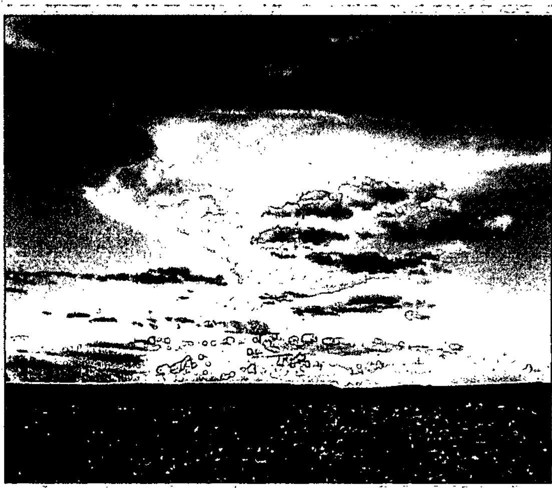
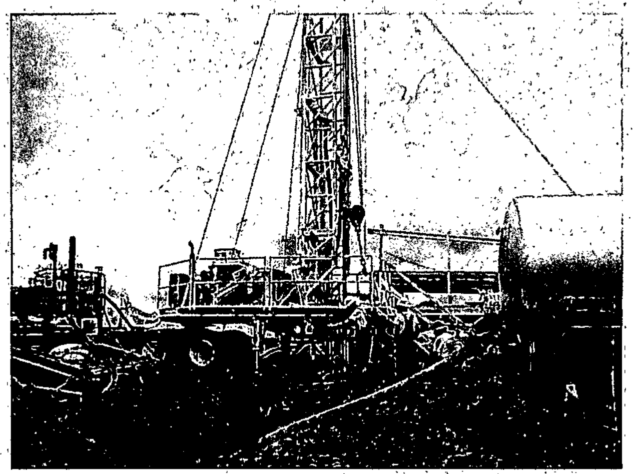
LOST CREEK ISR, LLC

Lost Creek Project

South-Central Wyoming

Technical Report





Volume 3 of 3

Application for

US NRC Source Material License

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LIST OF ABBREVIATIONS AND ACRONYMS

$[UO_2(CO3)_3]^{-4}$	uranyl tricarbonate ion
$[UO_2(CO3)_2]^{-2}$	uranyl dicarbonate ion
°F	degrees Fahrenheit
µCi/mL	microCuries per milliliter
µg	microgram
µg/L	micrograms per liter
µg/m3	micrograms per cubic meter
µmhos/cm	micromhos per centimeter
µR/hr	microRoentgens per hour
ACEC	Area of Critical Environmental Concern
ALARA	As Low As Reasonably Achievable
ANSI	American National Standards Institute
ARSO	Alternate Radiation Safety Officer
ASME	American Society of Mining Engineers
ASTM	American Society for Testing and Materials
ASQC	American Society for Quality Control
AUM	animal unit months
Basin	Great Divide Basin
BLM	Bureau of Land Management
BMP	Best Management Practice
BPT	Best Practicable Technology
$CaCO_3$	calcium carbonate
CFR	Code of Federal Regulations
CO	carbon monoxide
Conoco	Conoco, Inc.
CR	County Road
Cs-137	cesium-137
CSU	Colorado State University
CV	curriculum vitaes
DAC	derived air concentration
dBA	A-weighted decibels
DDE	Deep Dose Equivalent
DOE	Department of Energy
DOT	Department of Transportation
dpm	disintegrations per minute
DQO	Data Quality Objectives
Eh	oxidation-reduction potential
EHS	Environment, Health, and Safety
EHSMS	Environment, Health, and Safety Management System
ELI	Energy Laboratories Incorporated
EMT	Emergency Medical Technician
EPA	Environmental Protection Agency
ER	Environmental Report

