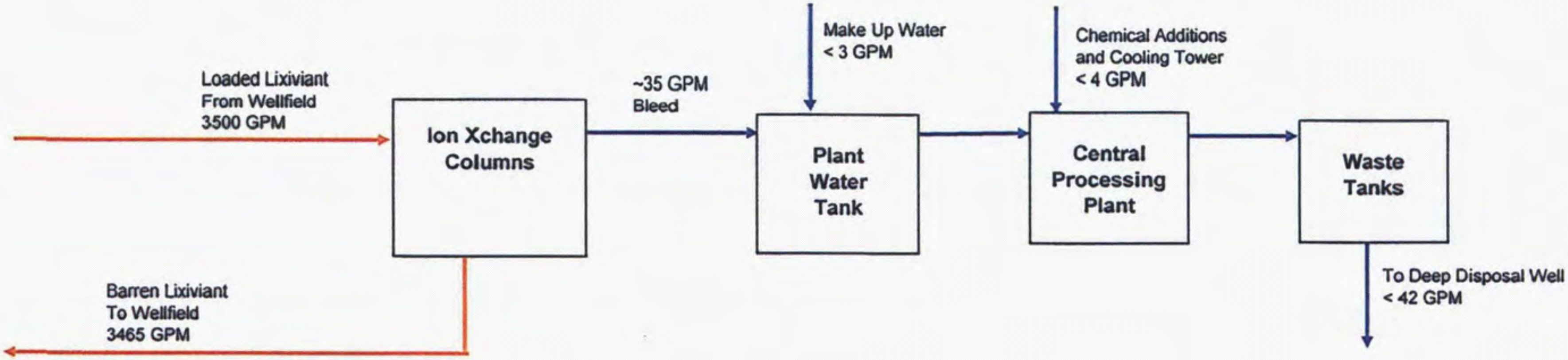
FIGURE 3-6
PLANT MATERIAL BALANCE

By: S.M.F.	Date: 10/15/2007
Contour Interval: N/A	Revision Date:
Scale: N/A	Datum: N/A

Typical Water Balance

Based on Nominal Flow Rate and 1% Bleed Rate



Note: The flow shown above represents an example capacity for the Nichols Ranch or Hank Units. The flow does not represent any design or regulatory limit imposed on the Units. The balance is nominal for a 1% wellfield bleed, and acutal balance may vary.

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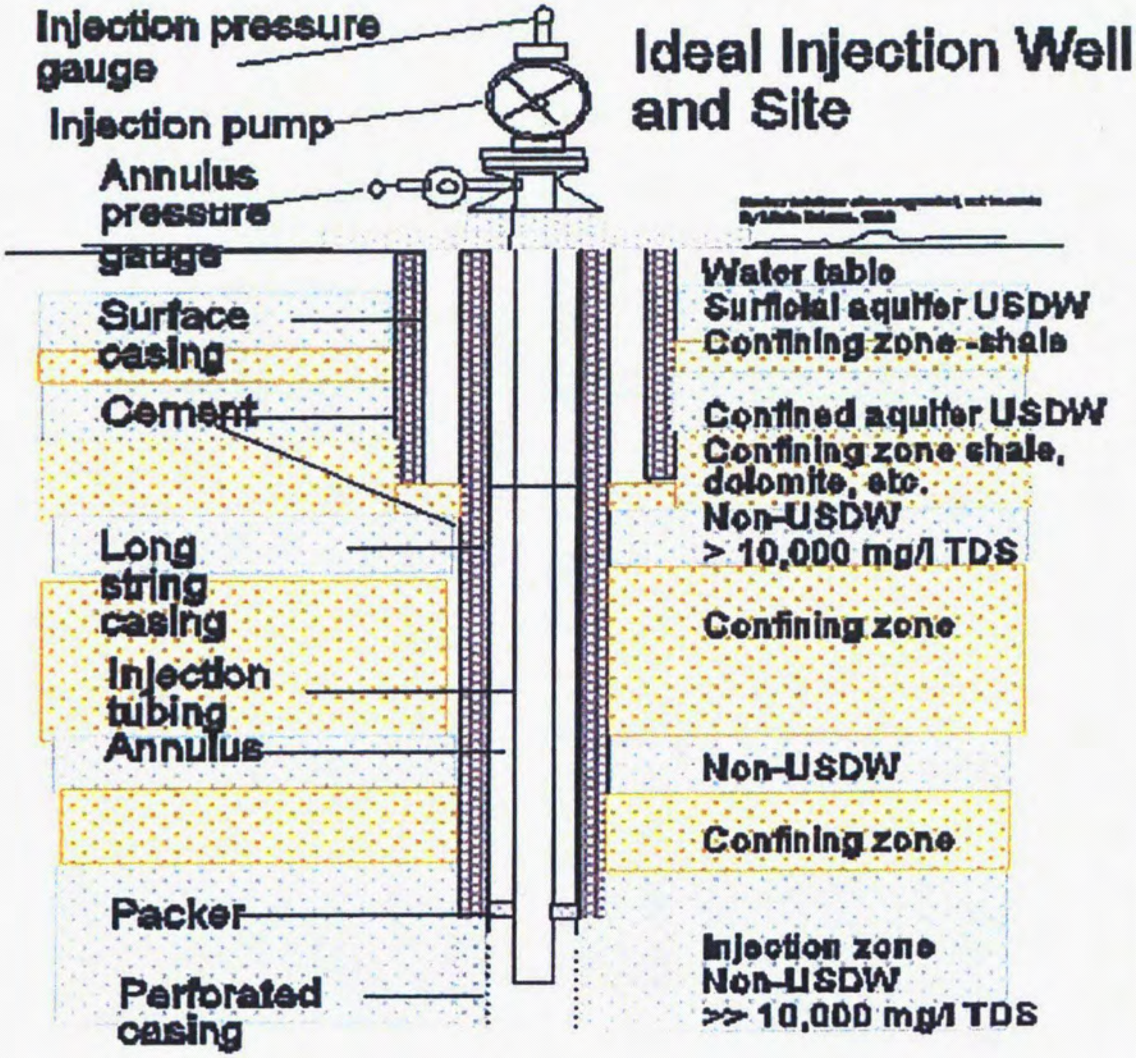
FIGURE 3-7
TYPICAL ISR WATER BALANCE

By: S.M.F.	Date: OCT. 17, 2007
Datum: N/A	Revision Date:
Scale: N/A	Contour Interval: N/A



Source: U.S. EPA

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FIGURE 3-8
DEEP DISPOSAL WELL

By: S.M.F.	Date: OCT. 17, 2007
Datum: N/A	Revision Date:
Scale: N/A	Contour Interval: N/A

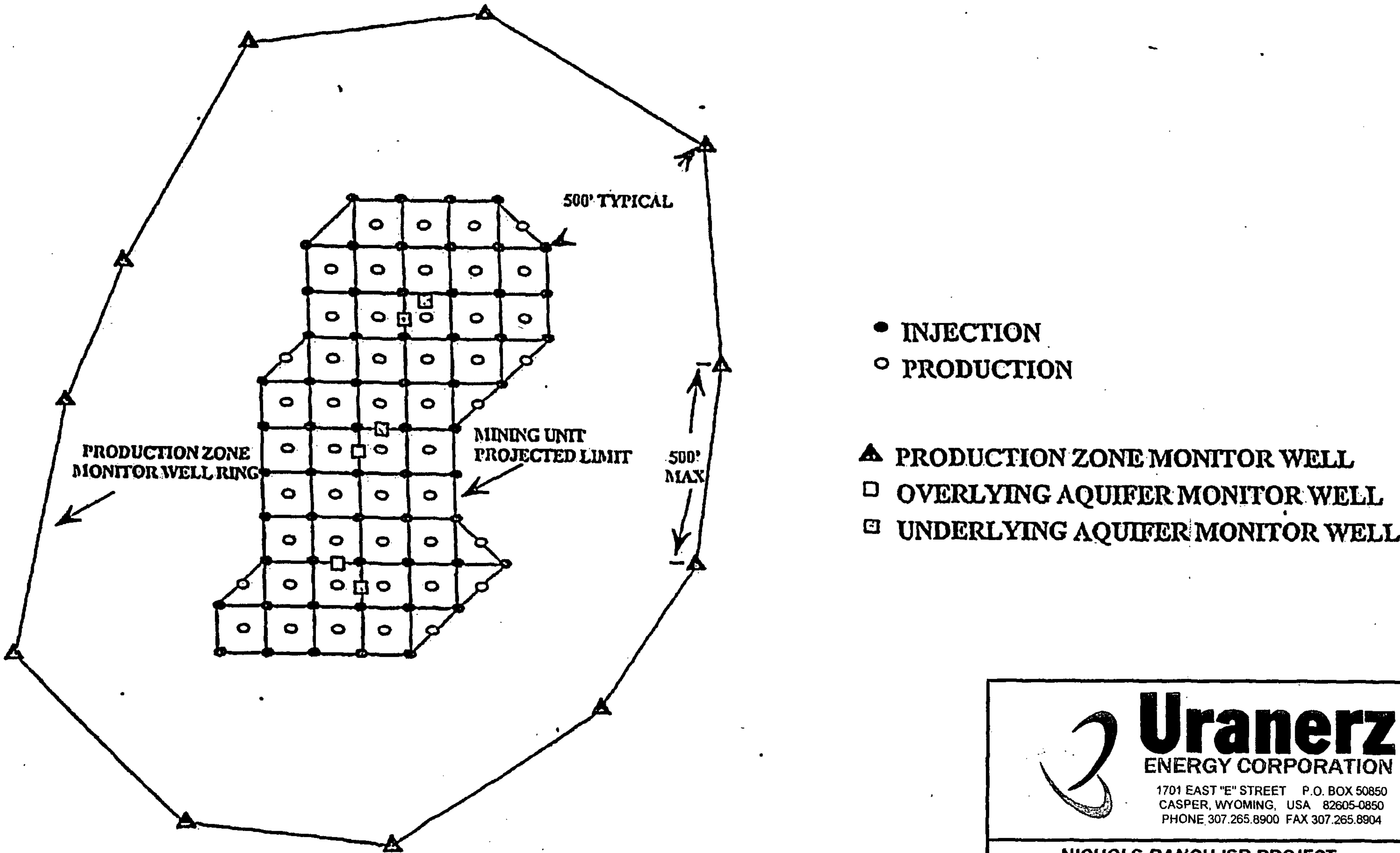

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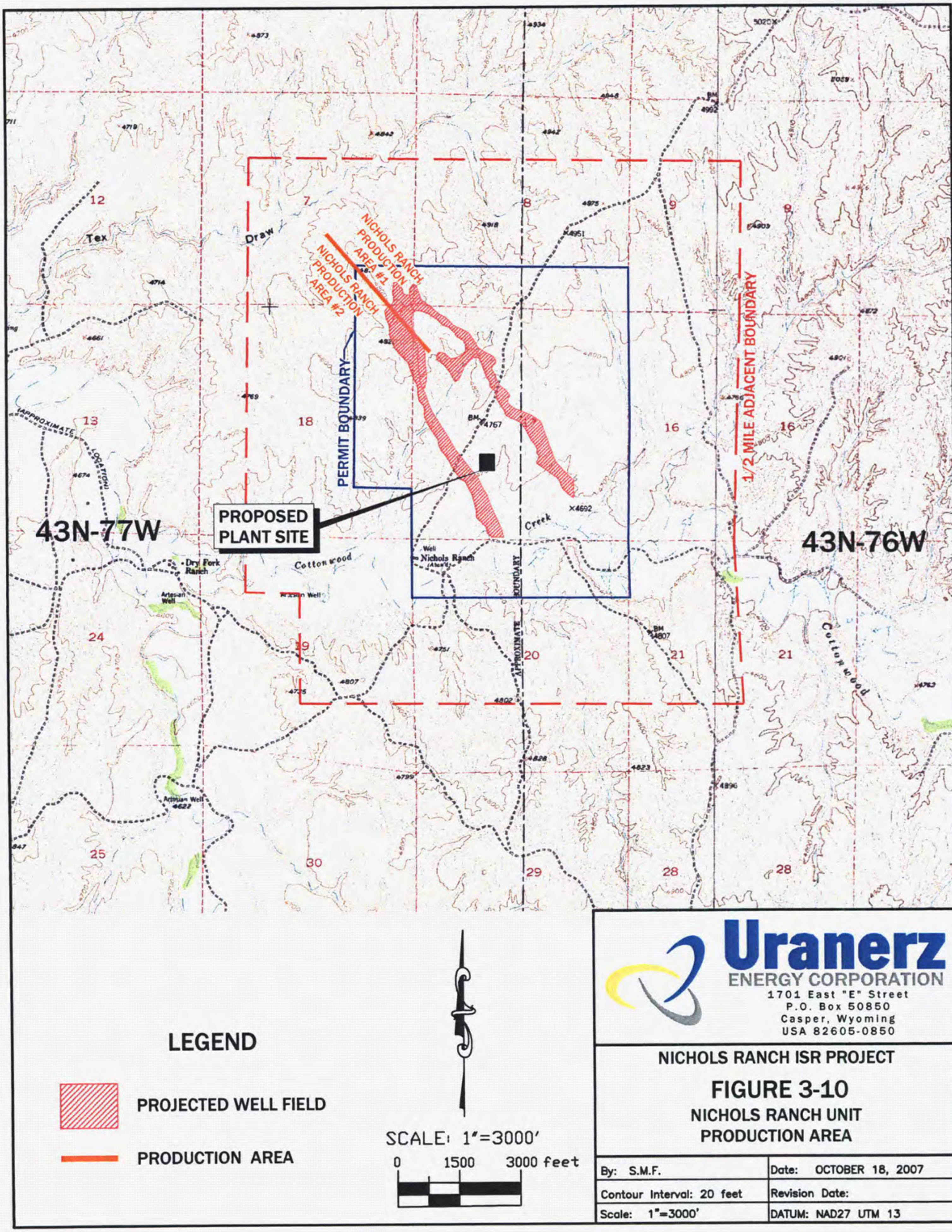
FIGURE 3-9
TYPICAL 5 SPOT WELL PATTERN

By: S.M.F.	Date: OCT. 17, 2007
Datum: N/A	Revision Date:
Scale: N/A	Contour Interval: N/A



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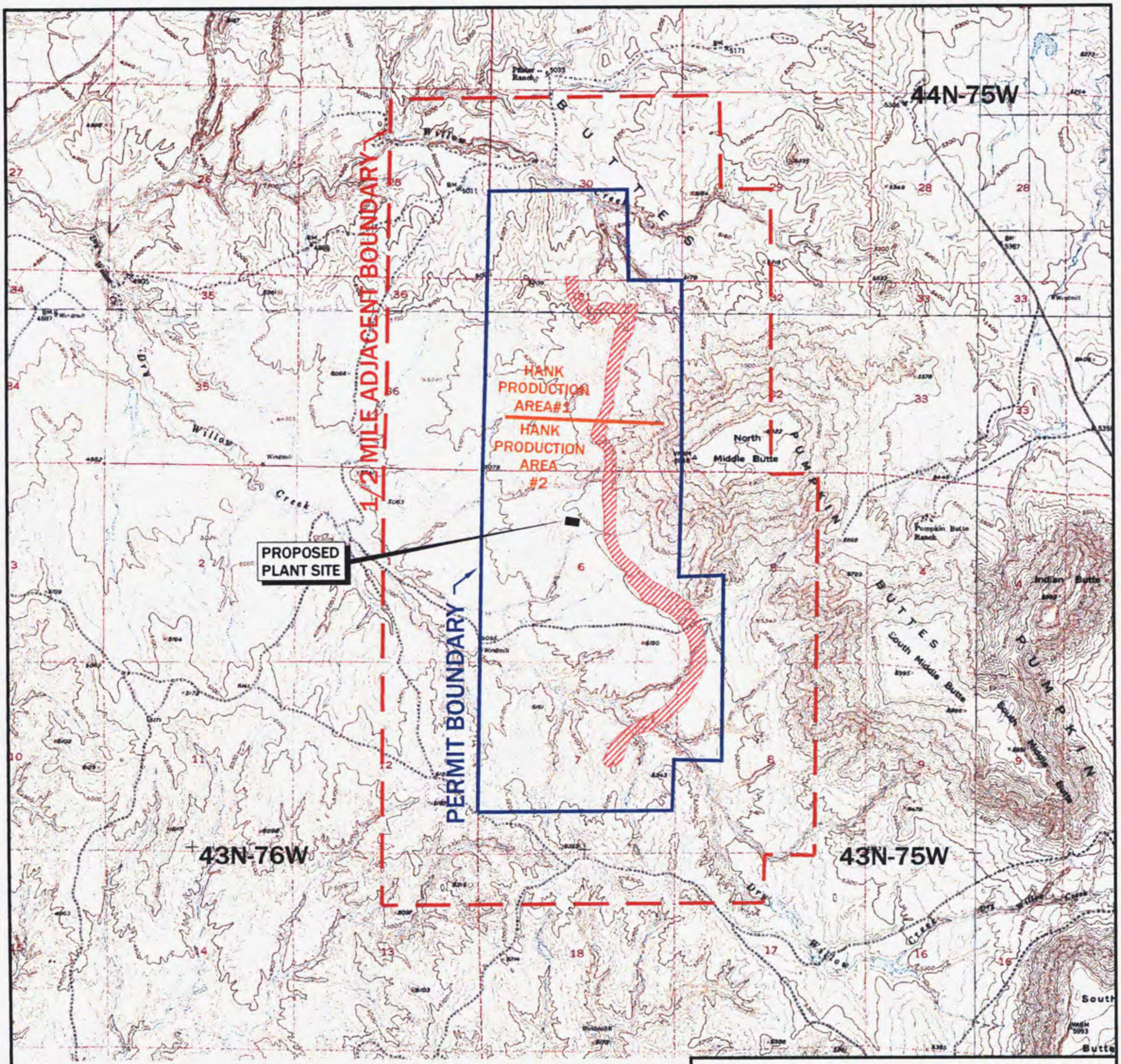
NICHOLS RANCH ISR PROJECT

FIGURE 3-10
NICHOLS RANCH UNIT
PRODUCTION AREA

By: S.M.F.	Date: OCTOBER 18, 2007
Contour Interval: 20 feet	Revision Date:
Scale: 1"=3000'	DATUM: NAD27 UTM 13



LEGEND

PROJECTED WELLFIELD

PRODUCTION AREA

SCALE: 1"=4000'

0 2000 4000 feet

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FIGURE 3-11

HANK UNIT PRODUCTION AREA

By: S.M.F.	Date: 10/18/2007
Contour Interval: 20 FEET	Revision Date:
Scale: 1"=4000'	Dwg: FIGURE 3-11

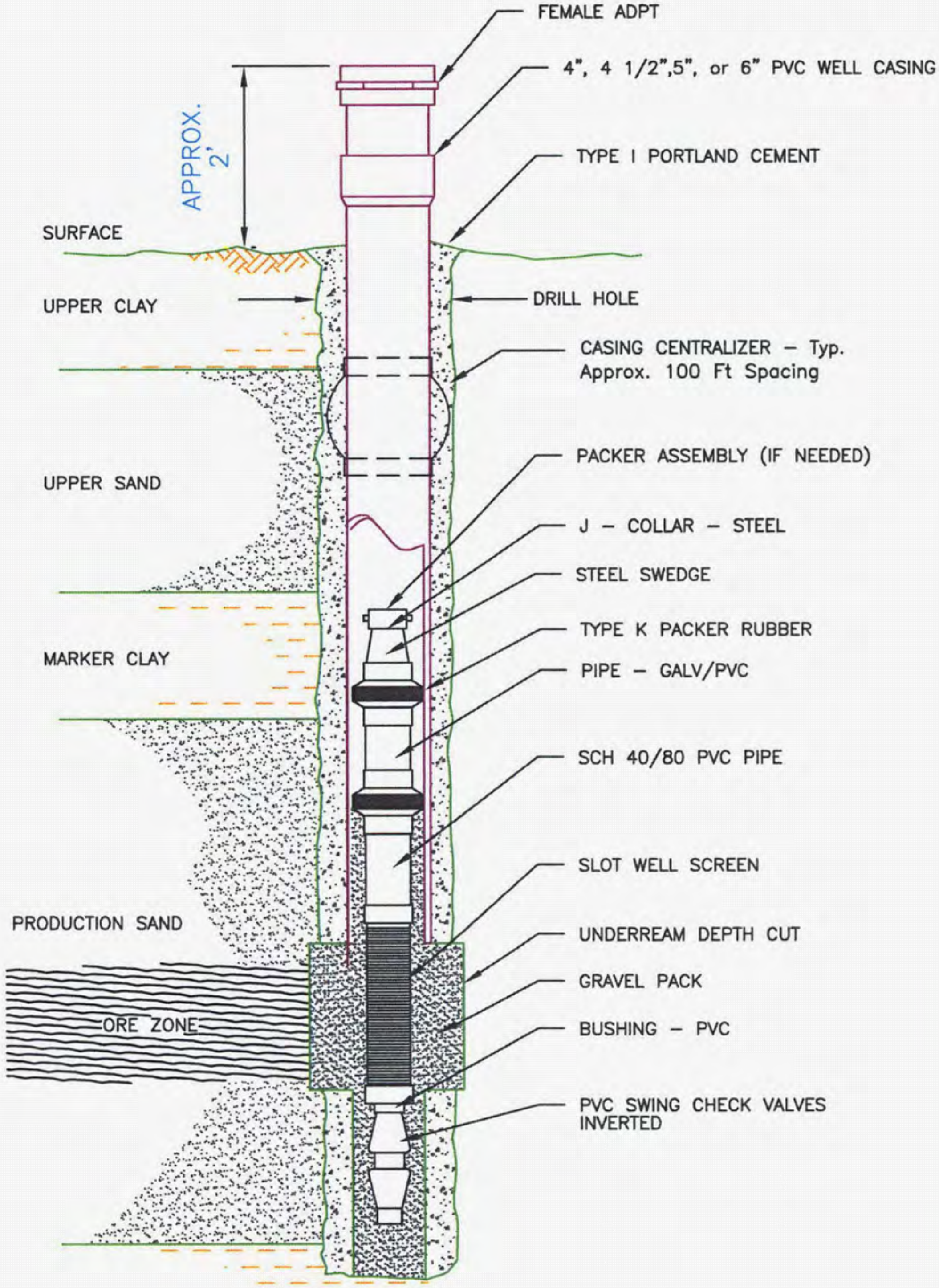

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FIG. 3-13 - NICHOLS RANCH ISR PROJECT