ft amsl	feet above mean sea level
ft bgs	feet below ground surface
ft/d	feet per day
ft/ft	feet per foot
ft/mi	feet per mile
ft/s	feet per second
ft^2/d	square feet per day
FTE	full-time equivalent
FSER	final safety evaluation report
FWS	Fish and Wildlife Service
g	gravity
g/L	grams per liter
GIS	Geographic Information System
gpd/ft	gallons per day per foot
gpm	gallons per minute
GPS	Global Positioning System
GSP	Gross State Product
HDPE	high-density polyethylene
HMA	Herd Management Area
HPGe	High-Purity Germaniun
HPIC	High-Pressure Ionization Chamber
HPRCC	High Plains Regional Climate Center
ICRP	International Commission on Radiological Protection
IEC	International Electrotechnical Institute
IR	Isolated Resource
ISO	International Organization for Standardization
ISR	In Situ Recovery
JCR	Job Completion Report
km	kilometers
lb/mi^3	pounds per cubic mile
LC	Lost Creek
LC ISR, LLC	Lost Creek ISR, LLC
LLD	lower level detection
LLRWDF	low-level radioactive waste disposal facility
LQD	Land Quality Division
LS	Lost Soldier
LSA	Low Specific Activity
m^2	square meters
m/s	meters per second
man-Sv	man-Sievert
mSv	milliSievert
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual

MBHFI	Migratory Birds of High Federal Interest
MCL	Maximum Contaminant Level
mg/L	milligrams per liter
MiniVol	Mini Volumetric
MIT	mechanical integrity test
mph	miles per hour
mrem/yr	millirem per year
MSHA	Mine Safety and Health Administration
Na_2S	sodium sulfide
NAAQS	National Ambient Air Quality Standards
NaI	sodium iodide
NARM	Naturally occurring and/or Accelerator-produced Radioactive Material
NEPA	National Environmental Protection Act
NFU, LLC	New Frontiers Uranium, LLC
NIRMA	Nuclear Information and Records Management Association
NIST	National Institute of Standards and Technology
NO_2	nitrogen dioxide
NQA	National Quality Assurance
NRC	Nuclear Regulatory Commission
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NSS	Native Species Status
NVLAP	National Voluntary Laboratory Accreditation Program
NWIS	National Water Information System
NWS	National Weather Service
O_3	ozone
OHV	off-highway vehicle
Pb-210	lead-210
PC	personal computer
pCi/L	picoCuries per liter
Permit Area	Lost Creek Permit Area
person-rem/yr	person-rem per year
PFN	Prompt Fission Neutron
PILT	Payments in Lieu of Taxes
PM_{10}	particulate matter less than ten micrometers
PPE	personal protective equipment
ppm	parts per million
Program	Contamination Control Program
Project	Lost Creek Project
PSD	Prevention of Significant Deterioration
psi	pounds per square inch
psig	pound-force per square inch gauge

PVC	polyvinyl chloride
PWMTF	Permanent Wyoming Mineral Trust Fund
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
Ra-226	radium-226
Ra-228	radium-228
rad/d	rad per day
rem	röntgen (roentgen) equivalent in man
RMP	Resource Management Plan
Rn-222	radon-222
RO	reverse osmosis
RSD	Radiation Safety Department
RSO	Radiation Safety Officer
RV	recreational vehicle
RWP	Radiation Work Permit
SAR	sodium adsorption ratio
SCS	Soil Conservation Service
SDR	standard dimension ratio
SDWS	Secondary Drinking Water Standard
SEM	scanning electron microprobe
SER	Safety Evaluation Report
SERP	Safety and Environmental Review Panel
SHPO	State Historic Preservation Office
SMU	soil mapping unit
SO_2	sulfur dioxide
SOP	standard operating procedure
SSC	structure, system, or component
SWEDA	Sweetwater Economic Development Association
TAC	Technical Assignment Control
T&E	threatened and endangered
TDS	total dissolved solids
TEDE	Total Effective Dose Equivalent
TER	Technical Evaluation Report
Texasgulf, Inc.	Texasgulf
Th-230	thorium-230
TR	Technical Report
U_3O_8	uranium oxide
UBC	Uniform Building Code
UCL	Upper Control Limit
UIC	Underground Injection Control
U-nat	natural uranium
Ur-E	Ur-Energy USA Inc.