TYPICAL INJECTION / RECOVERY WELL CONSTRUCTION DIAGRAM

JOB NO.: URZ Well Design			
DATE: Sept. 25, 2007			
SCALE: N.T.S.			
APPROVED BY: HA			
DRAWN BY: CB, JDN			
DRAWING NO.: Figure 3-13	REV.	DATE	DESCRIPTION

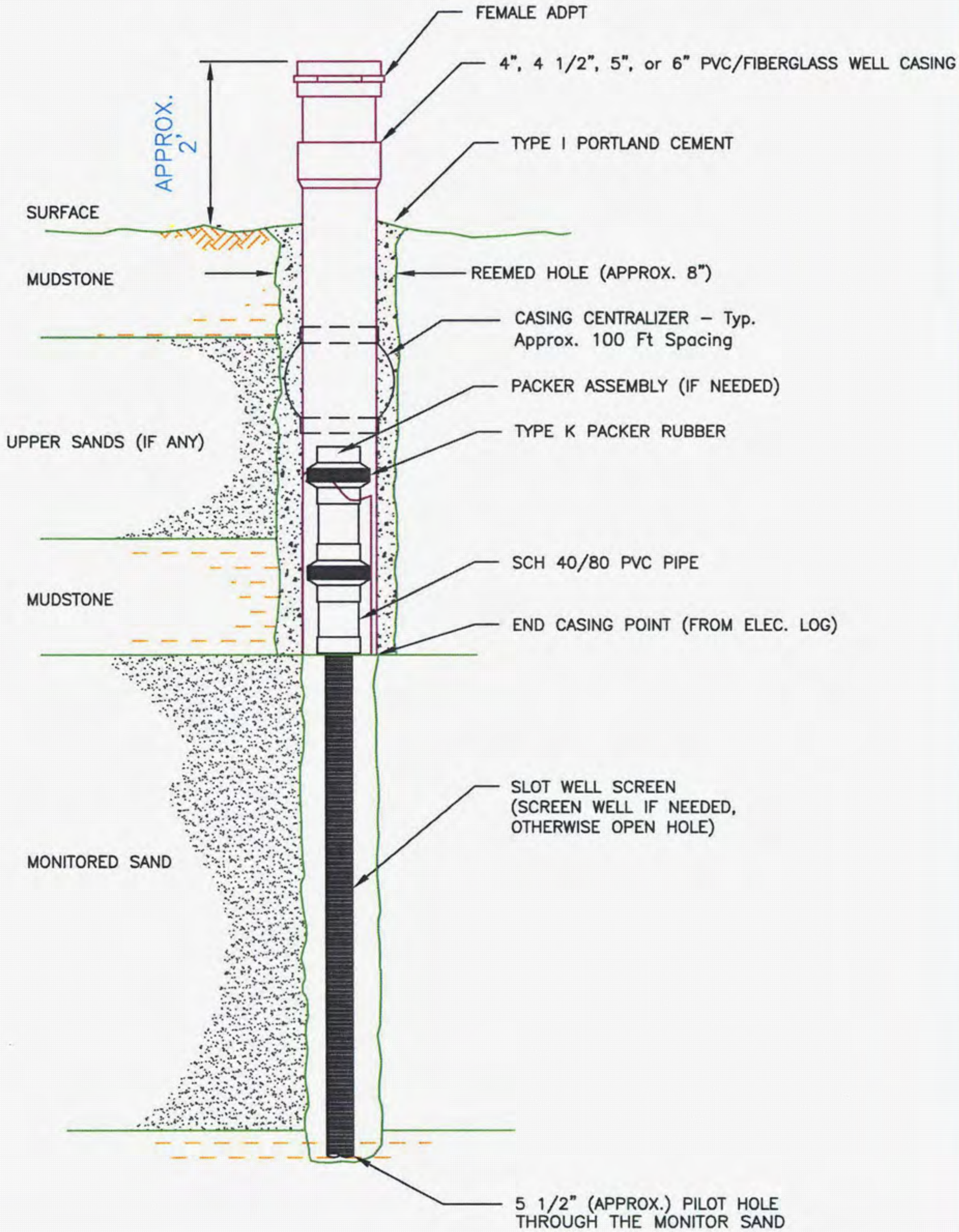

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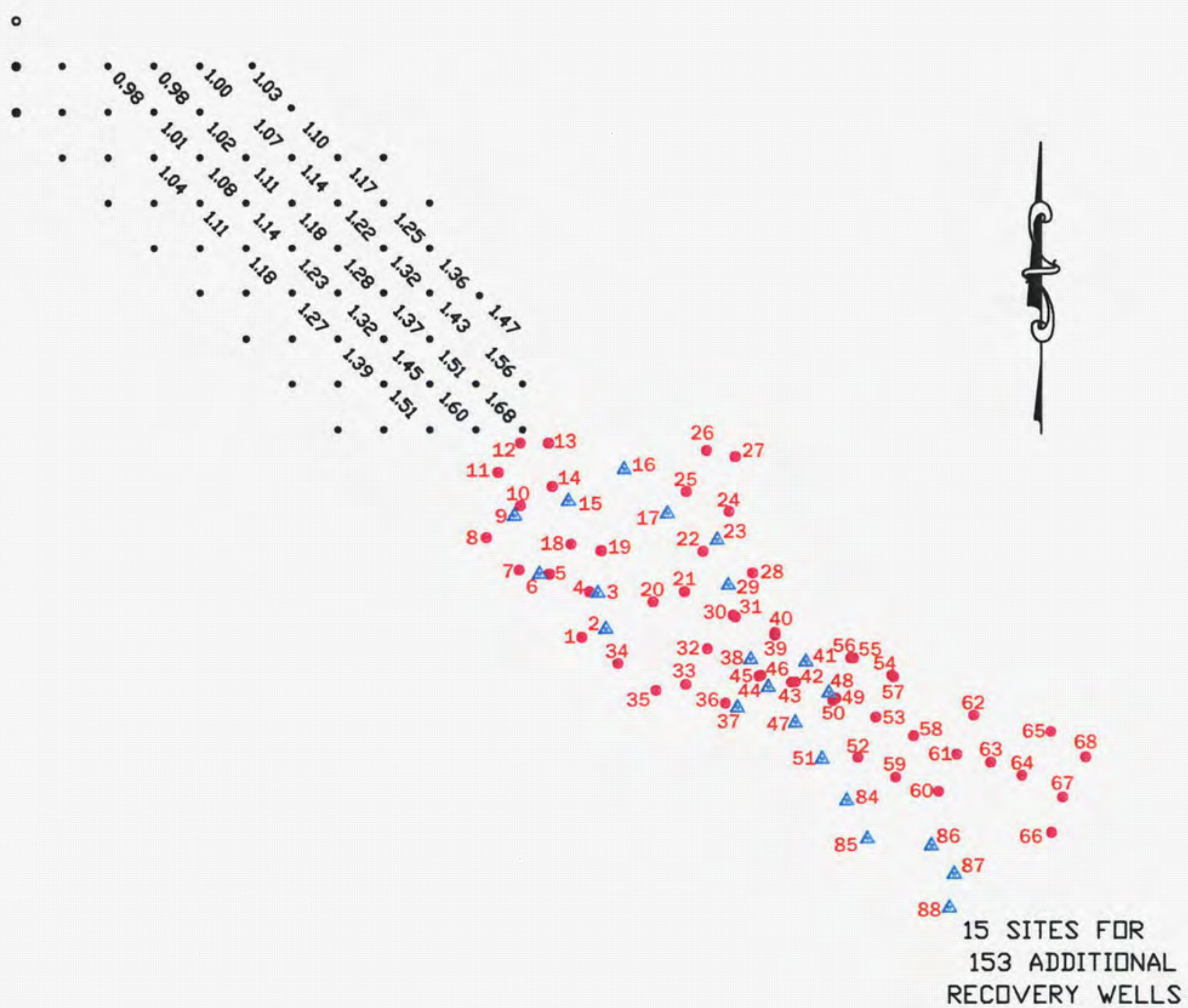
FIG. 3-14 - NICHOLS RANCH ISR PROJECT

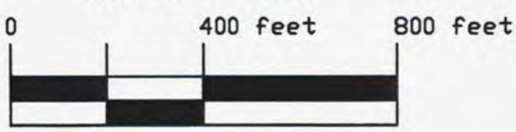
TYPICAL MONITOR WELL CONSTRUCTION DIAGRAM

JOB NO. Monitor Well Design			
DATE: Sept. 25, 2007			
SCALE: N.T.S.			
APPROVED BY: HA			
DRAWN BY: S.M.F.			
DRAWING NO. Figure 3–14	REV.	DATE	DESCRIPTION



LEGEND:
NUMBERS ARE HEAD DIFFERENCE BETWEEN 141' DRAWDOWN NODES, 0.47 NEEDED TO REVERSE GRADIENT

SCALE: 1"=400'



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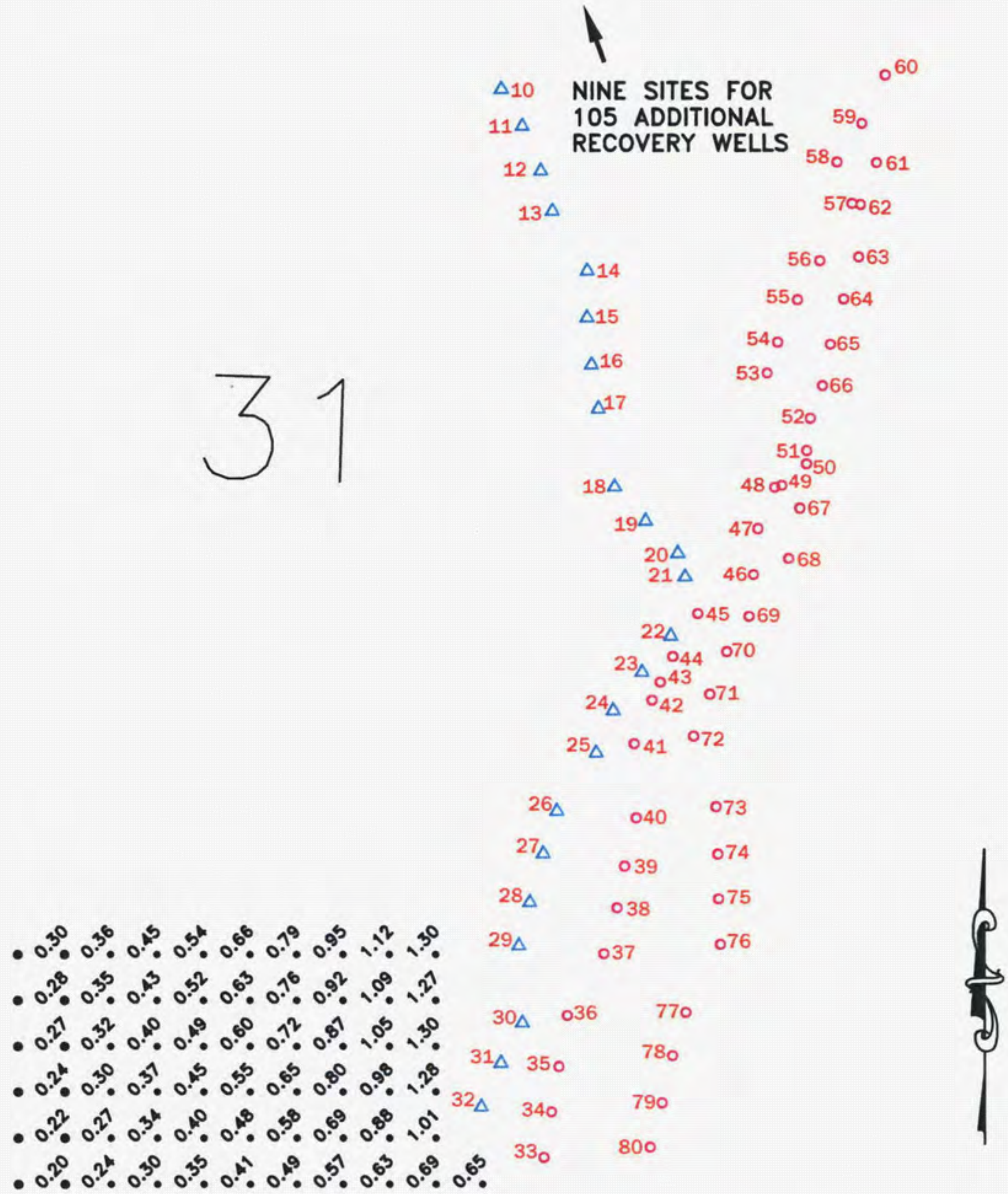
NICHOLS RANCH ISR PROJECT
FIGURE 3-15
RESULTS OF SIMULATION OF GRADIENT REVERSAL FOR NICHOLS RANCH UNIT

By: S.M.F.	Date: OCT. 18, 2007
Datum: UNKNOWN	Revision Date:
Scale: 1"=400'	Contour Interval: N/A

31



LEGEND:
NUMBERS ARE HEAD DIFFERENCE BETWEEN 100' DRAWDOWN NODES, 0.50 NEEDED TO REVERSE GRADIENT

SCALE: 1"=400'

0 400 feet 800 feet

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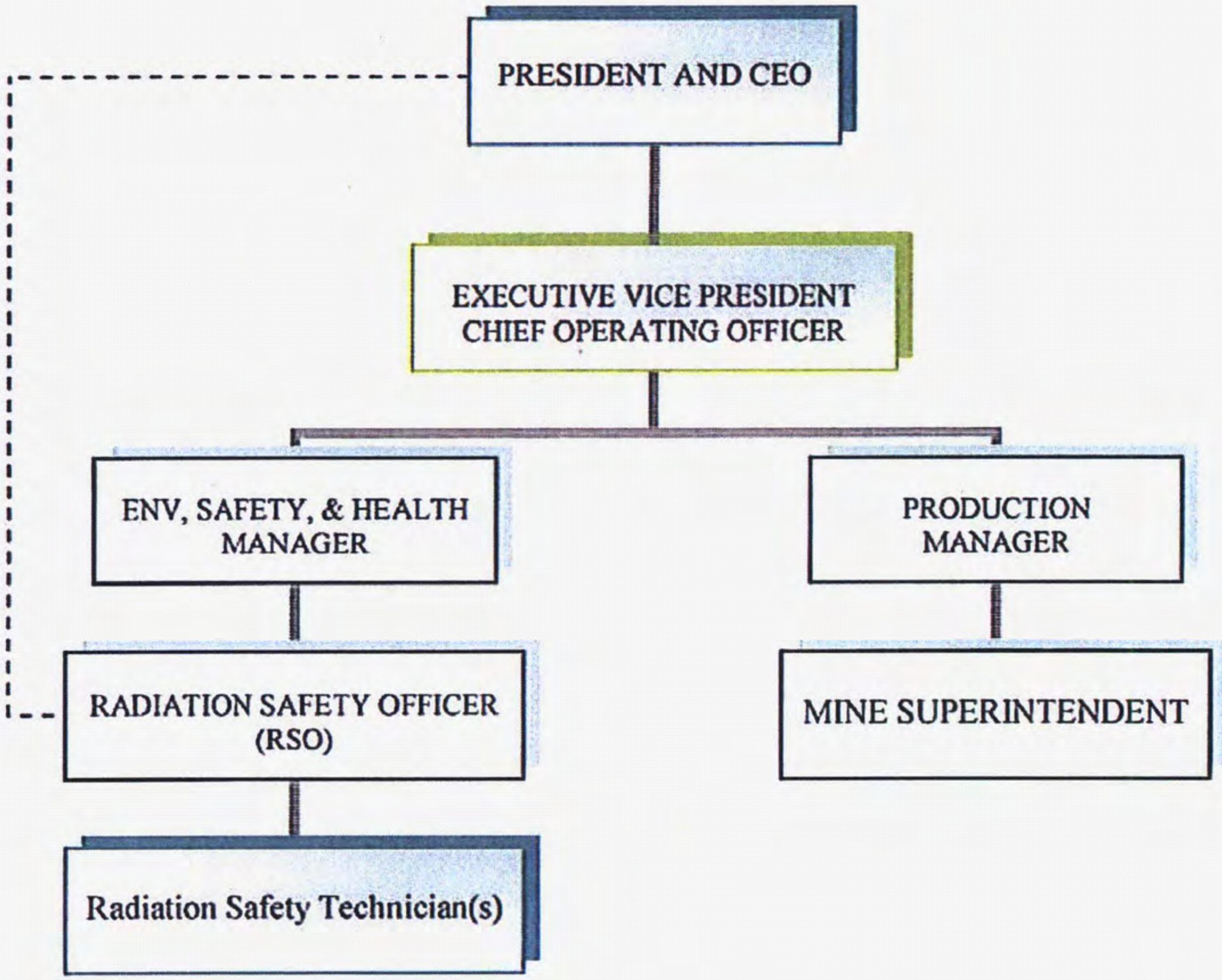
NICHOLS RANCH ISR PROJECT
FIGURE 3-16
RESULTS OF SIMULATION OF GRADIENT REVERSAL FOR HANK UNIT

By: S.M.F.	Date: OCT. 18, 2007
Datum: UNKNOWN	Revision Date:
Scale: 1"=400'	Contour Interval: N/A



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NICHOLS RANCH ISR PROJECT

FIGURE 3-18

URANERZ ORGANIZATION

By: S.M.F.	Date: OCTOBER 29, 2007
Contour Interval: N/A	Revision Date:
Scale: N/A	DATUM: N/A

4.0 EFFLUENT CONTROL SYSTEMS

This section describes the effluent control systems that will be used at the Nichols Ranch ISR Project. The potential effluents include radon, radioactive particulates in air, and radionuclides in liquid streams.

4.1 GASEOUS AND AIRBORNE PARTICULATES

The major airborne radioactive effluents include radon gas and radioactive particulates. To the extent practical, the facility ventilation systems for control of these effluents will be designed to accomplish the following:

- Provide for general area and local ventilation where concentrations of natural uranium and daughters, and radon or daughters may be present in excess of 25% of the values given in Table 1 of Appendix B to 10 CFR 20.
- Exhausted air will not enter air intakes that service other facility areas.

4.1.1 Radon

The principal gaseous radiological effluent is radon released from the circulating leach solution and/or in the elution and precipitation circuit. The buildup of radon in buildings will be controlled by general area and local ventilation systems.

4.1.1.1 General Area Ventilation

General ventilation of work areas in process buildings may be maintained by a forced air ventilation system. The general area ventilation system will be designed to force air to circulate through the process areas. The ventilation system will draw fresh air into the building and exhaust outside the building. The forced air system will be used when the buildings are normally closed due to weather or other factors. During favorable weather conditions, open doorways and convection vents will assist in providing a satisfactory work area ventilation.

4.1.1.2 Local Ventilation

A system independent of the general area ventilation will provide local ventilation for process vessels where significant concentration of radon could reasonably be expected to be released. The system will consist of ducting or piping near the expected point of release for the respective process vessel. Fans will collect gases through the ducting or piping and exhaust outdoors. The design will include considerations of redundancy or compensation. Airflow through openings in the vessels will be from the process area into the vessel and into the ventilation system, thus controlling any releases that occur inside the vessel. Separate and independent local ventilation systems may be used temporarily as needed for functional areas or nonroutine activities.

4.1.2 Particulate

The principal particulate radiological effluent is uranium and daughters released from the drying and packaging of yellowcake. An independent ventilation and filtration system is installed as a part of this operation.

A description of the effluent controls of vacuum drying and packaging system are summarized as:

- The drying chamber operates at negative pressure.
- A bag house is situated above the drying chamber. It provides for filtration of air and vapor from the drying chamber. The dry solids on the filter surfaces are discharged back to the drying chamber. The bag house is maintained under negative pressure by the vacuum system.
- A condenser is located downstream of the bag house. Dust passing through the bag filters is wetted and entrained in the condensing moisture within this unit. The gases are moved through the condenser by the vacuum system.
- The vacuum system is a water sealed unit. It provides a negative pressure on the entire system during drying and packaging. The water seal captures entrained particulate remaining in the gas stream.

- Ventilation is provided by the vacuum system when yellowcake is transferred from the drying chamber for packaging.
- The low intermittent air flow exiting the vacuum system precludes sampling of this effluent.
- The system is instrumented to shut itself down for malfunction or failure of the vacuum system. The system will alarm if there is an indication that the emission controls are not performing within specifications. Operating procedures will provide for return of the system to service upon correction of the malfunction or failure.

Instrumentation provides an audible and/or visual alarm if the vacuum level is outside specifications; the operation of this system is monitored during drying and packaging operations. In the event the instrumentation system fails, the operator will document checks of the vacuum every four hours. Additionally, during routine operations, the air pressure differential gauges for other emission control equipment is observed and documented at least once per shift during dryer operations.

The vacuum system is proven technology which is being used successfully at several uranium recovery facilities where uranium oxide is being produced.

4.2 LIQUIDS AND SOLIDS

This section provides description of disposal methods for the major liquid effluents and solid wastes at the Nichols Ranch ISR Project.

4.2.1 Liquid Effluents

Liquid effluents are expected to be generated from well development water, pumping test water, process bleed, process solutions, wash-down water, and restoration water.

The water generated during well development and pumping tests is expected to satisfy WDEQ-WDQ Class IV (Livestock) standards at a minimum and has minimal potential radiological impact on soils or surface water. No alternate handling or disposal method is required allowing water to be pumped onto the ground.

The process bleed and wash down water will be transferred to a deep disposal well. This deep disposal well will be equivalent in design and depth to existing deep disposal wells at similar ISR uranium recovery sites. This deep disposal well will be permitted through the WDEQ and operated according to permit requirements.

The restoration water will be treated by reverse osmosis or other purification technology. The treated restoration water will be re-injected into the production area undergoing restoration with the restoration water bleed transferred to the deep disposal well.

4.2.2 Solid Wastes

Solid wastes will normally consist of spent resin, empty packaging, miscellaneous pipes and fittings, tank sediments, and domestic trash. These materials will be classified as contaminated or noncontaminated based on their radiological characteristics.

4.2.2.1 Noncontaminated solid waste

Noncontaminated solid waste is waste which is not contaminated with radioactive material or which can be decontaminated and reclassified as noncontaminated waste. This type of waste may include trash, piping, valves, instrumentation, equipment and any other items which are not contaminated or which may be successfully decontaminated. Noncontaminated solid waste will be collected on the site in designated areas and disposed of in the nearest permitted sanitary landfill.

It is estimated that the site will produce approximately 700 to 1,000 cubic yards of noncontaminated solid waste per year. This estimate is based on the waste generation rates of similar in-situ uranium recovery facilities.

4.2.2.2 Contaminated solid waste

Contaminated solid waste consists of solid waste contaminated with radioactive material that cannot be decontaminated. This waste will be classified as 11.e(2) byproduct material. This byproduct material will consist of filters, personal protective equipment, spent resin, piping, etc. These materials will be temporarily stored on site and periodically transported for disposal. Uranerz will establish an agreement for disposal of this waste as 11.e(2) byproduct material in a licensed waste disposal site or licensed mill tailings facility.

It is estimated that the site will produce approximately 60 to 90 cubic yards of 11.e(2) byproduct material as waste per year. This estimate is based on the waste generation rates of similar ISR uranium recovery facilities.

4.3 CONTAMINATED EQUIPMENT

Surface contamination surveys will be conducted of potentially contaminated equipment and materials before they are released to unrestricted areas. The applicable surface contamination limits are provided by USNRC, *Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material*, Division of Fuel Cycle and Material Safety, April 1993. A comprehensive radiation survey will be made in conformance with these guidelines, which establishes that contamination is within the limits specified within the referenced guidelines and is as low as is reasonably achievable before release of the equipment or material for unrestricted use.

If contamination above these limits is detected, the equipment or material will be decontaminated until the limits are satisfied, or the item will not be released to unrestricted use.

Radioactivity on surfaces will not be covered by paint, plating, or other covering unless contamination levels, as determined by a survey and documented, are below the aforementioned limits before application of the covering. A reasonable effort will be made to minimize the contamination before use of any covering.

The radioactivity of the interior surfaces of pipes, drain lines, or duct work will be determined by making measurements at all traps and other appropriate access points, provided that contamination at these locations is likely to be representative of contamination on the interior of the pipes, drain lines, or duct work.

4.4 SYSTEM FAILURES

In the event that a spill occurs in the wellfield or process plants, measures will be taken to safely and quickly contain the spill and mitigate the impacts of any released material. Proper notification of plant and corporate management will be made along with properly contacting the NRC and State.

Spills are likely to occur from leaking pipelines and fittings. If a pipeline leak or spill occurs in the plants, the spill or leak will be contained within the building with all spilled material collected in the plant sump. This material will either be pumped back into the process or sent to the deep disposal well.

Wellfield spills will be contained as soon as possible. The area of the spill will be surveyed to identify any contaminated areas and then cleaned up and removed for disposal according to NRC and State regulations.

If any process vessels or tanks that contain or have contained radioactive materials have to be entered for any reason such as cleaning, inspection, or repairs, a radiation work permit (RWP) will be issued detailing the requirements for special air sampling, protective equipment, and increased exposure surveillance.

To notify operating personnel of potential issues with process and wellfield operations, instrumentation such as flow meters and pressure indicators will be used. If any process condition falls out of the normal operating range, audible and visual alarms will sound notifying employees of potential plant problems. The alarm notification will aid in reducing the severity of any potential spills that might occur.

5.0 OPERATIONS

Operations at the Nichols Ranch ISR Project site and facilities are conducted in conformance with applicable laws, regulations and requirements of the various Federal and State regulatory agencies. The organization and management controls described below are established to ensure compliance and further implement the company's policy for providing a safe working environment including the philosophy of maintaining radiation exposures as low as is reasonably achievable (ALARA).

5.1 ORGANIZATIONS

The management structure and responsibilities of the Uranerz Energy Corporation (Uranerz) organization are described in the following section. The organization function is to provide for development, review, approval, implementation, and adherence to operating procedures, radiation safety programs, environmental and groundwater monitoring programs, quality assurance programs, routine and non-routine maintenance activities, and changes to any of these programs or activities.

5.1.1 Management

The Uranerz organization management structure is shown in Figure 5-1 (see map pocket). The structure is applicable to site construction and site management. The structure is applicable to the central processing facility and the satellite facility. The responsibilities and authorities are described below for these management positions.

A Safety and Environmental Review Panel (SERP) will be established, in whole or part, from these management positions. The SERP is described in Section 5.2.

President

The President has the overall responsibility and authority for the radiation safety and environmental compliance programs. He is responsible for ensuring that operations are compliant with applicable regulations and permit/license conditions. The President is also responsible for maintenance of the license. The President provides for direct supervision of the Executive Vice President in this capacity.

<u>Executive Vice President</u>

The Executive Vice President reports to the President and is directly responsible for ensuring that operations personnel comply with radiation safety and environmental protection programs. The Executive Vice President is also responsible for compliance with all federal and state regulations, license conditions, and reporting requirements. The Executive Vice President has the responsibility and authority to terminate immediately any activity that is determined to be a threat to employee or public health, the environment, or potentially a violation of state or federal regulations. The Executive Vice President directly supervises the functional area managers.

<u>Production Manager</u>

The Production Manager reports directly to the Executive Vice President. The Production Manager is responsible for all production activity at the site. In addition to production activities, the Production Manager is also responsible for implementation of industrial and radiation safety, and environmental protection programs associated with operations. All site operations, maintenance, construction, environmental health and safety, and support groups report to the Production Manager. The Production Manager is authorized to implement immediately any action to correct or prevent hazards. The Production Manager has the responsibility and the authority to suspend, postpone, or modify, immediately if necessary, any activity that is determined to be a threat to employee or public health, the environment, or potentially a violation of state or federal regulations. The Production Manager cannot unilaterally override a decision for suspension, postponement, or modification if that decision is made by senior management, the Manager Environment, Safety, and Health, or the Radiation Safety Officer. The Production Manager directly supervises the Mine Superintendent.

<u>Mine Superintendent</u>

The Mine Superintendent reports directly to the Production Manager. The Mine Superintendent is responsible for day-to-day operation and management of activities at the site. The Mine

Superintendent is also responsible for line implementation of industrial and radiation safety, and environmental protection programs associated with operations. The Mine Superintendent oversees the operations, maintenance, construction, and support staffs.

ES&H Manager

The Manager Environment, Safety, and Health reports directly to the Executive Vice President. The Manager ESH is responsible for all radiation protection, health and safety, and environmental programs, and for ensuring compliance with all applicable regulatory requirements. The Manager ESH also has the responsibility to advise senior management on matters involving radiation safety and to implement changes and/or corrective actions involving radiation safety authorized by senior management. The Manager ESH is tasked to ensure that the radiation safety and environmental monitoring and protection programs are conducted in a manner consistent with regulatory requirements. This position assists in the development and review of radiological and environmental sampling and analysis procedures and is responsible for routine auditing of the programs. The Manager ESH has no production-related responsibilities. The Manager Environment, Safety, and Health supervises the Radiation Safety Officer.

Radiation Safety Officer

The Radiation Safety Officer (RSO) reports directly to the Manager Environment, Safety, and Health. The RSO is responsible for conducting the radiation safety program and for providing assistance in ensuring compliance with NRC regulations and license conditions applicable to worker health protection. The RSO is responsible for overseeing the day-to-day operation of the radiation safety program and for ensuring that records required by NRC are maintained. The RSO has the responsibility and the authority to suspend, postpone, or modify, immediately if necessary, any activity that is determined to be a threat to employee or public health, the environment, or potentially a violation of state or federal regulations, including the ALARA program. The RSO has no production-related responsibilities. The RSO supervises the Radiation Safety Technician(s).

Environmental and Radiation Safety Technicians
The Environmental and Radiation Safety technicians report directly to the Manager ESH and the RSO, respectively. The Environmental and Radiation Safety technicians assist the Manager ESH and the RSO with the implementation of the environmental monitoring and radiation safety programs. The Environmental and Radiation Safety technicians are responsible for the orderly collection and recording of all data from environmental and radiological safety programs. The Environmental and Radiation Safety technicians have no production-related responsibilities.

5.1.2 ALARA

The radiation safety and environmental programs at the Nichols Ranch ISR Project site will be implemented in the context of keeping personnel and environmental exposure to radiation and radioactive material as low as is reasonably achievable (ALARA).

5.1.2.1 Philosophy

The considered purpose of the radiation safety and environmental protection programs at the Nichols Ranch ISR Project site are to maintain exposure to radiation and radioactive materials ALARA for all employees, contractors, visitors, and the environment. The implementation and effectiveness of a successful ALARA program is the responsibility of everyone involved in conducting operations at the site.

5.1.2.2 Responsibilities

Responsibilities for implementation of the ALARA philosophy are shared by management, the RSO, and all workers at the Nichols Ranch ISR Project site.

Management
Management is responsible for developing, implementing, and enforcing the policies and procedures necessary for effective radiation safety, environmental protection, and ALARA

programs to ensure the health and safety of workers and visitors, and protection of the environment.

Management will provide the following:

1. A strong commitment to and continuing support for the development and implementation of the radiation safety, environmental protection, and ALARA programs;
2. Information and policy statements to employees, contractors, and visitors.
3. Periodic management review of operational and procedural efforts to maintain ALARA;
4. Continuing management evaluation of the radiation safety and environmental protection programs including staffing, and allocations of space and funding; and
5. Appropriate briefings and training in radiation safety, environmental protection, and ALARA concepts for all employees, and, when appropriate, for contractors and visitors.

Manager ESH and RSO

The Manager ESH and the RSO have primary responsibility for the technical adequacy and correctness of an ALARA application for the environmental protection and radiation safety programs. Each has continuing responsibility for surveillance and supervisory action in the enforcement of the ALARA program.

The Manager ESH and the RSO will be assigned the following:

1. Major responsibility for the development and administration of the environmental protection, radiation safety, and ALARA programs;
2. Sufficient authority to enforce regulations and administrative policies that affect any aspect of the environmental protection and radiation safety;
3. Responsibility to review and approve plans for new equipment, process changes, or changes in operating procedures to ensure that the plans do not adversely affect the environmental protection and radiation safety programs; and
4. Adequate equipment and facilities to monitor relative attainment of the ALARA objective.

Workers

Environmental protection, radiation safety, and ALARA programs are only as effective as the workers' adherence to the program. All workers at the Nichols Ranch ISR Project site will be responsible for the following:

1. Adhering to all policies, operating procedures, and instruction for environmental protection and radiation safety as established by management;
2. Reporting promptly to management equipment malfunctions or violations of standard practices or procedures that could result in increased radiological hazard;
3. Suggesting improvements for the environmental protection, radiation safety, and ALARA programs.

5.2 MANAGEMENT CONTROL PROGRAM

Activities will be conducted in a manner to protect the health and safety of employees, the public, and the environment. Management controls are provided to implement this policy.

5.2.1 Administrative Procedures

Activities that may affect health, safety, and the environment, including compliance with license commitments or conditions, will be conducted in accordance with written procedures or instructions.

5.2.1.1 Operating Procedures

Written operating procedures or instructions (procedures) will be established for all activities that involve handling, processing, or storing radioactive materials. These procedures will include consideration of pertinent radiation safety practices. Written procedures will also be established document control, record keeping, corrective action system, quality assurance, operations, industrial and radiation safety, workplace and environmental monitoring, and emergency response.

Procedures, new and revised, for activities involving radioactive material will include review and approval by the RSO. Approval and training will occur before implementation. A current copy of each procedure will be accessible to all employees. The procedures will include documentation of revision and date. Procedures will be reviewed annually by RSO.

5.2.1.2 Radiation Work Permits

Activities not covered by a written operating procedure but involving radioactive material will be conducted in accordance with requirements of a radiation work permit (RWP). The RWP will describe the job to be performed; precautions necessary to reduce exposure to radioactive materials; and monitoring and sampling requirements before, during, and after completion of the job.

The RWP will be completed in accordance with a written operating procedure. The RSO or RST will indicate approval of the RWP by signature. Those working under the RWP will acknowledge in writing that they understand the requirements.

5.2.1.3 Record Keeping

Records will be maintained of receipt, transfer, and disposal of source or byproduct material processed or produced at the site. Records will also be maintained of the radiation safety and environmental monitoring programs to include surveys, sampling, and calibrations. These records will be maintained for the period described by regulation or license.

The following records will be permanently maintained and retained until license termination:

- Records of deep well injection.
- Records containing information important to decommissioning and reclamation, including:
    - Descriptions of spills, contamination events and associated corrective actions.
    - Information related to site and aquifer characterization, and background radiation and radioactivity levels.

    - As built drawings of structures, equipment, restricted areas, wellfields, radioactive material storage, and any modifications showing the locations of these structures and systems through time.
    - Drawings of areas of possible inaccessible contamination, including features such as buried pipes or pipelines.
- Occupational exposure history of employees and contractors.
- Records of environmental monitoring.

Records will be maintained with safeguards against tampering and loss. Records will be maintained as hardcopy originals and/or electronic copy of same by scanning. Records will be readily retrievable for inspection at the site.

5.2.2 Safety and Environmental Review Panel

A Safety and Environmental Review Panel (SERP) will be established. The purpose of the SERP is to review proposed changes, tests, or new activities with respect to whether they first require a license amendment.

5.2.2.1 Organization

The SERP will consist of at least three members. One member will have management authority for implementing managerial and financial changes. One member will have expertise in operations and/or construction and will have responsibility for implementing any operational changes. One member will be the RSO, or designee, with responsibility for assuring that changes conform to radiation safety and environmental requirements. Additional members may be included in the SERP, as appropriate, to address specific issues or disciplines. Additional members may serve temporarily and may be consultants.

5.2.2.2 SERP Procedures

The SERP will function in accordance with a written operating procedure(s). The procedure(s) will ensure that approvals of changes in the facility, license, operating procedures, or conduct of tests or experiments are appropriately documented and reported. These approvals may be effected without obtaining a license amendment pursuant to 10 CFR 40.44, so long as the approved activity does not:

- Create a possibility for an accident of a different type than previously evaluated in the license application (as updated).
- Create a possibility for a malfunction of a structure, system, or control with a different result than previously evaluated in the license application (as updated).
- Result in a departure from the method of evaluation described in the license application (as updated) used in establishing the final safety evaluation report or the environmental assessment or technical evaluation reports or other analyses and evaluations for license amendments.

Absent approval by the SERP, a proposed activity may not occur without revision subsequently allowing SERP approval, or approval by NRC.

The RSO will not approve self-proposed changes to radiation safety and environmental requirements. A designee satisfying the qualification requirements of the RSO will serve as a SERP member in these cases.

5.2.2.3 SERP Records

The SERP records will include written safety and environmental evaluations that provide the basis(s) for determining whether changes satisfy the procedural requirements described previously. These records will be permanently maintained and retained until license termination and otherwise in conformance with previous description of record keeping requirements.

5.2.2.4 SERP Reports

The SERP records will include written safety and environmental evaluations that provide the basis(es) for determining whether changes satisfy the procedural requirements described previously. These records will be permanently maintained and retained until license termination and otherwise in conformance with previous description of record keeping requirements.

5.3 MANAGEMENT AUDIT AND INSPECTION PROGRAM

5.3.1 Audit

An audit will be completed annually of the content and implementation of radiation safety and ALARA programs. The scope of the review will be consistent with U.S. NRC Regulatory Guide 8.31 "Information Relevant to ensuring that Occupational Radiation Exposures at Uranium Mills Will Be As Low As Is Reasonably Achievable." Revision 1, 2002. A written report of the audit will be submitted to corporate and site management. A written report of the audit will be provided to the Safety and Environmental Review Panel for action as applicable.

5.3.2 Inspections

Inspections will be conducted periodically, as described below, of the wellfield and process areas. The purpose of the inspections will be to ensure that radiation protection, monitoring, and safety requirements are being followed and/or are properly functioning. The inspections will be performed and documented in accordance with a written procedure.

Daily

An ES&H staff representative will conduct a daily walkthrough inspection of the process and storage areas. The inspection will provide for a visual survey of proper implementation of procedures, housekeeping, and contamination control.

Weekly

The ES&H staff will complete a weekly inspection of the site. The scope of the inspection will include radiation safety practices, procedural compliance, environmental monitoring, and environmental conditions at the site.

Monthly

The ES&H manager will provide to site management a written summary of the conditions of radiation safety and environmental monitoring. The report will include summaries of personnel monitoring, radiation and contamination surveys, trends important to ALARA considerations, a general assessment of compliance, and a description of problems with recommendations for corrective action.

5.4 QUALIFICATIONS FOR PERSONNEL CONDUCTING THE RADIATION SAFETY PROGRAM

The qualifications are described below for personnel assigned responsibility for developing, conducting, and administering the radiation safety program. The qualifications will be consistent with NRC Regulatory Guide 8.31, "Information Relevant to ensuring that Occupational Radiation Exposures at Uranium Mills Will Be As Low As Is Reasonably Achievable", Revision 1, 2002 at Section 2.4.

Radiation Safety Officer

The RSO should have the following education, training, and experience:

Education: A bachelor's degree in the physical sciences, industrial hygiene, or engineering from an accredited college or university, or an equivalent combination of training and relevant experience in radiation safety. Two years of relevant experience may be considered equivalent to one year of academic study.

Radiation Safety Experience: At least one year of work experience relevant to uranium recovery operations in applied radiation safety, industrial hygiene, or similar work. This experience should involve actually working with radiation detection and measurement equipment, and administrative duties.

Specialized Training: At least 4 weeks of specialized classroom training in radiation safety applicable to uranium recovery. Refresher training on relevant radiation safety matters should be completed every 2 years.

Specialized Knowledge: Knowledge of the proper application and use of all radiation safety equipment used at the facility, the analytical procedures used for radiological sampling and monitoring, methodologies used to calculate personnel exposure to uranium and its daughters, an understanding of the processes and equipment used at the facility, and how the radiation hazards are generated and controlled.

Radiation Safety Technician

The radiation safety technician should have one of the following combinations of education, training, and experience:

Education: An associate degree or 2 or more years of study in the physical sciences, engineering, or a health-related field;

Training: At least 4 weeks of generalized training (up to 2 weeks may be on-the-job training) in radiation safety applicable to uranium recovery facilities;

Experience: One year of work experience using sampling and analytical laboratory procedures that involve radiation safety, industrial hygiene, or industrial safety measures to be applied at a uranium recovery facility;

Or

Education: A high school diploma;

Training: A total of 3 months of specialized training (up to one month may be on-the-job training) in radiation safety relevant to uranium recovery facilities;

Experience: Two years of relevant work experience in applied radiation safety.

The radiation safety technician should demonstrate a working knowledge of the proper operation of radiation safety instruments used in the facility, surveying and sampling techniques, and personnel dosimetry requirements.

5.5 RADIATION SAFETY TRAINING

All personnel will be provided training before entering controlled areas or beginning their jobs. The scope of the training will be based on access requirements to the facility and potential for exposure to radiation and radioactive materials. The scope of training will initially be determined with respect to whether the individual is a visitor, or an employee or contractor. Training of visitors will be applicable to newly hired employees and contractors, and visitors who will not or have not completed other site-specific training (e.g. as described below). All visitors to the facility will receive instruction on what they should do to avoid possible radiological and nonradiological hazards in the areas of the facility they will be visiting, escort requirement, and actions to take during an emergency.

All new employees and contractors will be instructed by means of an established course in the inherent risk of exposure to radiation and the fundamentals of protection against exposure to uranium and its daughters before beginning their jobs. The training will be commensurate with the risks and hazards associated with their requirements for access to the site. Those personnel who need unescorted access to the wellfield and process area will be provided a course of instruction covering those topics identified in NRC Regulatory Guide 8.31, "Information Relevant to ensuring that Occupational Radiation Exposures at Uranium Mills Will Be As Low As Is Reasonably Achievable", Revision 1, 2002 at Section 2.5. The instruction will be consistent with NRC Regulatory Guide 8.29, "Instruction Concerning Risks from Occupational Radiation

Exposure", Revision 1, 1996 and NRC Regulatory Guide 8.13, "Instruction Concerning Prenatal Radiation Exposure", Revision 3, 1999.