URPA	Ur-E Project Air
US	United States
USGS	United States Geological Survey
VP	Vice President
VRM	Visual Resource Management
WAAQS	Wyoming Ambient Air Quality Standard
WDEQ	Wyoming Department of Environmental Quality
WGFD	Wyoming Game and Fish Department
WHDP	Wyoming Housing Database Partnership
WOS	Wildlife Observation System
WQD	Water Quality Division
WRDS	Water Resources Data System
WS	Wyoming Statute
WSA	Wilderness Study Area
WSEO	Wyoming State Engineer's Office
WYDOT	Wyoming Department of Transportation
WYPDES	Wyoming Pollution Discharge Permit

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3.0 DESCRIPTION OF THE PROPOSED FACILITY

The Permit Area contains 4,220 acres (**Figure 3.1-1**). The surface area to be affected by the ISR operation is within the Permit Area and will total approximately 285 acres (**Figure 3.1-2**). The mine units, the Plant, the Storage Ponds, and the UIC Class I wells are the significant surface features associated with the uranium ISR operation.

The total area of the pattern areas, e.g., the total area to be used for lixiviant injection and ore recovery over the eight-year mine life, will be approximately 254 acres (**Figure 3.1-2**). The total area of the Plant and related facilities is expected to be less than ten acres, including the two Storage Ponds, each of which will be between two to four acres in size. Two to four UIC Class I wells will be completed; and the total area for those wells and associated pipelines is expected to be less than two acres.

3.1 ISR Process and Equipment

The Project will use techniques and technologies demonstrated at other ISR facilities and incorporate best practices and industry experience. The ISR process is based on extracting ore (in liquid form) from a series of mine units, more than one of which may be in production at a given time, and then processing the ore at the Plant.

The ISR process will be conducted using a carbonate lixiviant, which is pumped from the Plant through buried pipelines to the injection wells in the mine unit(s) in production. After circulation through the ore zone from the injection wells to the production wells, the lixiviant recovered from the production wells will be pumped from the mine unit(s) through buried pipelines to the ion exchange circuit in the Plant. There, the uranium will be removed by solid resin ion exchange. The carbonate lixiviant will then be regenerated and pumped back to the mine units to recover additional uranium. Additional details of the mine units, well construction, and instrumentation and control are provided in **Section 3.2.**

The Plant is designed for the concentration of uranium from dilute solutions by ion exchange. The Plant will house three distinct process circuits: the ion exchange circuit (also called the resin-loading circuit), the elution circuit, and the precipitation/filtration circuit. The final product will be yellowcake slurry with about 40 percent of water by volume. The slurry will be transported from the site via US DOT approved containers to a facility licensed by the NRC or an Agreement State for processing the slurry into dry yellowcake. Additional details on the Plant are provided in **Section 3.3**. Descriptions of other aspects of the ISR process, in particular effluent control (which involves the

Storage Ponds and the UIC Class I wells) and groundwater restoration, are provided in **Section 4** and **Section 6.2** of this report, respectively.

3.1.1 Site Facilities Layout

The approximate location of the Permit Area within the general region was previously shown in **Figure 3.1-1**. The Plant will be located in the central portion of the Permit Area in Section 18, Township 25 North, Range 92 West (**Figure 3.1-2**). It will include all the process circuits, the groundwater restoration facility, administration offices, and shop facilities. A plan view of the Plant is included in **Plate 3.1-1**. The Storage Ponds are adjacent to the Plant, as shown on **Plate 3.1-1**. The mine units will be along an east-west trend through the Permit Area (**Figure 3.1-2**). The UIC Class I wells will be in the southern portion of the Permit Area.

The Plant will be one of the first features constructed in the Permit Area, as noted on the project operation schedule (**Figure 3.1-3**). The primary access road and associated culverts will be constructed when the Plant is built; and the secondary access roads and associated culverts for each mine unit will be constructed prior to and during installation of that mine unit. The anticipated installation schedule for the mine units is shown in **Figure 3.1-3**. Secondary access roads and associated culverts for the Class I UIC wells will be constructed prior to installation of those wells. The primary and secondary roads will be built in accordance with BLM guidelines and standards described in Chapter 3, Section 2(i) of the LQD Rules and Regulations. Topsoil will be stripped based on the soil depths reported in **Section 2.6** and stored in a manner to prevent wind and water erosion, as required per Chapter 3, Section 2(i) of the LQD Rules and Regulations.