Those employees and contractors who will work in the wellfield or process area (i.e. working around radiation and/or with radioactive materials) will be provided additional training. The additional training will include more depth on the previously identified topics, particular instruction on the health and radiation safety aspects and nonradiological hazards of tasks, and the requirements of procedures and instructions pertaining to radiation safety.

A written or oral test will be given to each individual. The test will cover radiation safety and health protection principles and requirements as applicable to the Nichols Ranch ISR Project site. The test will be reviewed with the individual(s), including discussion of wrong answers. Individuals who fail the test will be provided additional training and successfully retested if the intention remains to place them in the wellfield or process area.

Employees and contractors will be provided refresher training annually. The refresher training will be an abbreviated form of the original training. Refresher training will also include relevant information available since the previous training, review of safety issues since the previous training, applicable changes in regulations and license conditions, and personnel exposure trends.

Training will be documented to include individuals name and employer, topic, date, and identification of instructor. Records will be maintained of this documentation and test results.

5.6 SECURITY

Security measures will be provided to prevent unauthorized entry to controlled areas and unauthorized access to licensed material in storage. The security measures will be comprised of passive and active controls. Passive controls will include fencing of wellfields and the process area. Passive controls will also include postings indicating that radioactive material may be present and that permission is required for entry. Active controls will also include capability to lock gates and doors. Visitors will not be allowed inside the wellfields or process area without an escort.

5.7 RADIATION SAFETY CONTROLS AND MONITORING

A corporate commitment to and support for the implementation of the radiation safety program has been established for the Nichols Ranch ISR Project sites. This commitment and support incorporates the ALARA philosophy into the environmental protection and radiation safety controls and monitoring programs described in the following sections.

5.7.1 Effluent Control Techniques

This section describes effluent control techniques designed to minimize in-plant and environmental emissions at each step of the process where release might occur.

5.7.1.1 Airborne Radioactive Effluents

The potential airborne radioactive effluents include radioactive particulates and radon gas.

5.7.1.1.1 Particulate

The potential for airborne radioactive particulate emissions is associated with the drying and packaging of the recovered uranium. These activities will occur in a closed system under vacuum. The use of vacuum drying and packaging equipment is briefly described in Section 4.1. This type equipment has been shown to eliminate particulate releases from drying and packaging activities at ISR uranium processing facilities.

Additionally, the vacuum drying and packaging will occur in a dedicated room or enclosure. This will provide for confinement of releases associated with these activities.

5.7.1.1.2 Radon

The potential for radon gas emission is associated with emanation from process solutions. Radon gas mobilization occurs from recovery solutions at process locations where systems allow venting. Control of radon gas will be achieved by using passive and mechanical ventilation in buildings where radon gas venting is expected. The application of ventilation is briefly described in Section 4.1. This type of control has been shown to be effective in reducing and controlling radon gas levels at ISR uranium processing facilities.

5.7.1.2 Liquid Radioactive Effluents

The major liquid effluents include well development water, pumping test water, process bleed, process solutions, wash-down water, and restoration water.

The primary control techniques are application of the systems and methods described in Section 4.2. Otherwise, general contamination control techniques of confinement, containment, isolation, and decontamination will be implemented by operating procedures to affect effluent control.

Nichols Ranch ISR Project will not release liquids into surface waters.

5.7.1.2.1 Contingency for Unplanned Releases

Administrative and engineering controls will be established to prevent both surface and subsurface releases to the environment and to mitigate the effects should a release occur. These controls, including response actions, will be implemented by operating procedures.

Releases can be of two primary types at an in-situ uranium recovery facility: surface releases such as vessel failure, piping failure, etc.; and subsurface releases such as well excursion or piping failure.

5.7.1.3 Surface Releases

Vessel failure – Releases may occur from leaks or ruptures of process vessels. These releases will initially be confined within the building by curbing and/or sloped flooring. The entire building will drain to a sump that will contain the solutions until transfer for appropriate management.

Piping failure – Releases may occur from leaks or breaks within the above ground segments of the piping system that transfers fluids between the wellfield and the process area. These are expected to be small and of short duration due to visual inspections and engineering controls that detect pressure changes in the piping systems subsequently alerting the plant operators through system alarms. Surface piping will be protected from vehicle traffic. All process solution pipelines will be pressure tested prior to use.

5.7.1.3.1 Subsurface Releases

Well excursion – Extraction fluids are normally maintained in the production aquifer within the immediate vicinity of the wellfield. The function of the encircling monitor well ring is to detect any extraction solutions migrating from the production area due to fluid pressure imbalance. This system has been proven to function satisfactorily over many years of operating experience with uranium in-situ uranium recovery operations.

A ring of perimeter monitor wells located no further than 500 ft from the wellfield and screened in the ore-bearing aquifer will surround all wellfields. Additionally, shallow and deep monitor wells will be placed in the first overlying and first underlying aquifer above each wellfield segment. These wells will be sampled biweekly for the presence of leach solution. The total effect of the close proximity of the monitor wells, the low flow rate from the well patterns, and over-production of leach fluids (production bleed) makes the likelihood of an undetected excursion extremely remote.

Migration of fluids to overlying and underlying aquifers has also been considered. Several controls are in place to prevent this. All current and future exploration holes will be plugged to prevent commingling of aquifers and to isolate the mineralized zone. In addition, prior to placing a well in service, a well mechanical integrity test will be performed. This requirement ensures that all wells are constructed properly and capable of maintaining pressure without leakage.

Piping failure – Releases may occur from leaks or breaks within the underground segments of the piping system that transfers fluids between the wellfield and the process area. These are expected to be small and of short duration due to engineering controls that detect pressure changes and flow rates in the piping systems subsequently alerting the plant operators through system alarms. All process solution pipelines will be pressure tested prior to use.

5.7.2 External Radiation Exposure Monitoring Program

Monitoring, surveys, instrumentation, and equipment will be provided to determine exposures of employees to external radiation during routine and non-routine operations, maintenance, and cleanup activities.

5.7.2.1 Personnel Monitoring

Industry experience reveals that personnel working at *in situ* uranium recovery facilities are not likely to exceed 10% of the applicable external occupational dose limit. However, individual monitoring devices will be provided to the group or category of workers who will receive the greatest external occupational dose; i.e. those assigned to the central processing plant and/or the satellite facility.

External exposure monitoring will be accomplished using thermoluminescent or optically stimulated luminescent dosimeters. These dosimeters have a lower limit of detection of one mrem and an upper limit of approximately 1,000 rem. The dosimeters will be processed at least quarterly by a vendor accredited by the National Voluntary Laboratory Accreditation Program.

Corrective action will be implemented for any worker reaching 25% of the annual limits of 10 CFR 20.

The program for external exposure monitoring and determining doses from external exposure will be conducted in accordance with or equivalent to NRC Regulatory Guide 8.34, "Monitoring Criteria and Methods to Calculate Occupational Radiation Doses", 1992.

Documentation of these monitoring results will be completed consistent with NRC Regulatory Guide 8.7, "Instructions for Recording and Reporting Occupational Radiation Exposure Data", Revision 1, 1992.

5.7.2.2 Exposure Rate Surveys

Exposure rate surveys will be performed on at least a quarterly frequency in the process areas. Surveys will be performed at normally and periodically occupied locations and areas of potential gamma sources such as process vessels, filter press, dryer, and yellowcake storage. Routine survey locations are shown on Figure 5-2a and 5-2b (see map pocket).

The surveys will be performed with instrumentation that, individually or in combination, covers a range of approximately 0.010 mrem per hour to five mrem per hour. The survey instruments will be portable and hand-held. The instruments will be calibrated at least annually. The instruments will be calibrated and operated in accordance with manufacturers instructions. The instruments will satisfactorily complete a performance check each day of use.

The results of these surveys will be used to establish postings in accordance with requirements of 10 CFR 20. The results of these surveys may be used to supplement personnel monitoring when work is being performed where workers are required to be monitored.

Exposure rate surveys will be made consistent with NRC Regulatory Guide 8.30 "Health Physics Surveys in Uranium Mills", Revision 1, 2002.

5.7.3 Airborne Radiation Monitoring Program

A program will be implemented at the Nichols Ranch ISR Project sites for determination of concentrations of uranium and radon daughters in air. The scope of the program will include routine and non-routine operations, maintenance, and cleanup. Results of the program will be used for personnel exposure calculations, and to implement ALARA with respect to airborne radiation exposures and airborne radioactive releases. The airborne radiation monitoring program will be implemented in conjunction with the respiratory protection program.

The routine airborne radioactivity sampling locations are shown in Figure 5-2a and 5-2b (see map pocket).

Air sampling will be conducted in accordance with or equivalent to NRC Regulatory Guide 8.25, "Air Sampling in the Workplace", 1992. The program will be implemented consistent with NRC Regulatory Guide 8.30 "Health Physics Surveys in Uranium Mills", Revision 1, 2002.

5.7.3.1 Airborne Uranium Particulate Monitoring

Airborne uranium particulate monitoring will include both breathing zone (e.g. lapel) and area sampling. The samples will be collected under known physical conditions. Typically, the air filter will be glass fiber or paper, flow rate will be 2 to 5 liters per minute for breathing zone and 20 to 50 liters per minute for area, and start and stop time will be recorded. The flow meters will be calibrated after repair or modification, but at least annually. The samples will be analyzed onsite for gross alpha count rate. The resulting airborne radioactivity concentration will be interpreted as total uranium to support the calculations described in Section 5.7.4.

5.7.3.1.1 Breathing Zone

Breathing zone air samples will be a method used to monitor the worker's intake of uranium.

This type of air sampling will be used routinely for drying and packaging activities. This type air sampling will be used for non-routine operations, maintenance, and cleanup as required by operating procedure and/or RWP.

5.7.3.1.2 Area

Air samples will also be collected for general and/or local areas when and/or where there is potential for generation of airborne radioactive material.

These samples will be used to verify that confinement or containment is effective, and provide warning of elevated concentrations for planning or response actions. In each case, the sampling point will be located considering airflow patterns and to provide the most reasonable representation of the work environment.

This type of air sampling will be used routinely for drying and packaging activities. This type of air sampling will be used for non-routine operations, maintenance, and cleanup as required by operating procedure and/or RWP.

5.7.3.1.3 Action Level and Limit

An administrative action level will be established for these type of air samples of one derived air concentration (DAC) described in Section 5.7.4; air sample results greater than this administrative action level will be reported to the RSO. An administrative limit will be established for these type of air samples of 12 DAC-hours per week; individual exposure greater than this limit will require the individual to be restricted from work involving potential exposure to airborne radioactive material unless approved by the RSO.

5.7.3.2 Radon

Radon monitoring will be conducted of the general work areas. The radon detectors will be of the track-etch type. The detection limit will be at least 0.33 pCi/l per 90 days of exposure. The radon detector will be exchanged quarterly. The detectors will be analyzed for total radon.

5.7.3.3 Radon Daughter Concentration Monitoring

The airborne concentration of radon daughters will be determined using the modified Kusnetz method. The flow meters will be calibrated after repair or modification, but at least annually. The air sample result will support the calculations described in Section 5.7.4.

This type of sampling will be made of the process areas. The sampling frequencies and actions levels will be as described in NRC Regulatory Guide 8.30 "Health Physics Surveys in Uranium Mills", Revision 1, 2002 at Section 2.3.

5.7.3.4 Respiratory Protection Program

Respiratory protection equipment will be used when other means are not available or sufficient to control a worker's exposure to airborne radioactivity. Respiratory protection will routinely be used for drying and packaging activities. Respiratory protection will be used when airborne radioactivity levels are known or expected to exceed one DAC as described in Section 5.7.4, and when surface contamination levels are known or suspected to exceed 220,000 dpm/100 m^2. Respiratory protection will be used for non-routine operations, maintenance, and cleanup as required by operating procedure and/or RWP.

The respiratory protection program will be conducted in accordance with or equivalent to NRC Regulatory Guide 8.15, "Acceptable Programs for Respiratory Protection", Revision 1, 1999.

5.7.4 Exposure Calculations

The methodologies to calculate intake of radioactive materials by personnel in work areas where airborne radioactive material may exist are in accordance with 10 CFR 20.1204 and 20.1201. Exposure calculations will be completed for routine operations, non-routine operations, maintenance, and cleanup activities. The intake estimates will be based on actual exposure times and airborne concentrations of radioactive material. Exposure times will be determined from interview, the radiation work permit, other record of work, or a combination. The airborne radioactivity concentrations will be determined as described in Section 5.7.3.

Exposure calculations for airborne radioactive material will be made in accordance with or equivalent to NRC Regulatory Guide 8.34, "Monitoring Criteria and Methods to Calculate Occupational Radiation Doses", 1992 at Section 3.

5.7.4.1 Uranium

The predominant method will be by comparison of the airborne concentration of uranium to the Derived Air Concentration value of 10 CFR 20, Appendix B, Table 1, Column 3, Uranium-natural. A solubility classification "D" will be assigned to all uranium at the Nichols Ranch ISR Project sites. Account will be made for use of respiratory protection with respect to Appendix A of 10 CFR 20.

The resulting intakes will also be compiled to allow comparison to the weekly intake limit for soluble uranium of 10 CFR 20.1201(e).

The resulting intakes are recorded onto each worker's occupational exposure record.

5.7.4.2 Radon Daughters

The predominant method will be by comparison of the airborne concentration of radon daughters in terms of working level (WL) to the Derived Air Concentration value of 10 CFR 20,

Appendix B, Table 1, Column 3, Radon-222, as WL. A classification "with daughters present" will be assigned to all radon daughter sample results at the Nichols Ranch ISR Project sites. Account will be made for use of respiratory protection with respect to Appendix A of 10 CFR 20.

The resulting intakes are included in each worker's occupational exposure record.

5.7.4.3 Prenatal and Fetal Radiation Exposure

Monitoring, calculations, and dose assignment will be performed in accordance with the guidance of NRC Regulatory Guide 8.36 "Radiation Dose to the Embryo/Fetus", 1992. Guidance and dose limits set forth in NRC Regulatory Guide 8.13 "Instruction Concerning Prenatal Radiation Exposure", 1999 will also be provided. Efforts will be made to avoid substantial variation above a uniform monthly exposure rate to a declared pregnant woman with respect to the 0.5 rem limit.

5.7.4.4 Recording Radiation Dose

The radiation dose assigned to a worker that requires monitoring as a result of exposure calculations described here will be recorded in conformance with NRC Regulatory Guide 8.7 "Instructions for Recording and Reporting Occupational Radiation Exposure Data", 1992.

5.7.5 Bioassay Program

A bioassay program will be provided to confirm results of the airborne radioactivity monitoring program. The bioassay program will be applicable to all workers routinely or potentially exposed to airborne uranium. The type of bioassay will be urinalysis.

The program will include baseline samples from all new employees. Bioassay samples will be collected at least once per month from those workers involved with uranium extracted into solution from ion exchange through final packaging, and those who conduct regular maintenance on drying and ventilation/filtration equipment. Additional bioassay samples may be collected with respect to specific activities, as described on a Radiation Work Permit, or when air sampling data are not available. Random sampling of other personnel will be conducted on the same monthly schedule. The program will include exit samples from all employees upon termination of employment.

Action levels for bioassay results will be those described in Table 1 of NRC Regulatory Guide 8.22 "Bioassay at Uranium Mills", 1988.

The bioassay program, including time of sample collection, availability of results, method of sample collection, measurement sensitivity, and quality control will be implemented consistent with the NRC Regulatory Guide 8.22 "Bioassay at Uranium Mills", 1988.

5.7.6 Contamination Control Program

A contamination control program will be established to prevent contaminated employees and equipment from entering clean areas or from leaving the site. The contamination control program will be implemented considering the guidance of NRC Regulatory Guide 8.30 "Health Physics Surveys in Uranium Mills", Revision 1, 2002.

5.7.6.1 Surveys for Surface Contamination in Restricted Area

Inspection will be made daily in the drying and packaging areas for visible yellowcake on surfaces. Inspection will be made weekly in the other process areas for visible yellowcake on surfaces. Visible yellowcake will be cleaned up promptly, but not later than the end of the shift or workday. Spills will be cleaned up before the yellowcake dries so that re-suspension during cleanup will be lessened.

A survey for removable surface contamination will be made weekly in rooms within the process area where work with uranium is not performed, such as break rooms, change rooms, control rooms, and offices. An area will be promptly cleaned if surface contamination levels exceed 1000 dpm/100cm^2.

5.7.6.2 Surveys for Surface Contamination in Unrestricted Area

A survey for removable surface contamination will be made monthly in the unrestricted area, to include eating areas, change rooms, and offices. An area will be promptly cleaned if surface contamination levels exceed 500 dpm/100cm^2.

5.7.6.3 Surveys for Contamination of Skin and Personal Clothing

All personnel leaving the restricted area will be required to survey the soles of their shoes. The alpha contamination limit for these surveys is 5000 dpm/100cm^2.

Employees working in the precipitation, drying and packaging areas, as well as those involved in process equipment maintenance or repair are provided appropriate protective clothing and equipment. Protective clothing is laundered on site or, if a disposable type, is disposed of in a facility licensed to accept such wastes.

All employees with potential exposure to yellowcake dust can shower and change clothes each day prior to leaving the site. An employee is considered uncontaminated after showering and changing clothes. In lieu of showering, employees are required to survey their clothing, shoes, hands, face and hair with an alpha survey instrument prior to leaving the site. The alpha contamination limit for these surveys is 1000 dpm/100cm^2.

The RSO or designee will perform an unannounced spot survey for alpha contamination on selected yellowcake workers leaving facility each quarter.

5.7.6.4 Surveys of Equipment Prior to Release to Unrestricted Areas

Personnel will conduct contamination monitoring of small, hand-carried items for use in wellfield and controlled areas as long as all surfaces can be reached and the item does not originate in yellowcake areas. The alpha contamination limit for these surveys is 1000 dpm/100cm^2. Requirements for contamination control of equipment and materials released for unrestricted use are otherwise described in Section 4.3.

5.7.6.5 Surveys for Contamination on Respirators

Respiratory protection equipment will be surveyed for alpha contamination by a standard wipe or smear technique. Removable alpha contamination levels will be less than 100 dpm/100 cm^2 prior to reuse of the equipment.

5.7.6.6 Instrumentation

The direct alpha surveys will be performed using a scaler/ratermeter with ZnS type probe. The removable alpha surveys will be performed using a standard cloth smear and a scaler/ratermeter with ZnS type probe. The survey instruments will be portable and/or hand-held. The instruments will be calibrated at least annually. The instruments will be calibrated and operated in accordance with manufacturers instructions. The instruments will satisfactorily complete a performance check each day of use.

5.7.7 Airborne Effluent and Environmental Monitoring

A program will be established for measuring concentrations and quantities of radioactive materials released to and in the environment surrounding the facility. This program will be implemented consistent with NRC Regulatory Guide 4.14 "Radiological Effluent and Environmental Monitoring at Uranium Mills", Revision 1, 1980.

The sampling and measurement locations of the program are shown in Exhibit 5-1 (see map pocket).

5.7.7.1 Stack Sampling

The operational characteristics of the vacuum drying process preclude collection of air samples from the respective exhaust. No air samples will be collected from the yellowcake dryer exhaust since there are no emissions.

5.7.7.2 Air Samples

Radon samples will be collected continuously at the same locations as the pre-operational radon sampling. The radon samples will be collected by use of track-etch type detectors, effectively equivalent to those provided for area monitoring of the workplace. The detectors will be changed once per calendar quarter. The detectors will be analyzed for total radon.

5.7.7.3 Water Samples

Samples are collected from both surface water and groundwater to support the environmental monitoring program.

5.7.7.3.1 Surface Water

Surface water samples will be collected annually at the same locations as the used for the pre-operational surface water sampling. The surface water samples will be a grab sample. The sediment samples will be analyzed for total uranium, Th-230, Ra-226, and Pb-210.

5.7.7.3.2 Groundwater

The groundwater monitoring program is described in Section 5.7.8.

5.7.7.4 Vegetation, Food, and Fish Samples

No sampling will be made of vegetation, food, or fish. The evaluation described in Section 7.3 indicates the ingestion pathway to be insignificant; i.e. the predicted dose to an individual will be less than five percent of the applicable radiation protection standard.

5.7.7.5 Soil and Sediment Samples

Surface soil samples will be collected annually at the same locations as the radon sampling. The surface soil samples will be a grab sample of 0" – 6". The surface soil samples will be analyzed for total uranium, Th-230, Ra-226, and Pb-210.

Sediment samples will be collected annually at the same locations as those used for the pre-operational sediment sampling. The sediment samples will be a grab sample. The sediment samples will be analyzed for total uranium, Th-230, Ra-226, and Pb-210.

5.7.7.6 Direct Radiation

Gamma measurements will be made continuously at the same locations as the radon sampling. The gamma measurements will be made with passive integrating detectors, effectively equivalent to those provided for personnel monitoring. The detectors will be changed once per calendar quarter.

5.7.8 Groundwater Monitoring Program

The groundwater monitoring program for the Nichols Ranch ISR Project will be based on information obtained from pre-mining baseline geologic and hydrologic information, wellfield testing, and wellfield groundwater baseline sampling.

5.7.8.1 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 of 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 is all accomplished by conducting a very capital intensive multi-step program that includes interaction with the WDEQ-LQD.

5.7.8.2 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 Wyoming Department of Environmental Quality.

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.

5.7.8.3 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 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.

5.7.8.4 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 Safety and Environmental Review Panel (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.

5.7.8.5 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.

5.7.8.5.1 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-LQD 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-LQD 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 5-1. The third and fourth sampling events will be analyzed for the possible UCL parameters chloride, total alkalinity, and conductivity.

5.7.8.6 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-LQD 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 undergroundwater 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 halfway 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.

5.7.8.7 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.

5.7.8.8 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.

5.7.8.9 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 $CaCO_3$.

Table 5-1 Restoration Target Values 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

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.

5.7.8.10 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.

5.7.8.10.1 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-LQD on a quarterly basis. These data will also be available to the NRC for review.

5.7.8.10.2 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.

5.7.8.10.3 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. 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, the WDEQ-LQD and NRC Project Manager will be verbally notified within 24 hours. The WDEQ-LQD 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 mitigated. 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 such time that the concentrations of excursion parameters in the affected monitor well(s) has returned to concentrations less than the established UCL's.

5.7.9 Quality Assurance

A quality assurance program will be established to provide a measure of the completeness and accuracy of sampling and measurement results. The results of the quality assurance program will demonstrate effectiveness of implemented programs or allow for identification of deficiencies so that corrective action can be taken. The quality assurance program will be applied to all radiological, effluent, and environmental programs.

5.7.9.1 Organization

The organizational structure described in Section 5.1 will be responsible for implementation of the quality assurance program.

5.7.9.2 Procedures

The quality assurance program will be implemented in accordance with written operating procedures as described in Section 5.2. These procedures will include consideration of quality assurance and quality control for activities of measurement, sampling, sample analysis, calibration, calculation techniques, data evaluation, and data reporting.

5.7.9.3 Records

Records will be maintained to document the activities performed in the program. The records will be specified in the applicable operating procedure. These records will include field logs, chain-of-custody, measurement results, instrument performance checks, calibration, data reduction, and data review and approval.

Record keeping will be in conformance with Section 5.3.2.

5.7.9.4 Quality Control in Sampling

Quality control for sample and measurement collection will be included in the respective operating procedure. Requirements will be designed to ensure that the sample or measurement is representative of actual conditions. Chain-of-custody records will be maintained for samples in accordance with an operating procedure.

5.7.9.5 Quality Control in Laboratory

Quality control of laboratory measurements and analyses will be included in the respective operating procedure, or a supporting operating procedure or instruction.

5.7.9.5.1 Calibration

Requirements will include use of calibration standards or sources traceable to National Institute of Standards and Technology.

5.7.9.5.2 Performance Checks

Determination of the background counting rate and the response of radiation detection systems to appropriate check sources will be performed on a scheduled basis for systems in routine use.

The results of these measurements will be recorded and monitored. Investigative and corrective action will be taken when the performance check falls outside a predetermined control value.

5.7.9.5.3 Quality Control Samples

Quality control samples will be collected to assess field activities, intralaboratory, and interlaboratory analyses. Control values will be established for evaluation of these results. Investigative and corrective action will be taken when the results fall outside a predetermined control value.

Quality control for field activities will include replicates and blanks. Intralaboratory quality control will be accomplished by use of duplicate samples. Interlaboratory quality control will include use of replicates or duplicates to different contract laboratories and/or will be made by reference to a contract laboratory's participation in an independent verification program; e.g. EPA or state qualifications or certifications.

5.7.9.6 Computational Checks

Computations of the concentration of radioactive materials will include the independent verification of a fraction of the results of the computation or of the calculation method or both by a person other than the one performing the original computation.

5.7.9.7 Review and Analysis of Data

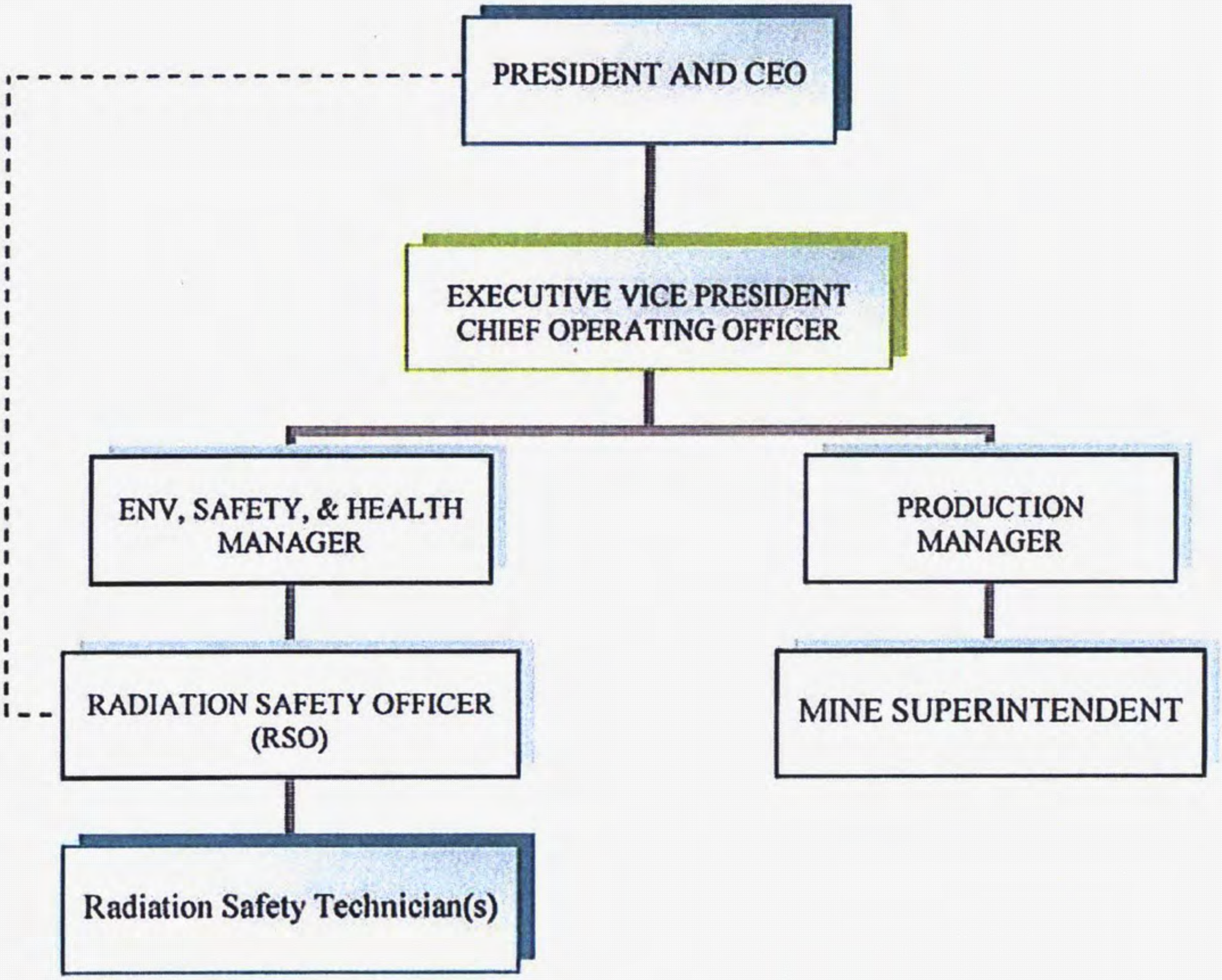
Requirements for review and analysis of data will be included within operating procedure or instructions governing collection and analysis of samples and measurements. These requirements will cover examination of data from actual samples and from quality-control activities for reasonableness, completeness, and consistency. Provisions will be made for investigation and correction of recognized deficiencies and for documentation of these actions.

5.7.9.8 Review of Quality Assurance Program

Reviews will be made to verify implementation of the quality assurance program. The audits will be performed by individuals qualified in the respective techniques who do not have direct responsibilities in the areas being reviewed.

Results will be documented and provided to the Safety and Environmental Review Panel (SERP). Follow-up action, including additional review of deficient areas, will be taken upon recommendation of the SERP.

The quality assurance program will be implemented consistent with NRC Regulatory Guide 4.15 "Quality Assurance for Radiological Monitoring Programs (Normal Operations) – Effluent Streams and the Environment", Revision 1, 1979.



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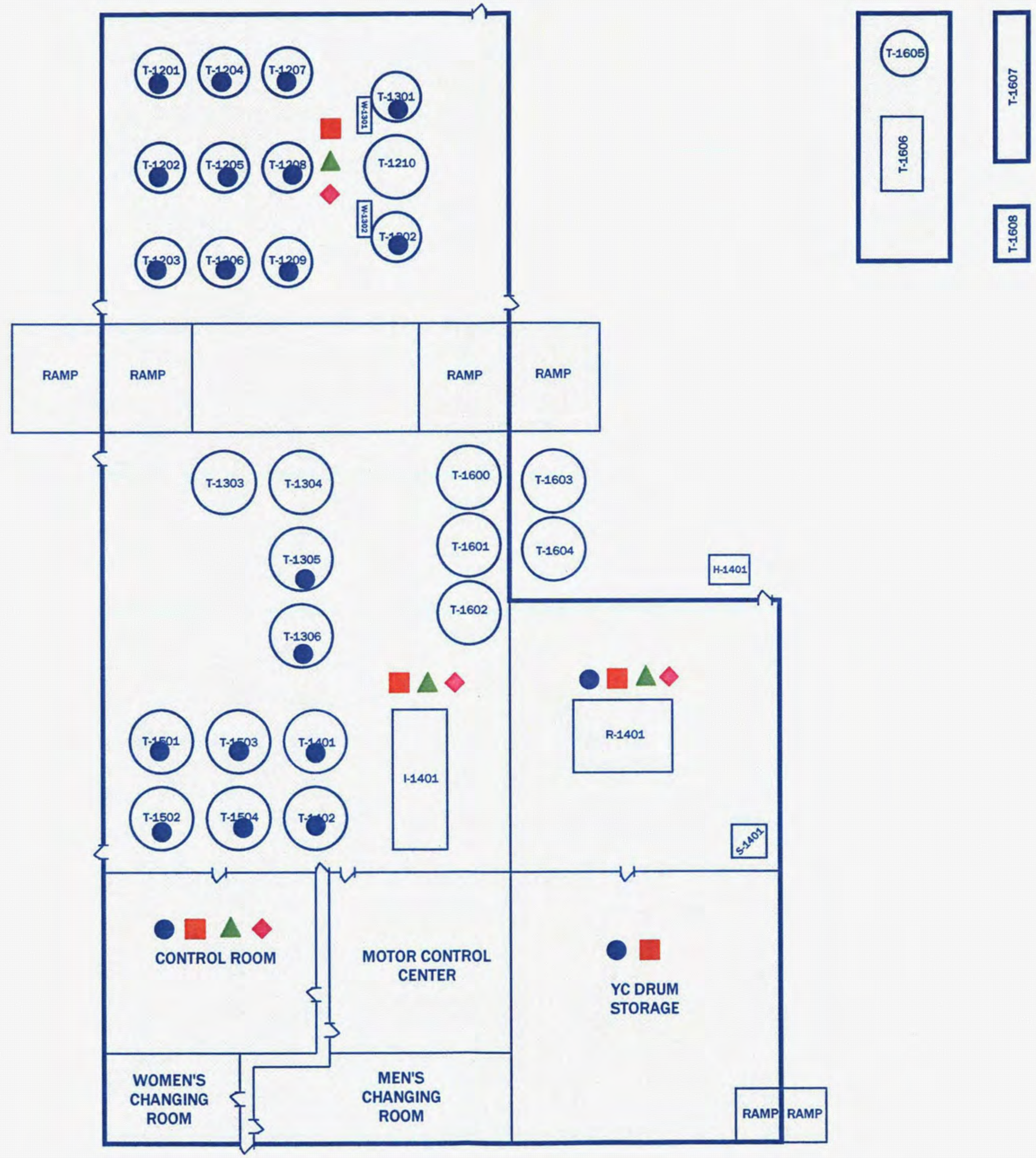
NICHOLS RANCH ISR PROJECT

FIGURE 5-1

URANERZ ORGANIZATION

By: S.M.F.	Date: OCTOBER 29, 2007
Contour Interval: N/A	Revision Date:
Scale: N/A	DATUM: N/A



LEGEND

WELL FIELD = 1100'S
IX = 1200'S
ELUTION = 1300'S
YELLOWCAKE = 1400'S
WASTE = 1500'S
CHEMICALS = 1600'S
TANKS = T
SCREENS = W
FILTERS = I
DRYERS = R
HEATERS = S
COOLING TOWERS = H
PUMPS = P

SYMBOL LEGEND

- ● Exposure Rate Survey
- ■ Airborne Radioactivity - Particulate
- ▲ Airbrone Radioactivity - Radon
- ◆ Airborne Radioactivity - Working Level

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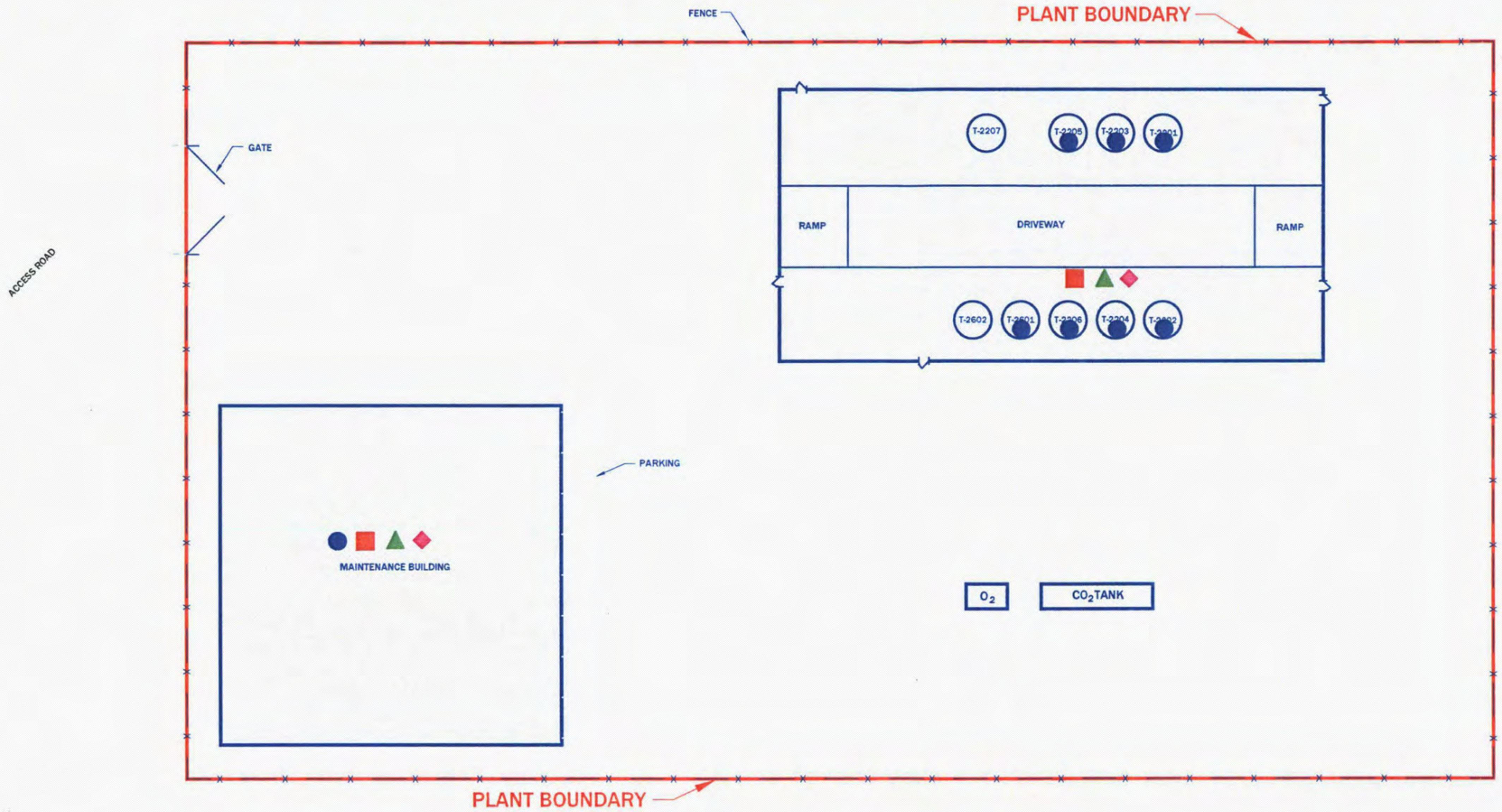
NICHOLS RANCH ISR PROJECT

FIGURE 5-2a

Central Process Plant Survey Locations

By: S.M.F.	Date: OCTOBER 18, 2007
Contour Interval: N/A	Revision Date:
Scale: 1"=30'	Datum: NAD27 UTM 13



LEGEND

WELL FIELD = 2100'S
IX = 2200'S
CHEMICALS = 2600'S
TANKS = T
PUMPS = P

SYMBOL LEGEND

- ● Exposure Rate Survey
- ■ Airborne Radioactivity - Particulate
- ▲ Airbrone Radioactivity - Radon
- ◆ Airborne Radioactivity - Working Level

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NICHOLS RANCH ISR PROJECT

FIGURE 5-2b

Process Satellite Plant Survey Locations

By: S.M.F.	Date: OCTOBER 18, 2007
Contour Interval: N/A	Revision Date:
Scale: 1"=40'	Datum: NAD27 UTM13

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED: DRAWING NO.: EXHIBIT 5-1, "ENVIRONMENTAL MONITORING LOCATIONS"

WITHIN THIS PACKAGE... OR, BY SEARCHING USING THE DOCUMENT/REPORT DRAWING NO. EXHIBIT 5-1

D-01

6.0 RECLAMATION PLAN

The objective of the Reclamation Plan is 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.

6.1 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.

6.1.1 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.

6.1.2 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. 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 6.1.4). 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.

6.1.3 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 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.

6.1.3.1 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.

6.1.3.2 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.

6.1.3.3 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.

6.1.3.4 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.

6.1.4 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.

6.1.5 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 Wyoming Department of Environmental Quality-Land Quality 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.
3. The casing is cut off at least two feet below the ground surface. Abandonment fluid is used to fill the void to the top of the cut-off casing.
4. Cement or a plastic plug 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.

6.2 SURFACE RECLAMATION AND DECOMMISSIONING

6.2.1 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.

6.2.2 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.

6.2.3 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 Wyoming Department of Environmental Quality-Land Quality Division (WDEQ-LQD) 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 6A. 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-LQD 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.

6.2.4 Vegetation Reclamation Practices

All revegetation practices will be conducted in accordance with the WDEQ-LQD 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 6-1 shows the seed mixture that will be used for reclamation. This mixture was developed through discussions with the landowner and approved by the WDEQ-LQD. 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-LQD 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-LQD 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-LQD.

Table 6-1 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

6.2.5 Road Reclamation

6.2.5.1 Access Roads

Two access roads will be built to connect both the Nichols Ranch central processing plant (CPP) 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 roadbed 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.

6.2.5.2 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 6A. At the time of decommissioning, the landowner 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 roadbed is back to the approximate original grade. Next, the roadbed will be either disced or ripped. The disturbed area will then be mulched and seeded with the permanent seed mixture.

6.2.6 Site Decontamination and Decommissioning

6.2.6.1 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.

6.2.6.2 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.

6.2.7 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.

6.2.8 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-LQD 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-LQD.

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-LQD with a copy to the NRC.

Addendum 6B 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.

7.0 ENVIRONMENTAL EFFECTS

7.1 SITE PREPARATION AND CONSTRUCTION

The environmental impacts of site preparation and construction for the Nichols Ranch ISR Project will be minimal. Even though the project boundaries (permit 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 lifetime 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 ISR operations in the Powder River Basin of Wyoming 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. The landowner that the Nichols Ranch ISR Project is located on has specific road construction practices that will be implemented if access roads have to be constructed. The details for road construction can be found in Addendum 6A in Chapter 6.0 of this license application. When the access roads are no longer needed for the operation of the project, those access roads that the landowner does not want 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 60-80 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.

7.2 EFFECTS OF OPERATION

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.

7.2.1 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. Berms and contouring when and where possible 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 of Chapter 2.0 provides a map of the surface drainage areas for the Nichols Ranch ISR Project.

7.2.2 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 form 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 well heads, or other measures to protect the wells from damage will be utilized.

7.2.3 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) 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 ft contour is projected to extend out 22,500 ft or approximately 4 mi from the Nichols Ranch ISR Project area. Table 7A.1-1 in Addendum 7A presents the WELFLO model printout of the simulated drawdown.

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.

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). 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 ft unit contour extends out approximately 900 ft from the edge of the wellfields. Table 7A.2-1 in Addendum 7A presents the output from the WELFLO program for the Hank simulation.

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.

7.2.4 Air Quality

The Nichols Ranch ISR Project will result in minimal and temporary impacts to air quality in the region of the project. By using the in situ recovery method for the extraction of the uranium, minimal emissions are created. The principal emission will be fugitive dust evolved from vehicle traffic to and from the project site and from wellfield activities since the majority of the roads in the project are unpaved. Negligible amounts of fugitive dust will be evolved from the disturbance of the soils during well development.