The Plant and the pattern area of each mine unit will all be fenced with barbed wire per BLM specifications. As appropriate, areas will be either gated or have cattle guards to minimize livestock access. The Storage Ponds will be fenced with a BLM approved game fence to prohibit large animal access (e.g., deer, elk, wild horses, and cattle). Electrical power will be brought into the site, through an overhead transmission line, from the powerline to the west of the site to a transformer at the Plant. The overhead line will be constructed in accordance with BLM guidelines for wildlife protection and to minimize surface disturbance. From the transformer to the header houses and from the header houses to the production and injection wells, power will be transmitted through underground lines that will be located along the same corridors as the pipelines for fluid transmission to and from the wells. Drinking water will be bottled water brought in from off-site; and water needed for other domestic purposes (about ten gpm) will be provided from an on-site well completed in the FG Sand.

3.1.2 Ore Deposits

As described in **Section 2.6** of this report, the ore deposits in the Permit Area generally occur at depths of 300 to 700 ft bgs in long narrow trends varying from a few hundred to several thousand feet long and 50 to 250 feet wide. The depth depends on the local topography, the dip of the formation, and the stratigraphic horizon. The available geologic and hydrologic data presented in **Sections 2.6** and **2.7** of this report, respectively, identify uranium mineralization in several sandstone layers (e.g., from shallow to deeper, the FG, HJ, and KM Horizons).

The three mineralized Sands in the HJ Horizon, from 350 to 500 ft bgs, are targeted for this permit application. The richest mineralized zone, locally designated as the Middle HJ (MHJ) Sand, is about 30 feet thick at 400 to 450 ft bgs, and is believed to contain over 50 percent of the total resource. Depending on location within the Permit Area, only one or all three of the mineralized Sands may be present at that location.

3.2 Mine Unit Processes, Instrumentation, and Control

The portion of the Permit Area underlain by uranium ore, that is economic to recover, has been divided into mine units for scheduling purposes and for establishing baseline data, monitoring requirements, and restoration criteria. Each mine unit will consist of a reserve block covering about 50 acres and represents an area LC ISR, LLC expects to develop, produce, and restore as a unit. Six or more such units will be required to mine the Permit Area. Typically, two or three mine units may be in production at any one time with additional mine units in various states of development and/or restoration.

The mine units will be subdivided into operational areas referred to as header houses; and, each mine unit may include as many as ten header houses. Each header house will be designed to accommodate the well controls and distribution plumbing for approximately twenty production wells and the associated injection wells (usually about 40 injection wells). With the Plant operating at a nominal flow rate of 6,000 gpm, approximately 180 production wells and 360 injection wells will be in operation.

3.2.1 Mine Unit Chemistry

During operations, barren lixiviant will enter the formation through the injection wells and flow to the production wells. The carbonate lixiviant will be made from varying concentrations and combinations of sodium carbonate, sodium bicarbonate, carbon dioxide, oxygen, and/or hydrogen peroxide added to the native groundwater. The combined carbonate/bicarbonate concentration in the injected solution typically will be maintained at less than five grams per liter (g/L), and the hydrogen peroxide and/or oxygen concentration typically will be less than one g/L. These limits help reduce the possibility of "gas lock" in the formation, which reduces ISR efficiency.

The carbonate/bicarbonate lixiviant is used because of its selectivity for uranium and minor reaction with the gangue minerals. The primary chemical reactions expected in the aquifer are provided in **Figure 3.2-1**. When the lixiviant is injected into the ore zone, the dissolved oxidant reacts with the uranium mineral and brings the uranium to the U^{+6} oxidation state. The uranium then complexes with some of the carbonates in the lixiviant to form an uranyl dicarbonate ion $UO_2(CO_3)_2^{-2}$ and/or an uranyl tricarbonate ion $UO_2(CO_3)_3^{-4}$, both of which are soluble and stable in solution. A small portion of the radium content will also be mobilized along with the uranium. Depending on site conditions, other metals such as arsenic, molybdenum, selenium, and/or vanadium, may also be mobilized.

The chemical reactions which mobilize the uranium will continue as long as the lixiviant is being injected into the orebody. Injection and production at each header house, and eventually each mine unit, will be discontinued once uranium recovery is no longer deemed economical, and restoration will be started (**Section 6.1** of this report).