The gaseous pollutants produced from the diesel and gas vehicles used for the Nichols Ranch ISR Project are considered a non-stationary source which results in negligible impacts to the project area. Equipment used for development of the wellfields and construction activities will be used intermittently. Other vehicle traffic associated with the Nichols Ranch ISR Project will be gas and diesel vehicles equipped with required pollution control devices.

Fugitive dust emissions associated with wind erosion are considered to be negligible. Measures such as reseeding and prompt reclamation of disturbed areas such as wellfields will be utilized to minimize the dust emissions. These measures will also be used for additional areas such as topsoil stockpiles.

Emissions from the processing facilities associated with the Nichols Ranch ISR Project are limited to airborne effluents generated from process tanks and vessels. The amounts of emissions that are released from the processing facility are considered to be very minimal to negligible. Table 7-1 identifies the emission sources from the processing facilities and their estimated emission quantities.

Radon gas may be evolved in certain processing steps. When the pregnated lixiviant is brought to the surface from the ore zone aquifer, radon can be evolved by the dissolution of the radon from the lixiviant. The release of radon by this method could potentially adversely affect the surrounding atmosphere at the point of release. Certain areas of the wellfields and processing facility could be affected. To reduce the potential of radon gas evolution, methods such as using down flow ion exchange columns will be utilized. The down flow ion exchange columns keep the radon gas in solution by keeping it under a constant pressure. However, caution and proper safety measures must and will be taken when disconnecting ion exchange columns for resin transfer. Radon gas could be emitted from the ion exchange columns when the columns are taken off line and opened to the atmosphere. Caution and proper safety measure must also be taken in the wellfield where radon gas can be vented from wellheads.

Table 7-1 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

The yellowcake dryer that will be located at the Nichols Ranch Unit could potentially release airborne particulate emissions such as uranium and radon daughters to the atmosphere. To reduce the chance of dryer particulate emissions, a vacuum dryer is utilized. By keeping the dryer under a constant vacuum, any particulates that are generated in the drying process are captured in the dryer itself and then deposited in a closed loop dust collection system that empties into 55 gallon drums. Any potential radiological impacts of particulate emissions that might leave the dryer on the local populations are detailed by the use of the MILDOS computer model developed by the NRC. Section 7.3 provides a detailed discussion of this model.

7.2.5 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-mile buffer (see Exhibits D9-1-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 mi^2 (39,659.6 acres).

7.2.5.1 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 non existent and no mitigation factors are needed.

7.2.5.2 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 (refer to the Reclamation Plan). Reclamation will be directed toward the restoration of the site primarily for livestock grazing and wildlife habitat.

7.2.5.2.1 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.

7.2.5.2.2 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.

7.2.5.2.3 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.

7.2.5.2.4 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.

7.2.5.2.5 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 a negligible short-term adverse impacts on lagomorph populations. No adverse long-term impacts are likely to occur.

7.2.5.2.6 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.

7.2.5.2.7 Raptors

Forty raptor nests occur within the wildlife study area, of which 14 were determined to be active. Twelve of the 14 active nests were located in the Hank Unit and two of the active nests were located in the Nichols Ranch Unit. Two active red-tailed hawk, two long-eared owl, one great-horned owl, and two prairie falcon nests were observed in the Hank 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.

7.2.5.2.8 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.

7.2.5.2.9 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.

7.2.5.2.10 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.

7.3 RADIOLOGICAL EFFECTS

This section provides an evaluation of the radiological effects of the Nichols Ranch ISR Project. The evaluation considers potential exposure pathways to humans from operation of the Nichols Ranch and Hank Unit facilities.

The evaluation described in this section is based on the description of the sites and operations provided in Chapter 3.0 of this report. Otherwise, pertinent inputs and assumptions are included here.

7.3.1 Exposure Pathways

The potential exposure pathways considered here are water, air, and external. The water and external pathways are not quantitatively evaluated since there are no liquid effluents to surface water and no particulate effluents to air. The air pathway is quantitatively addressed but the scope is limited to radon since there are no particulate emissions.

7.3.1.1 Exposures from Water Pathways

The extraction solutions in the ore zone will be monitored and controlled to detect and prevent migration. The monitoring and controls are described in Section 5.7.8 of this report.

The primary method of liquid waste disposal at the facility will be by deep disposal well. The deep disposal well(s) will be completed at depths significantly deeper than zones planned for mining and current CBM operations and will be isolated geologically from underground sources of drinking water. The deep disposal wells are described in Sections 3.2.6 of this report.

The uranium ion exchange, precipitation, drying and packaging facilities will be located on curbed concrete pads to prevent liquids from entering the environment. Solutions collected on these pads, including water used to wash down equipment, drain to a sump and are either pumped back into the process circuit or to the disposal well.

No liquid effluents will be discharged to surface water. There are no surface waters on either site. Thus no definable water related pathways exist for routine operations.

7.3.1.2 Exposures from Air Pathways

Release rates of airborne radioactivity were estimated for the Nichols Ranch ISR Project. Dose commitments received by individuals and the general population within an 80 km radius of the site were estimated from atmospheric dispersal of such radioactivity with respect to regional meteorological data. Only airborne releases of radon are considered. Particulate emissions are not considered since such releases are not expected under normal operating conditions for vacuum dryers.

The computer code MILDOS-Area (MILDOS) was used to calculate both the release rates (source terms) and the dose commitments. The dose commitments include contribution from each of the Nichols Ranch and Hank Unit sites. Extra-regional population doses are also estimated as a result of transport of radon. The results are provided as total effective dose equivalent per year.

7.3.1.2.1 Site Description

The physical description of the sites is provided in Chapter 3.0 of this report. The location of the sites is described in Figure 7-3 (see map pocket). The dose estimates are provided for intervals, directions, and elevations relative to the drying/packaging location at the Nichols Ranch facility; this location is subsequently referred to as the Nichols Ranch Central Processing Plant (mill center).

7.3.1.2.2 Population Distribution

The population distribution within 80 km of the mill center is provided in Table 7-2. Figure 7-4 (see map pocket) shows the locations of the cities within 80 km of the mill center.

Table 7-2 Population Distribution Within 80 km of Nichols Ranch Central Processing Plant.

Cities Within 80 km of Mill Center	Population	Distance from Mill Center (km)	Direction from Mill Center
Gillette	19,646	74	NE
Kaycee	249	56	W
Midwest	408	40	SW
Edgerton	169	37	SW
Wright	1,347	35	E

The population dose beyond 80 km is estimated using the code's predetermined population dose for year 1978. The population dose is adjusted for population growth by the ratio of estimated United States population for year 2000 of 268 million to the estimated United States population for year 1980 of 228 million, or 1.2.

7.3.1.2.3 Individual Receptor Locations

The locations of the nearest residents to the Nichols Ranch Central Processing Plant are provided in Table 7-3. Locations of site boundaries to the Nichols Ranch CPP are provided in Table 7-4. Figure 7-3 (see map pocket) shows the locations of the nearest residents to the mill center.

Table 7-3 Nearest Residents to Nichols Ranch Central Processing Plant.

Nearest Residence	Number of Inhabitants	Distance from mill center km		Elevation from mill center z m
		x(E)	y(N)	
T-Chair (Rolling Pin) Ranch	5	3.7	-2.2	-7
Dry Fork Ranch	3	-2.7	-1.1	-58
Christensen Ranch	1	1.8	7.8	-1
Pfister Ranch	3	7.8	7.4	78
Pumpkin Butte Ranch	2	11.1	3.6	218
Van Buggenum Ranch	0	15.4	5.3	130
Ruby Ranch	2	19.0	2.9	101
Hank Satellite Plant	0	7.9	3.5	121

Table 7-4 Center of Site Boundary from Nichols Ranch Central Processing Plant.

Location	Distance from mill center x(E), y(N) km		Elevation from mill center z m
Nichols Ranch – north central	-0.4	1.3	57
– east central	0.6	0.2	-2
– south central	-0.3	-1.1	-18
– west central	-1.4	0.5	12
Hank – north central	7.9	6.6	86
– east central	8.8	3.3	160
– south central	7.9	1.3	139
– west central	7.1	4.2	102

7.3.1.2.4 Time Parameters

The dose commitments were completed for development, production, and restoration of wellfields for the operating years 2011 through 2019. The respective schedule is provided in Table 7-5.

The time parameters were input as:

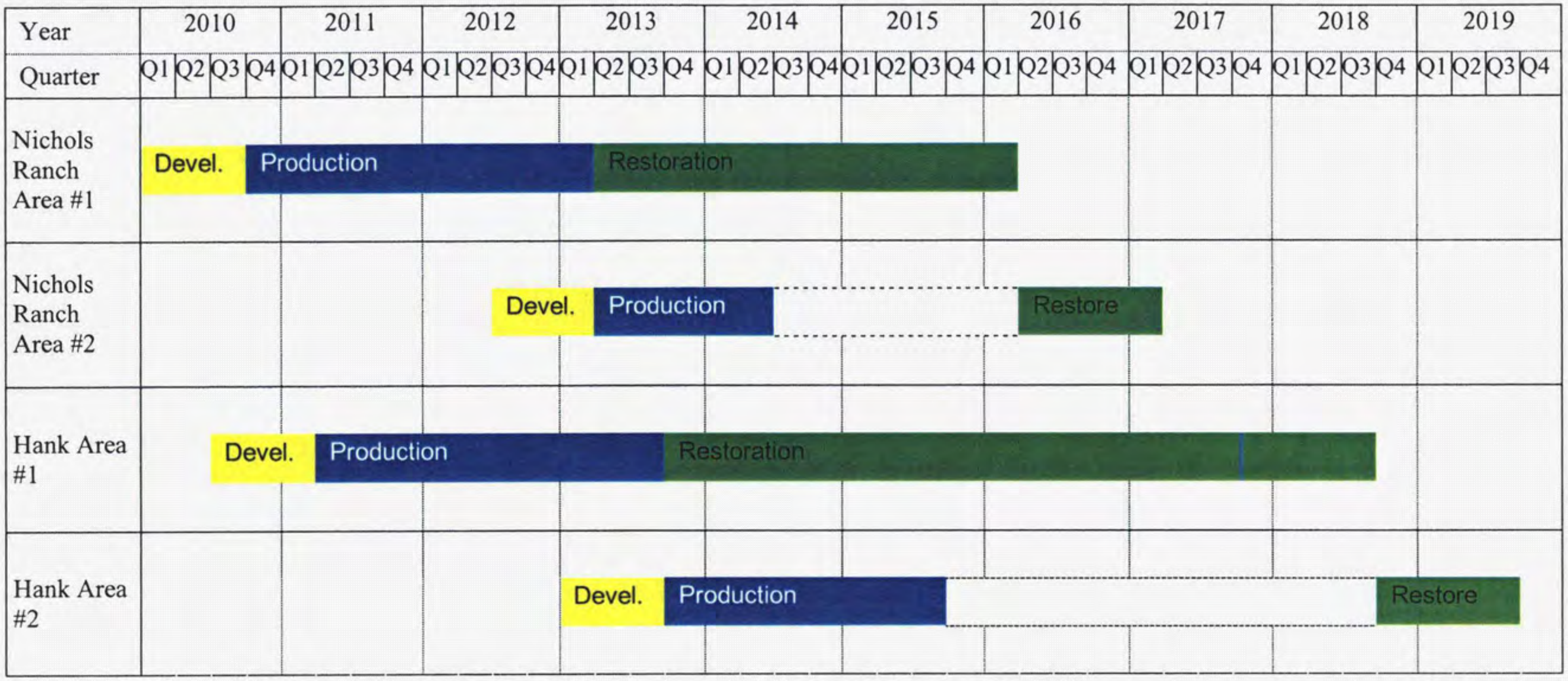
- Beginning Year: 2011.
- Number of Time Steps: 9.
- Time Increment: 1 year.
- Population Adjustment: 1.2 (see "Population Distribution")
- Source Adjustment: varied per source to reflect development, production, and restoration schedule of Table 7-5.

7.3.1.2.5 Food Pathway Parameters

The MILDOS code requires four inputs to describe the feeding habits of livestock near the sites. The inputs used to describe the fraction of total annual livestock feed requirements are:

- Pasture Grass/Individual: 0.5 (default)
- Pasture Grass/Population: 0.5 (default)
- Hay/Individual: 0.5 (default)
- Hay/Population: 0.5 (default)

Table 7-5 Development, Production, and Restoration Schedule.



The MILDOS code also requires input of the areal food-production rate per unit area around the facility. The inputs used are:

- Vegetables: 3120 kg/y-m^2
- Meat: 345 kg/y-m^2
- Milk: 134 kg/y-m^2

7.3.1.2.6 Meteorological Parameters

The meteorological parameters for the MILDOS code were input as:

- The annual average morning and afternoon mixing heights each as the code default of 100 m
- The Briggs height cutoff vertical dispersion coefficient as the code default of 50 m
- The fractional joint frequency distribution of wind speed, direction and stability for Gillette, Wyoming for years 1996 through 2005. Atmospheric stability class G was summed with class F.

7.3.1.2.7 Source Terms

The parameters and values used to develop the source terms and the resulting annual releases are listed in Tables 7-6 and 7-7 for Nichols Ranch and Hank Units, respectively. The respective source terms determined by MILDOS are included in these tables.

The fraction of radon attributable to the site was input as one for Casper, Wyoming.

A source term for release of particulates from drying and packaging activities was not developed since no particulate emissions are expected under normal operating conditions for vacuum dryers.

Table 7-6 MILDOS Input Parameters - Nichols Ranch Unit.

	(values in gray are calculated by MILDOS)*		
	Common Parameters (each wellfield)		Units
Location	X (location relative to the plant which is considered (0,0,0)	-0.9	km
	Y (location relative to the plant which is considered (0,0,0)	0.4	km
	Z (location relative to the plant which is considered (0,0,0)	6	m
	area of active drilling (ore zone)	228644	m^2
	emanation fraction	0.2	
	Ra concentration in ore	311	pCi/g
	thickness	2.2	m
	density	1.9	g/cm3
	porosity	0.3	
	fraction of Rn	0.75	
	rate of Rn venting	0.01	/d
	volume in circulation	149068 519	L
	New Wellfield Source Parameters (each wellfield)		
Mud pits	storage time in pit	30	d
	ore material into pit	136534	g/y
	number of mud pits	966	
	Total amount of Rn-222 released from drilling activities	0.045	Ci/yr
	Production Wellfield Source Parameters (each wellfield)		
Ore zone	Rn-222 source	1.1 E+13	pCi/d
Process water	treated water purge rate	190779	L/d
	Rn-222 release from purge water	20	Ci/yr
	Rn-222 release from well venting	150	Ci/yr
Ion exchange columns	column volume	14158	L
	column unloading rate	2	/d
	porosity of resin	0.4	
	Rn-222 release from ion exchange column	1.2	Ci/yr
	Total amount of Rn-222 released from production activities	170	Ci/yr
	Restoration Wellfield Source Parameters (each wellfield)		
Ore zone	Rn-222 source	1.1 E+13	pCi/d
Process water	treated water purge rate	310698	L/d
	operating days	360	d/yr
	Rn-222 release from purge water	31	Ci/yr
	Rn-222 release from well venting	150	Ci/yr
	Total Rn-222 released from restoration activities	180	Ci/yr

* Values may not sum within table due to rounding.

Table 7-7 MILDOS Input Parameters – Hank Unit.

	(values in gray are calculated by MILDOS)*		
	Common Parameters (each wellfield)	Units	
Location	X (location relative to the plant which is considered (0,0,0)	8.2	km
	Y (location relative to the plant which is considered (0,0,0)	3.5	km
	Z (location relative to the plant which is considered (0,0,0)	142	m
	area of active drilling (ore zone)	313627	m^2
	emanation fraction	0.2	
	Ra concentration in ore	277	pCi/g
	thickness	2.6	m
	density	1.9	g/cm3
	porosity	0.3	
	fraction of Rn	0.75	
	rate of Rn venting	0.01	/d
	volume in circulation	245770913	L
	New Wellfield Source Parameters (each wellfield)		
Mud pits	storage time in pit	30	d
	ore material into pit	160949	g/y
	number of mud pits	776	
	Total amount of Rn-222 released from drilling activities	0.038	Ci/yr
	Production Wellfield Source Parameters (each wellfield)		
Ore zone	Rn-222 source	1.6 E+13	pCi/d
Process water	treated water purge rate	408813	L/d
	Rn-222 release from purge water	37	Ci/yr
	Rn-222 release from well venting	220	Ci/yr
Ion exchange columns	column volume	14158	L
	column unloading rate	2	/d
	porosity of resin	0.4	
	Rn-222 release from ion exchange column	1.0	Ci/yr
	Total amount of Rn-222 released from production activities	260	Ci/yr
	Restoration Wellfield Source Parameters (each wellfield)		
Ore zone	Rn-222 source	1.6 E+13	pCi/d
Process water	treated water purge rate	119918	L/d
	operating days	360	d/yr
	Rn-222 release from purge water	11	Ci/yr
	Rn-222 release from well venting	220	Ci/yr
	Total Rn-222 released from restoration activities	230	Ci/yr

* Values may not sum within table due to rounding.

7.3.1.2.8 Results

Dose modeling was completed as described above for the primary years of operation of the Nichols Ranch ISR Project, Nichols Ranch and Hank sites. The operations modeled included wellfield development, production, and wellfield restoration. The source terms were adjusted to reflect actual periods of activity per year. The results of the dose modeling are summarized below with respect to the nearest residents, site boundaries, and the surrounding population. The 40 CFR 190 doses are zero because does from radon is excluded from the scope of the standard. The report of the MILDOS code execution is provided as Addendum 7B.

7.3.1.2.8.1 Individual Receptor Dose

Estimated annual doses at individual receptor locations are shown in Table 7-8. The estimated doses result exclusively from radon daughters, since there are no particulate releases from the facility. The total effective dose equivalent (TEDE) is at least 100 times less than the dose limit to individual members of the public in 10 CFR 20 of 100 mrem/y.

Estimated annual doses at site boundary locations are shown in Table 7-9. The estimated doses result exclusively from radon daughters, since there are no particulate releases from the facility. The total effective dose equivalent (TEDE) is substantially less than the dose limit to individual members of the public in 10 CFR 20 of 100 mrem/y.

Table 7-8 Summary of Total Effective Dose Equivalent to Individual Receptors, mrem/year.

	Year								
Receptor	2011	2012	2013	2014	2015	2016	2017	2018	2019
T-Chair Ranch	0.09	0.1	0.1	0.2	0.1	0.1	0.05	0.03	0.03
Dry Fork Ranch	0.04	0.04	0.06	0.07	0.05	0.04	0.02	0.01	0.008
Christensen Ranch	0.1	0.1	0.2	0.2	0.2	0.1	0.08	0.06	0.04
Pfister Ranch	0.4	0.5	0.6	0.9	0.8	0.4	0.4	0.04	0.3
Pumpkin Butte Ranch	0.3	0.4	0.5	0.7	0.6	0.4	0.3	0.3	0.2
Van Buggenum Ranch	0.09	0.1	0.1	0.2	0.2	0.1	0.09	0.08	0.06
Ruby Ranch	0.07	0.08	0.1	0.1	0.1	0.08	0.06	0.05	0.04

Table 7-9 Summary of Total Effective Dose Equivalent Site Boundary, mrem/year.

	Year								
Boundary Location	2011	2012	2013	2014	2015	2016	2017	2018	2019
Nichols Ranch									
– north central	1	1	2	2	2	2	0.4	0.03	0.02
– east central	0.5	0.6	0.9	0.9	0.6	0.6	0.2	0.02	0.02
– south central	0.3	0.3	0.4	0.5	0.3	0.3	0.09	0.02	0.01
– west central	2	2	3	3	2	2	0.6	0.02	0.02
Hank									
– north central	0.5	0.7	0.8	1	1	0.6	0.6	0.5	0.4
– east central	2	3	3	5	5	3	2	2	2
– south central	0.3	0.4	0.6	0.8	0.7	0.4	0.4	0.3	0.3
– west central	0.6	0.8	1	2	1	0.7	0.7	0.7	0.5

7.3.1.2.8.2 Population Dose

Estimated annual doses populations are shown in Table 7-10. The estimated doses result exclusively from radon daughters, since there are no particulate releases from the facility. There is no regulatory limit for population dose. The TEDE for the population within 80 km of the mill center is about 162,500 to 32,500 times less than the dose to this population attributable to natural background radon of 300 mrem/y (21,819 persons x 0.3 rem/y = 6500 person-rem/y).

Table 7-10 Summary of Total Effective Dose Equivalent to Populations, person-rem/year.

	Year								
Receptor	2011	2012	2013	2014	2015	2016	2017	2018	2019
Population within 80 km	0.09	0.1	0.1	0.2	0.1	0.1	0.07	0.06	0.04
Population beyond 80 km	4	4	6	8	6	4	3	2	2
All populations	4	4	6	8	6	4	3	2	2

7.3.1.3 Exposures from External Radiation

The drying and packaging operations are conducted under vacuum such that there are no particulate emissions. The drying and packaging controls are described in Section 4.1.2 of this report. Therefore, there is no potential for deposition and concentration of source material in surface soils from routine site operations.

Certain process areas at either site will routinely exhibit exposure rates well above background. However, these areas include controls to prevent unintended or unmonitored access of the general public. These process areas are of such a distance from any site boundary that natural attenuation in air reduces the exposure rate to background levels.

There is no source created by operations to establish a concern for external exposure. Also, no definable external exposure pathways exist for routine operations.

7.3.1.4 Total Human Exposures

The dose estimates described above for the air pathway represent the maximum annual dose that could be received via all pathways by an individual at the nearest residence (i.e. the individual likely to receive the highest dose from the licensed operation). These estimates were effectively executed by the MILDOS-AREA code as described in Section 7.3.1.2 given the absence of the water and external exposure pathways. The results satisfy the regulatory requirements of 10 CFR 20.1301(a)(1) and 1302(b).

The public dose limits of 40 CFR 190 and the constraint requirement of 10 CFR20.1101 are not applicable because the scope of each excludes radon.

The Nichols Ranch ISR Project (Project) does not impose a significant dose on any individual member of the public. The Project does not appreciably contribute to total population dose.

7.3.1.5 Exposure to Flora and Fauna

The project will not have any significant impact on flora and fauna as a result of planned or accidental air emissions or fluid discharges. As noted above, the primary emission associated with ISR is Rn-222 and its daughters since there are no particulate emissions or fluid discharges. Any fluid discharge would be the result of an accidental spill from a pipeline break or leak. Spills of this nature would most likely occur within the restricted wellfield areas and between the wellfields and the process facility. Spills occurring on the process facility pad are far less likely to contact soil and vegetation. The reason for this is that the pad is engineered to contain a spill from a pipe rupture or leaking fluid vessel.

The engineering controls and operational monitoring program that will be in place combine to provide strong assurance that spills will be quickly detected and minimized. In addition to these measures, any contamination that might result from an accidental spill will be reconciled through corrective action protocol. Corrective action involves identifying the area affected by the spill, conducting radiological surveys and removing contaminated soil and vegetation. Corrective action also includes documenting the event. Extensive experience has shown that single-event spills arising from a pipeline leak or break do not cause significant contamination of soil and vegetation.

With regard to fauna, there is no opportunity for animals (domestic or wildlife) to consume contaminated vegetation or seeds. As just noted above, other than limited accidental spills which would be immediately assessed and undergo remediation, the operation will not significantly impact food (vegetation/seeds) sources that wildlife and domestic animals depend upon.

Although this is in fact the case, the operation's potential radiological impact on human health and the environment was assessed through MILDOS radiological modeling.

Briefly, MILDOS is an air dispersion model which provides an estimate of radiation dose commitment to the public from all sources associated with the operation. To do this, the model requires certain input parameters such as: (1) local meteorological dispersion characteristics; (2) radiation source term location, type (e.g., gaseous/particulate/fluid), particle size, strength, volume and duration; (3) population distribution within 80 km of the process site; (4) location of the nearest residences; and (5) food chain pathways (crop production/consumption and contributions from consuming meat and milk from grazing animals).

Given the various input parameters, the model generates dose commitments to the population as a whole and to certain organs such as bone, lung, liver, kidney, bronchi and whole-body. Exposure pathways include inhalation, ground, emersion in cloud, and the consumption of vegetation, meat and milk. As can be seen from this description, the MILDOS model provides a comprehensive assessment of potential exposure from a number of sources.

Referring back to the conclusions of the MILDOS radiological assessment given in Section 7.3.1.4, it was noted that dose estimates are well within the regulatory limits given in 10 CFR 20.1301(a)(1) and 1302(b). If fact, dose estimates are many times lower than the 10 mrem standard set for members of the public. It is understood that the dose standards set for humans are also protective of animals and wildlife.

7.4 NONRADIOLOGICAL EFFECTS

7.4.1 Nonradioactive Airborne Effluents

Nonradioactive airborne effluents that are released from the Nichols Ranch ISR Project will not have a significant environmental impact. Fugitive dust from vehicular travel on access roads and wellfield development, and emissions such as CO_2, NaOH, and HCl consist of the majority of the non-radioactive airborne effluents. Because of the minimal amounts of these non-radioactive airborne effluents, no air quality permits are anticipated to be required from the Wyoming Department of Environmental Quality. The nonradioactive airborne effluents and their estimated emissions quantity are detailed in Table 7-1.

Measures will be taken to minimize impacts from non-radioactive airborne effluents. Dust suppressant may be used to reduce fugitive dust when conditions are such that the use of the suppressant is warranted. Gaseous effluents will be vented to the atmosphere to quickly dissipate the effluent so that it will not impact the surrounding area.

7.4.2 Nonradioactive Liquid Effluents

Nonradioactive effluents will not be discharged to the environment during the operation of the Nichols Ranch ISR Project. The processing plants will be zero discharge facilities as all nonradioactive effluents will be sent to the deep disposal well.

7.5 EFFECTS OF ACCIDENTS

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.

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7.5.1 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.

7.5.1.1 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}/mile. 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 two 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 and 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.

7.5.1.2 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 miles 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 D1-2 of Appendix D1. 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.

7.5.1.3 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 7-11 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.

Table 7-11 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

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 $4.8x10^{-7}$ accidents/mi 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.

7.5.1.4 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 7.5.1.1 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.

7.5.1.5 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 miles 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.

7.5.2 Tank Failure

Process fluids will be contained in process vessels and pipes during the operation of the Nichols Ranch CPP and the Hank Satellite. Process instrumentation, controls, and alarms will monitor the flows and levels of tanks to maintain proper levels in the vessels. If a tank or process vessel were to have an unlikely failure such as a rupture in the process building, all fluid would be contained in the process building. The fluid would be collected in the plants sumps and then pumped to either other process vessels or to the deep disposal well. After the fluids have been removed, the area then would be washed down with plant water. The water would be collected in the plant sump system and pumped to either process vessels or the deep disposal well eliminating any environmental impact for the tank failure.

A process vessel or tank that fails outside of the process plants could result in spill of a process chemical such as HCL or H_2O_2. In the unlikely event that such a failure were to occur, the process chemical would be contained in the containment basin surrounding the vessel. The process chemical would then be either pumped to another tank or into a tanker truck to be properly disposed of in accordance with State requirements. If any soil is contaminated from the failure, then it will be removed and disposed of according to the requirements of the State. The environmental impact of such an incident would be minimal with no long-term impact.

An additional measure that will be put forth to mitigate any potential tank failures is in designing of the plant concrete floors. The concrete floors will be designed to support the full weight of any vessel, including contents, plus a safety factor so that tanks will not collapse or rupture as a result of a flooring failure. With that, tanks will either be constructed on reinforced concrete floors or reinforced concrete pads that will be designed by registered civil engineers and meet all building codes and standards.

7.5.3 Pipeline Failure

7.5.3.1 Process Pipelines

The failure of a process pipeline could result in the discharge of pregnant or barren lixiviant to the surface if the failure were to occur in the pipelines located in the wellfield. Measures such as high and low pressure alarms/shutdowns and flowmeters will be utilized on the piping leading to and from the wellfield to the CPP and satellite plant to minimize the amount of process fluid that is lost if a failure were to occur. If the amount and/or concentration of the process fluid lost in a pipeline failure constitute an environmental concern, the affected area would have the contaminated soil surveyed and removed for disposal according to NRC and State regulations. The probability of a failure to a process pipeline located in the wellfield is considered small since most pipelines will be buried approximately two to five feet below the surface and made out of corrosion free high density polyethylene. The pipelines will also be inspected and tested prior to burial to ensure that the pipelines are sound. Pressure test results will be documented.

The worst case scenario for a pipeline failure would involve a major pipeline rupture releasing barren or pregnant lixiviant for an hour at full operating capacity. If this were to occur, 210,000 gallons of barren or pregnant lixiviant would be released to the environment surrounding the area of the incident at the Nichols Ranch CPP. The pipeline would have to suffer a complete line break with no operators or plant personnel detecting the failure in a timely manner. The likelihood of this happening is considered very low since most industry experience has been that major pipeline ruptures are not complete line breaks, but smaller openings such as cracks, small punctures, or other types of partial line breaks. This was detailed in the NRC staff Hydro Resources Inc. Final Environmental Impact Statement for the Crownpoint Uranium Solution Mining Project (NUREG-1508, 1997). The Crownpoint FEIS also stated that the experience for pipeline ruptures shows less than 25% of the volume of the lixiviant contained in the pipeline is spilled in the worst case scenario, and in actuality, most leaks and spills occur through minor cracks or disconnection on smaller pipes.

7.5.3.2 Coal Bed Methane Gas Pipeline Failure

With the coal bed methane production in the Hank and Nichols Ranch Units, a rupture of a methane pipeline could occur resulting in the escape of the flammable and explosive methane gas. If such an event were to occur, the area surrounding the rupture would have to be evacuated with all equipment being shutdown and if necessary, a total plant shutdown and evacuation if the rupture was located near the CPP or satellite plant. The area in the vicinity of the methane pipeline rupture would remain sealed off until such time that the methane gas is turned off and the pipeline repaired. The environmental impact of such a failure would be minimal as the methane would be released to the atmosphere where it would quickly dissipate. The probability of such an event occurring is low since the methane pipelines that would be located in the Hank and Nichols Ranch Units would be buried approximately 6 feet under the surface and clearly identified with signage.

The worst case scenario for a methane pipeline would involve a major pipeline rupture as a result of a drilling rig drilling into the pipeline. This event could potentially result in an explosion of the methane gas, which could result in significant property loss and fatalities. The probability of this happening is low given that coal bed methane pipelines located in the Hank and Nichols Ranch Units will be clearly identified with signage. In addition to the signage, procedures will be developed on steps to be taken when drilling near methane pipelines. Measures such as verifying the location of the pipeline, flagging off the pipeline corridor, and maintaining a set distance from the methane pipeline when drilling wells will be implemented. Most of the methane pipelines will be in place before the Nichols Ranch ISR Project begins. Communication with the coal bed methane producers and Uranerz Energy Corporation has taken place and will continue so that any potential incidents involving methane pipelines are minimized.

7.5.4 Fires and Explosions

Fire and explosion hazards for the Nichols Ranch CPP and Hank satellite will be low since neither of the two plants uses flammable liquids or products in the yellowcake process. Propane will be utilized for the heating of oil for the vacuum dryer located at the Nichols Ranch CPP. The propane would be the primary source for a potential fire at the CPP. Building heat at Hank and Nichols Ranch Units will be supplied by electric heaters. If an explosion were to occur at the CPP, the uranium present in the plant would not appreciably disperse to the environment. The uranium will be kept in solution, adsorbed on ion exchange resin, as wet yellowcake slurry, or as dried yellowcake product contained in sealed 55-gallon drums. Any spilled fluids or slurries as a result of an explosion would be contained in the process building or in their containment area. The Dryer section of the Nichols Ranch CPP would contain the dried yellowcake product, sealed in 55-gallon drums or contained in the vacuum dryer, where any potential release from an explosion would occur and be contained.

Potential fire and explosions for the wellfields would be from an accumulation of gaseous oxygen in a "header house." Injection and recovery well piping systems are brought into manifolds in the wellfields for operational control. Piping manifolds, pump motor starters/controllers, and gaseous oxygen delivery systems are situated in the header houses. The header houses are designed to be an all-weather building equipped with electric heaters to keep piping from freezing during the cold months. If a gaseous oxygen accumulation were to occur in the header house and then ignited through some ignition source, an explosion could occur. The explosion could result in the rupture of pipelines containing mining solutions within the header houses and a spill to the area surrounding the header house.

To minimize the risk of an explosion in a header house caused by an accumulation of gaseous oxygen, each header house is equipped with a continuously operating exhaust fan. Additionally, the gaseous oxygen and primary mining solution lines entering the header houses are equipped with automatic low pressure shut off valves that will minimize any release of the oxygen or solution if the lines were ruptured.

7.5.5 Tornados

The Nichols Ranch ISR Project is located in Campbell and Johnson Counties, Wyoming. Both counties have experienced tornado activity. Johnson County has reported 17 tornados from the years 1950-2003. Campbell County has seen 69 tornados from the 1950-2003 time period (Wyoming Climate Atlas, 2004). The tornados occurring in Johnson County have been on the order of F0 (40-72 mph wind speed), and F1 (73-112 mph wind speed) as rated on the Fujita Scale. The majority of the Campbell County tornados are also F0 and F1 tornados, but Campbell County has also experienced several F2 (113-157 mph wind speed) tornados. The most recent F2 tornado struck the town of Wright, Wyoming on August 12, 2005 resulting in the death of two people, numerous injuries, and forty plus homes destroyed. Wright, Wyoming lies approximately 22 air mi to the east of the project area.

The probability of occurrence of a tornado in the area that the Nichols Ranch ISR Project is located in is approximately 3.2×10^{-4} per year (NUREG-0706, Section 7.1.6.3.1, Table 7-5). The region is classified as a Region III tornado intensity area with typical tornados having winds speeds of 240 miles per hour comprising of rotational wind speeds of 190 mi per hour and transitional wind speeds of 50 miles per hour. The design of the plant structures are not designed to withstand a tornado of this intensity.

With the nature of ISR operations, there is little that can be done to secure the facilities with advance warning than without it. Since most of the uranium is in the form of wet slurry or contained as a dry powder, the potential environmental effects resulting from a tornado encounter would be minimal. The strongest recorded tornado in Johnson and Campbell Counties was a F2 tornado in Campbell County. Using the Fujita Scale for F2 tornado, the typical damaged resulting from a F2 tornado is roof damage, unsecured mobile homes being removed from their foundations, and light structures severely damaged or destroyed. With most of the dried yellowcake product being stored in 55-gallon drums or in the vacuum dryer, both located in an engineered steel building, the dried yellowcake should not be released in the air by a tornado. However, if a tornado does cause damage to the building housing the vacuum dryer and the stored yellowcake to the point that the building collapses, then a possibility exists that some of the dried yellowcake could be released to the environment from damaged 55-gallon drums or from a damaged vacuum dryer.

The NRC in NUREG-0706, Generic Environmental Statement for Uranium Milling, performed a conservative dispersion model for uranium released to the environment by a tornado incident. The NRC staff assumed 25,100 pounds of dry yellowcake, or approximately 26 55-gallon drums of dried yellowcake, were picked up by a tornado. The model then calculated the maximum radiation exposure to the public due to the accident at three distances. At a distance of 2.5 mi away from the facility, the estimated 50 year does commitment to the lungs of an individual was estimated at $8.3x10^{-7}$ rem. From the facility to the model facility fenceline approximately 1,600 ft away, the 50 year dose commitment to the lungs of an individual was estimated to be $2.2x10^{-7}$ rem. For the nearest resident to the model site, 6,500 ft away, the 50 dose commitment was estimated at $2.4x10^{-7}$ rem.

7.5.6 Well Casing Failure

The failure of an injection well casing would have the potential for the most significant environmental impact since this failure could introduce lixiviant into a United States Drinking Water (USDW) aquifer that is not exempted from the process. This type of incident has the possibility to last for several days before being detected by the monitoring well system that will be in place. If such a failure were to occur, the defective well would either be immediately repaired, or plugged and abandoned in accordance to State of Wyoming regulations. If contamination of an aquifer other than the ore zone aquifer was determined, wells would be drilled into the contaminated aquifer then pumped until concentrations of the lixiviant constituents were reduced to acceptable levels. With proper well construction procedures and well testing procedures, including verifying the integrity of the well casing, and proper cementing of the wells, the probability of such a failure is minimal.

To minimize the risk of a casing failure significantly impacting the environment, monitor wells are completed in the aquifers above and below the ore zone. The monitor wells are routinely sampled during the extraction process to check the fluid levels and quality of water. By doing such routine monitoring for fluid levels and water quality, any excursions of the lixiviant to these aquifers can be observed if such an incident were to occur. In addition to the routine monitoring of the monitor wells, casing integrity tests will be performed on all injection wells prior to putting the injection wells into production. The integrity testing will also be conducted after any work that involves entering the cased wells with a cutting tool such as a drill bit or underreamer is preformed.

The failure of a recovery well causing a significant impact is not very high since recovery wells normally do not cause fluid migration to aquifers above and below the ore zone. The recovery wells generally operate at a lower pressure than the aquifers located above and below the ore zone aquifers meaning that any casing failures by a recovery well would more than likely lead to the water in the aquifers flowing into the failed well casing instead of the lixiviant being introduced into the aquifer.

7.5.7 Aquifer Communication Through Old Exploration Holes

The communication between aquifers of lixiviant through old exploration holes in the project area is unlikely. The old exploration holes that have been drilled in the project area are thought to be abandoned using either abandonment mud, drilling mud, a combination of bentonite and abandonment mud, or a combination of bentonite and drilling mud. The mud in the old exploration holes provides an effective seal against fluid communication between the various aquifers penetrated by the drilling of the exploration holes. Additionally, the rapid swelling and bridging of the isolating shales between the sandstone aquifer units provides the abandoned exploration drill holes additional sealing. In the event that an aquifer is contaminated from leakage from an abandoned drill hole, new wells would be drilled and completed in the contaminated aquifer. Water samples would be collected and if needed, the well would be produced to reduce the concentration of contamination in the aquifer to an acceptable level.

Another measure that will be taken to ensure that there is no communication between the aquifers from prior exploration holes is conducting pump tests before the start-up of a production area. The pump test will demonstrate that there is no significant communication between aquifers. In the event that leakage between aquifers from old exploration holes is detected during the tests, the old exploration holes would be re-entered and plugged. If contamination of an aquifer is also indicated, wells would be drilled and completed in the contaminated aquifer, water samples collected, and if needed, the wells would be produced to reduce the concentration of lixiviant to an acceptable level.

7.5.8 Aquifer Communication Through Coal Bed Methane and Oil/Gas Wells

The likelihood of lixiviant communicating from the ore zone aquifer to another aquifer through a coal bed methane (CBM) well or an oil/gas well is very low. Oil/gas wells that exist in the project area have been in place since the 1980's. If any issues with their completion existed, current water quality base line sampling that has taken place for the Nichols Ranch ISR Project would have indicated contamination when compared to historic water quality sampling that took place in the 1970's. Additionally, the oil/gas wells are completed as such that their integrity would not allow communication between aquifers. Cementing of the oil/gas wells occurs from the surface to at least 1,000 ft deep. A cement bond log is run after the wells are completed to ensure that the cementing job used for completion has been properly done. Pressure monitoring on the oil/gas wells also ensures that the oil/gas wells are working properly and that the wells integrity is intact.

CBM wells are also completed in the same manner as the oil/gas wells. The CBM wells are usually 1,000 ft or deeper to reach the coals seams under the project area. When the CBM wells are drilled, they are drilled to the top of the coal seam and then cemented from there to the surface. A cement bond log is run after the cement job has had time to cure to ensure that the well is completed properly. The CBM wells that are and will be located at the Nichols Ranch ISR Project site will all be in place prior to the start of mining. Production area pump tests conducted prior to mining along with monitor wells installed in the overlying and underlying aquifers will be able to detect if any CBM wells are causing aquifer communication. In the event that a CBM or oil/gas well is found to be causing communication, contact will be made with the company that owns the well to work on repairing, or plugging and abandoning the well. If any contamination of an aquifer is detected, monitor wells will be drilled and completed in the contaminated aquifer. Water quality sample will be taken and, if necessary, the wells produced until the concentration of any lixivant in the aquifer is reduced to acceptable levels.

7.6 ECONOMIC AND SOCIAL EFFECTS OF CONSTRUCTION AND OPERATION

7.6.1 Benefits

7.6.1.1 Employment

The construction and operation of the Nichols Ranch ISR Project will provide jobs to approximately 55-65 company employees and 10–20 contract employees during the life of the project. Because mining is a basic industry, this job creation will produce a multiplier effect on employment in the region. Since employees are expected to live in the region, the entire income benefit will also accrue to the local economy.

7.6.1.2 Taxes

The extraction and selling of yellowcake product during the life of the Nichols Ranch ISR Project will produce direct and indirect tax benefits to local, state, and federal governments through the collection of sales taxes, severance taxes, and state and federal royalties.

7.6.1.3 Roads

Uranerz Energy Corporation will assist in the maintenance of existing gravel roads used by Uranerz from the county gravel road to the project area during the life of the Nichols Ranch ISR Project. The assistance with the road maintenance will lower the cost of maintenance to the other road users that include the land owner, oil/gas producers, and coal bed methane producers.

7.6.1.4 United States Nuclear Energy Supply

The yellowcake product that is produced by the Nichols Ranch ISR Project will provide a domestic source of uranium to be used for the production of nuclear power. The production of nuclear power aids in providing an inexpensive, environmentally friendly source of energy to meet the growing energy demand of the world.

7.6.2 Socioeconomic Costs

7.6.2.1 Public Facilities and Services

No adverse impacts on public facilities and services, such as congestion of streets and highways, overloading of utilities such as water supply and sewage treatment systems, and the overtaxing of local schools, hospitals, police and fire protection is expected with the Nichols Ranch ISR Project. Employees for the Nichols Ranch ISR Project will be drawn from the surrounding areas located near the project site so that minimal impacts will be made to the individual communities and their facilities and services.

7.6.2.2 Housing

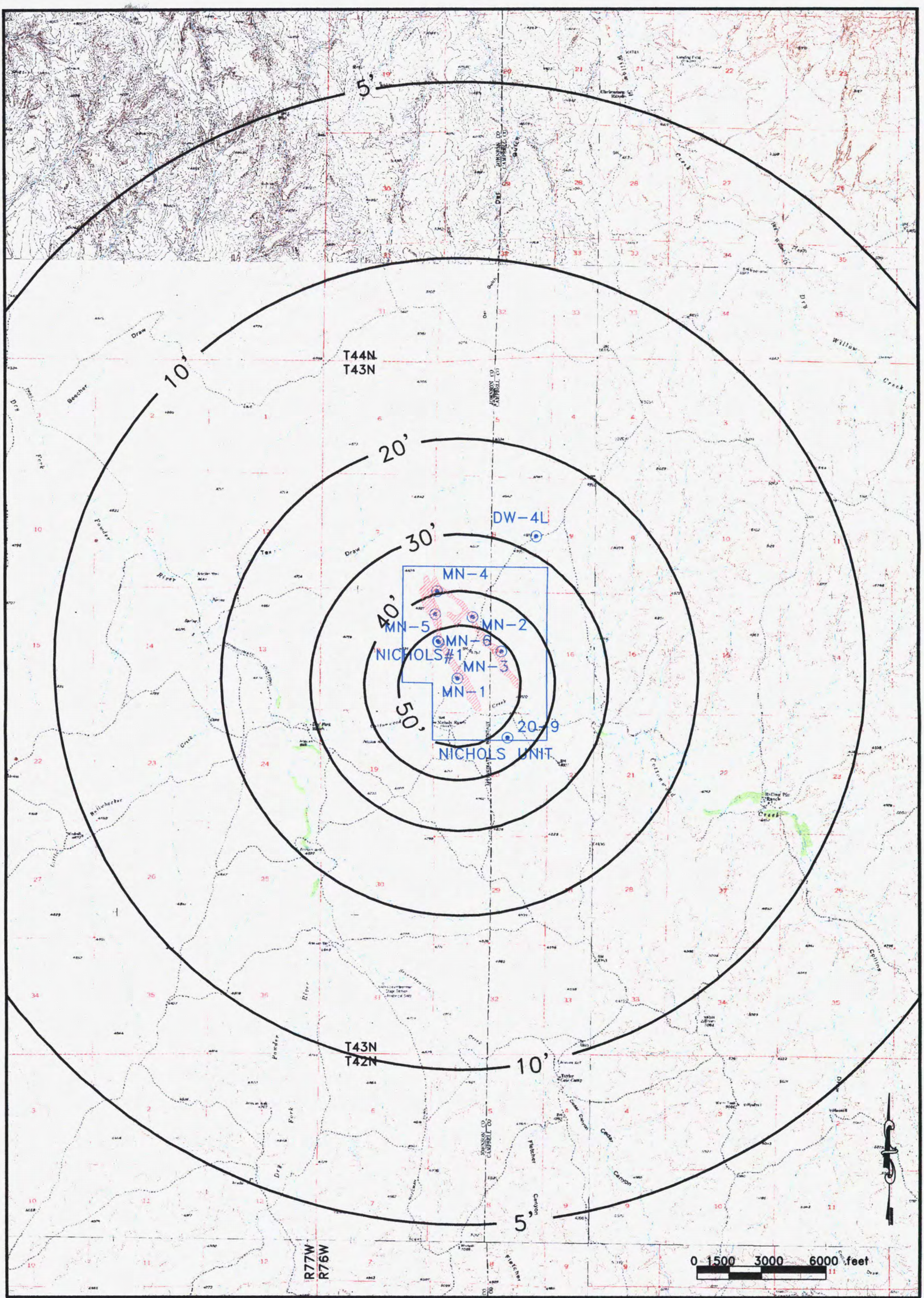
Although Wyoming is dealing with a housing shortage because of a statewide energy boom, the Nichols Ranch ISR Project should not have a negative impact on the housing in the areas surrounding the project area. The Nichols Ranch ISR Project will draw from the workforce that is present in the project area. By doing this, there will not be a need for new housing to be developed to accommodate employees.

7.6.2.3 Impairment of Historical, Scenic, and Recreation Values

With the location of the Nichols Ranch ISR Project on private, remote land with limited access, historical, scenic, and recreational values will not be adversely impacted. No official or unofficial historic and scenic places of interest exist or are found at the Nichols Ranch ISR Project. If any cultural resources are encountered during the construction or operation of the Nichols Ranch ISR Project, the appropriate agencies will be notified immediately. The recreational values of the land in the project area, such as hunting, are controlled by the landowner and will not be significantly impacted by the proposed project.

7.7 MINERAL RESOURCE IMPACTS

The only known mineral that can be recovered in economical quantities in the Nichols Ranch ISR Project area is uranium. Large coal seams do exist within the project area, but they are at such a depth that they are not economically feasible to mine at the current coal prices. Oil and gas production has and is occurring in the Hank Unit of the project. Because of its depth (<9,000 ft) compared to the depth of the uranium (300 to 700 ft) no impacts will occur. Coal bed methane (CBM) activity is also currently taking place in the project area. No adverse impacts are expected to occur between the CBM and uranium mining activities because of the separation of the depth between the two; CBM being deeper (~1,000 ft plus). Communication and working agreements have and are being developed between the CBM producers and Uranerz Energy Corporation to alleviate any possible concerns and impacts that may arise.



By: lgrh	Date: 10/16/07
Contour Interval	Revision Date:

DWG: C:\PROJECTS\2007-14\DRAINAGE AREA\DRAWDOWN lgrh

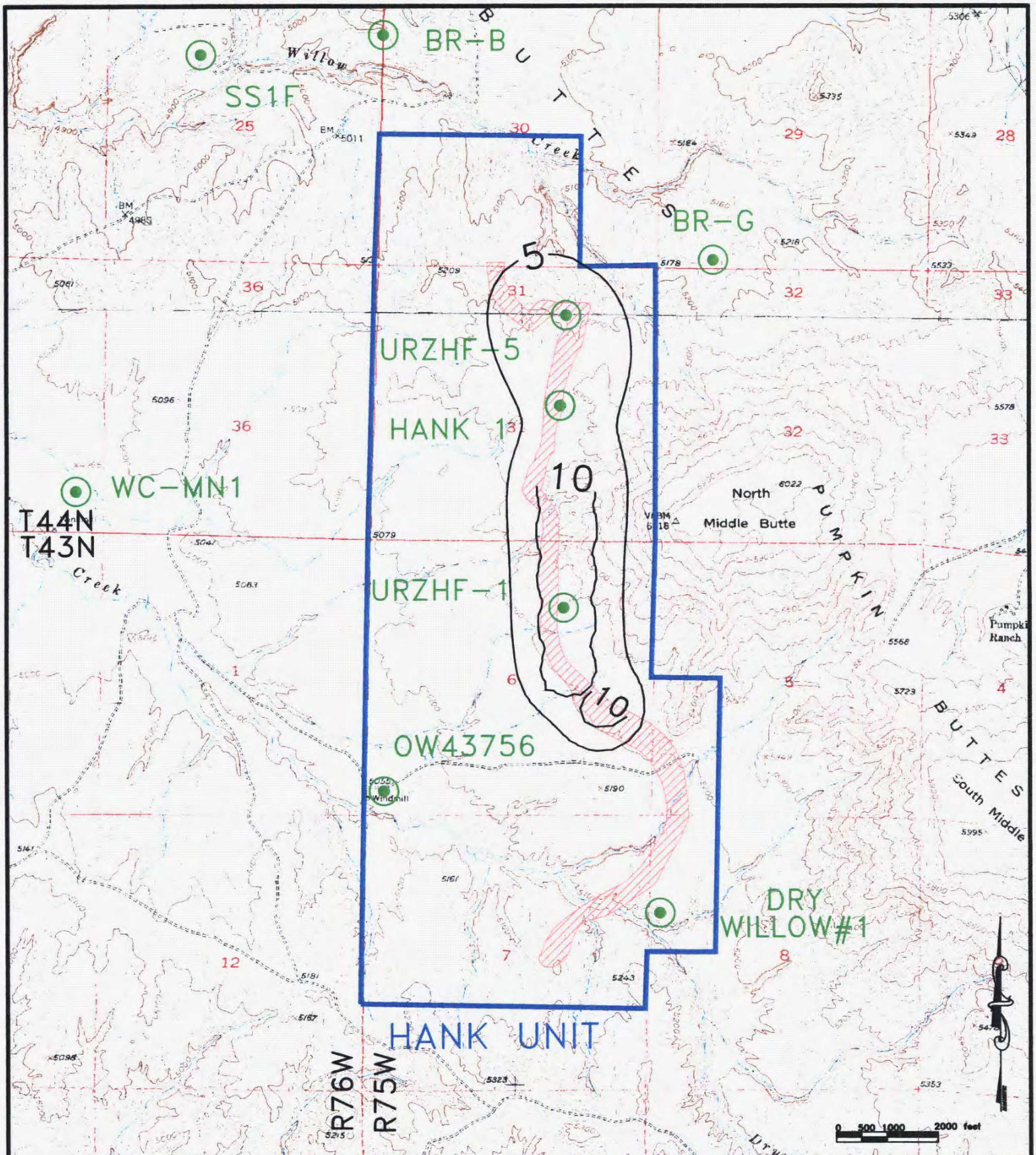
LEGEND: WELLFIELD

MN-1 A SAND WELL

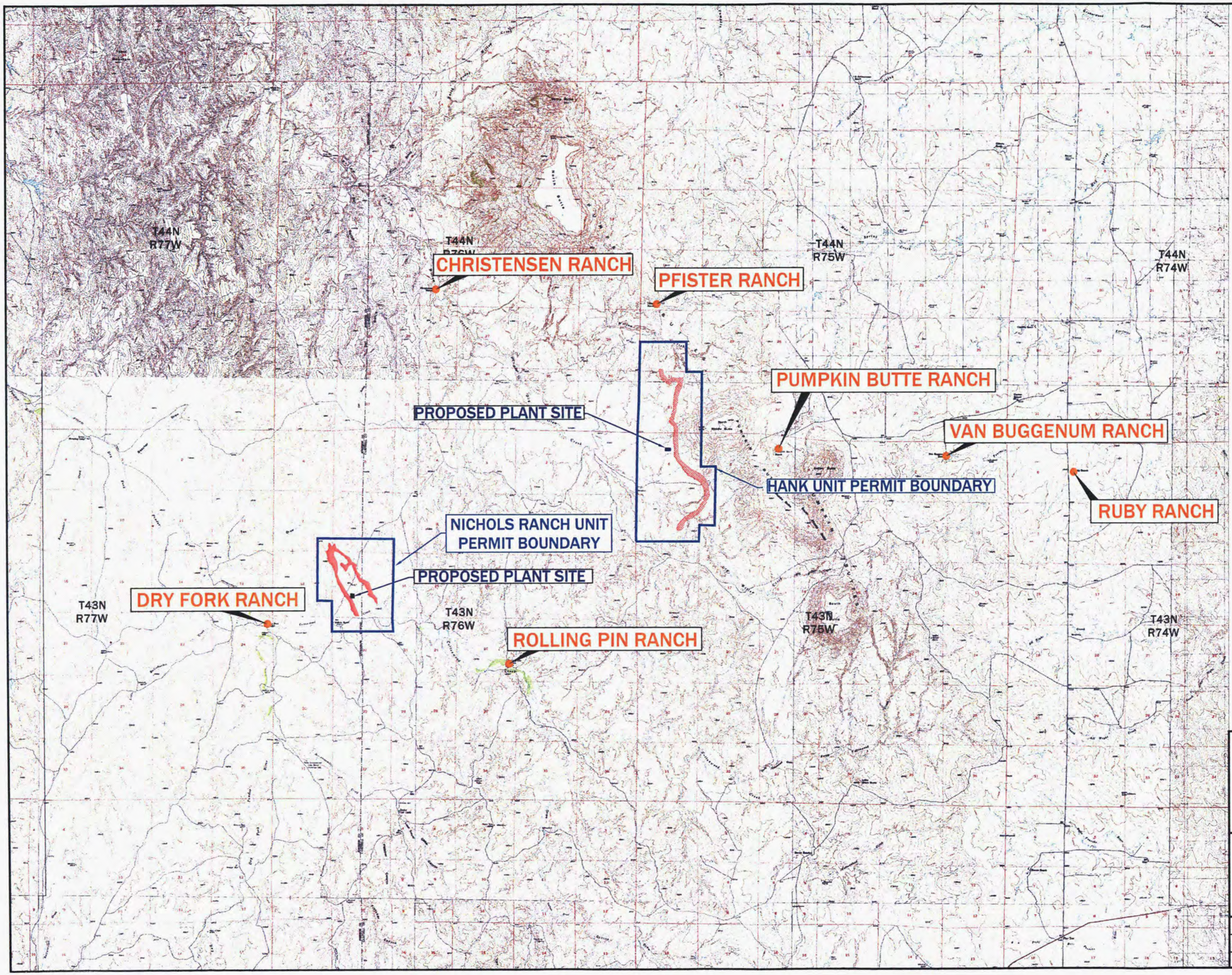
Land surface contours in feet

Uranerz ENERGY CORPORATION
1701 East "E" Street
P.O. Box 50850
Casper, Wyoming
USA 82605-0850

FIGURE 7-1. NICHOLS RANCH UNIT PREDICTED DRAWDOWN IN THE A SAND AT THE END OF THREE YEARS OF ISR, FT.



By: lgrh	Date: 10/10/07	LEGEND: WELLFIELD	Uranerz ENERGY CORPORATION 1701 East "E" Street P.O. Box 50850 Casper, Wyoming USA 82605-0850	FIGURE 7-2. HANK UNIT PREDICTED DRAWDOWN AT THE END OF THREE YEARS OF ISR FOR THE F SAND, FT.
Contour Interval:	Revision Date:	URZNF-3 F SAND WELL		
DWG: C:\PROJECTS\2007-14\SANDS lgrh				



SCALE: 1"=8000'

0 4000 8000 feet

LEGEND

PROJECTED WELL FIELD

RESIDENCE

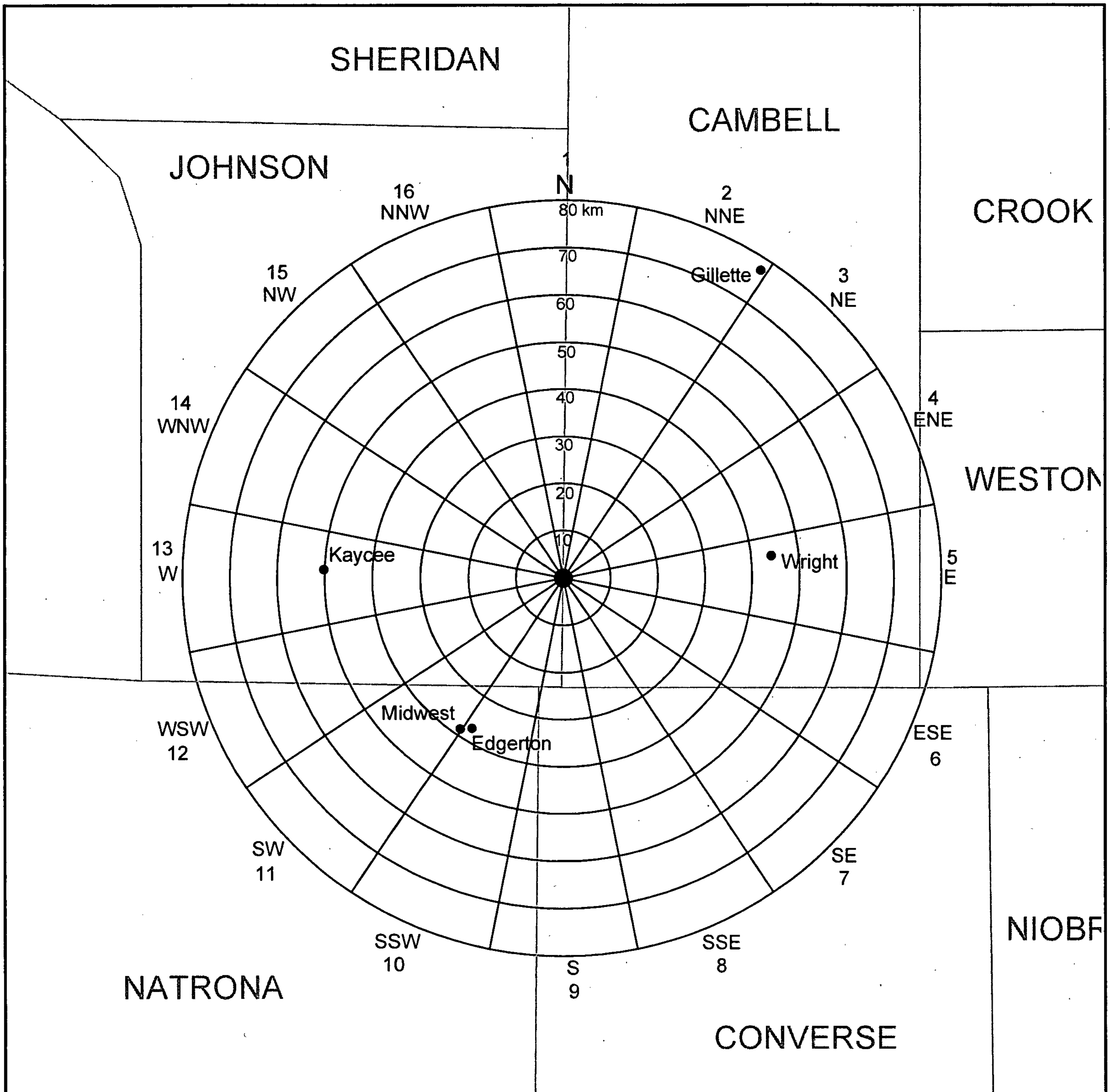
Uranerz
ENERGY CORPORATION
1701 East "E" Street
P.O. Box 50850
Casper, Wyoming
USA 82605-0850

NICHOLS RANCH ISR PROJECT

FIGURE 7-3

LOCATION OF NICHOLS RANCH, HANK SITES AND NEAREST RESIDENTS TO NICHOLS RANCH CENTRAL PROCESSING PLANT

By: S.M.F.	Date: OCT. 17, 2007
Contour Interval: 20 FEET	Revision Date:
Scale: 1"=8000'	Datum: NAD 27 UTM 13



Uranerz
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CASPER, WYOMING, USA 82605-0850
PHONE 307.265.8900 FAX 307.265.8904

NICHOLS RANCH ISR PROJECT

FIGURE 7-4

LOCATION OF CITIES WITHIN 80km OF NICHOLS RANCH CENTRAL PROCESSING PLANT

By: S.M.F.	Date: NOV. 8, 2007
Datum: UNKNOWN	Revision Date:
Scale: NOT TO SCALE	Contour Interval:N/A

DWG#: FIGURE 7-4

8.0 ALTERNATIVES TO THE PROPOSED ACTION

8.1 ALTERNATIVE MINING METHODS

Alternate 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 in an NRC evaluation (NUREG-0925, 1983, Section 2.3.5). The advantages 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 body 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 form 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

8.2 ALTERNATIVE SITES

The planned locations of the Central Processing Plant (CPP), Main Office Building, and Main Maintenance Shop for the Nichols Ranch Unit are shown in Figure 3-1 (see map pocket) of Chapter 3.0, Description of the Facilities. The Hank Unit Satellite Ion Exchange Plant, Office Building, and Maintenance Shop are shown in Figure 3-2 (see map pocket) of Chapter 3.0, Description of the Facilities. All of these facilities were located off of the ore zone on the most topographically suitable land within the project area. With these considerations, no realistic alternative site locations exist.

8.3 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 mining aquifers. Because of these reasons, the solutions were not considered for the Nichols Ranch ISR Project.

8.4 GROUNDWATER RESTORATION ALTERNATIVES

Uranerz Energy Corporation will utilize the combination of groundwater sweeps, groundwater transfers, 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.

8.5 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 that ponds and irrigation have on the project area. The deep disposal wells to be used will be drilled to a depth of at least 6,000 ft deep or deeper. This is consistent with other deep disposal wells located in the project region that are used by other ISR operations. Each disposal well must be authorized by the State of Wyoming and the EPA UIC Program to receive the liquid effluent wastes.

9.0 BENEFIT-COST SUMMARY

9.1 GENERAL

Uranium that will be recovered 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 pro-rated 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.

9.2 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.

9.3 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 or class of use such that pre-mining use suitability of the groundwater is maintained.

9.4 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, subject to the necessary license conditions, is the appropriate regulatory action.

10.0 ENVIRONMENTAL APPROVALS AND CONSULTATIONS

10.1 PERMITS AND LICENSES REQUIRED FOR THE NICHOLS RANCH ISR PROJECT

Various state and federal permits and licenses that are needed or are in-hand for the Nichols Ranch ISR Project are listed in Table 10.1. Prior to the start of mining (the injection of lixivant into the ore body 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.

Table 10-1 Permit and Licenses for the Nichols Ranch ISR Project.

Permit, License, or Approval Name	Agency	Status
Source Material License	NRC	Pending
Permit to Mine	WDEQ-LQD	Pending
Permit to Appropriate Groundwater	SEO	Existing wells are approved, new well permits will be filed prior to drilling
DEQ Drilling Permit	WDEQ-LQD	In Possession, No. 336DN-TFN 4 5/276
BLM Drilling Permit	BLM	In Possession, W-169662
Wellfield Authorization Permit	WDEQ-LQD	In Preparation
Deep Disposal Well Permits	WDEQ-WQD	In Preparation
WYPDES	WDEQ-WQD	In Preparation
11(e)2 Byproduct/Waste Disposal Agreement	N/A	In Preparation
Pemit to Construct Septic Leach Field	County	In Preparation
Air Quality Permit	WDEQ-AQD	Not Needed

Notes: NRC - Nuclear Regulatory Commission
WDEQ-LQD - Wyoming Department of Environmental Quality Land Quality Division
WDEQ-WQD - Wyoming Department of Environmental Quality Water Quality Division
WDEQ-AQD - Wyoming Department of Environmental Quality Air Quality Division
SEO - State Engineer's Office
BLM - Bureau of Land Management

11.0 REFERENCES

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