3.2.2 Mine Unit Design

Delineation drilling in the Permit Area will better define ore resources for design of mine units. A mine unit will consist of interconnected patterns of production and injection wells (e.g. the pattern area) within a ring of monitor wells to detect horizontal excursions of injection or production fluid away from the mineralized zone. Monitor wells will also be completed in overlying and underlying aquifers as necessary to detect vertical excursions. Inside the pattern area, monitor wells (which may double as production or injection wells) will also be completed in the mineralized zone to provide information on the mining process.

The Project proposes relatively small monitor rings, each containing approximately 1.2 million pounds of reserves, within the HJ Horizon. In the simplest scenario, where only one sand is present in a horizon, the production, injection, and monitor wells will be installed in that sand. Where more than one sand is present in the horizon, e.g., the MHJ and LHJ Sands, only one sand is mined at a time. The production and injection wells are installed with the lowest sand in the horizon and that sand mined. The lowest sand is then sealed off, and the next sand up completed and mined. This process continues until all the sands within the horizon are mined. Restoration occurs in the reverse, with the uppermost sand being restored then sealed off and the next sand below opened up for restoration, in progression until all the sands are restored. The wells in the monitor ring are designed so the open intervals correspond to the depths of the sands adjacent to each well.

The mine units as currently projected are shown in **Figure 3.1-2**. The size and location of the mine units will be modified as needed based on final delineation of the ore deposit, performance of any prior mine units, and development requirements. Prior to operation of any new mine unit, a Hydrologic Testing Proposal and subsequent Test Report will be submitted to WDEQ-LQD for review and approval; and these documents will detail the aquifer conditions in the mine unit, monitor well locations, pattern areas, and similar information necessary for efficient operation of the mine unit.

Drilling practices, including site preparation/reclamation and drill hole abandonment, currently in use by LC ISR, LLC will continue to be used. Widely adopted industrial practices are followed, and agency consultations were made on drilling site preparation/reclamation and proper drill hole abandonment. LC ISR, LLC has made an effort to research existing information on historic drilling operations in the Permit Area and, if necessary, properly abandon remnant drill holes or wells. If previously unknown drill holes or wells are detected during the mine unit installation and testing, e.g., if communication is detected during a pump test, the drill hole or well will be abandoned in accordance with the procedures currently in use, which are outlined in **Section 3.2.2.1** and **Section 6.3.2**, respectively.

3.2.2.1 Production and Injection Well Patterns

The production and injection well patterns will be based on conventional five-spot patterns, modified as necessary to fit the characteristics of the orebody. The conventional five-spot pattern is four injection wells surrounding a central production well. The cell dimensions will vary depending on the characteristics of the formation and the orebody; but the injection wells are expected to be between 75 and 150 feet apart.

All the production and injection wells will be completed, so they can be used as either a production well or an injection well. This design allows changes in the solution flow patterns to improve uranium recovery and to restore the groundwater in the most efficient manner.

3.2.2.2 Monitor Well Locations

Monitor wells will be located in a perimeter ring around the mine unit, with the completion interval of each well targeted to the mineralized zone(s) adjacent to that well. Distances from the perimeter monitor wells to the injection/production patterns in each mine unit are anticipated to be on the order of 500 feet. The distance between each of the monitor wells in the ring is also anticipated to be on the order of 500 feet. The actual distances will be based on the aquifer characteristics of that mine unit to ensure any excursion can be detected in a timely manner. The adjacent monitor wells will be recompleted to appropriately monitor the adjacent production and injection wells.

Production zone monitor wells will be installed inside the pattern area to provide information on baseline conditions and on progress of recovery and restoration. The completion interval of a production zone monitor well will target the mineralized zone(s) adjacent to that well. The number of production zone monitor wells in a given mine unit will be based on the size of that pattern area and the density of production and injection wells in the pattern area. Most production zone monitor wells are also used as injection and/or production wells.

Overlying and underlying monitor wells will also be completed in the aquifers immediately above and below the uppermost and lowermost mineralized zone, respectively. Overlying and underlying wells will be installed at a density of about one well for each four acres of mine unit area. The actual density will be based on the aquifer characteristics of the mineralized zone and the overlying or underlying aquifer; and specific locations may be targeted depending on the thickness and continuity of the shale separating the mineralized zone from the overlying or underlying aquifer. If conditions are encountered at a prospective mine unit, such that vertical confining layers are very thin or absent, then the local stratigraphy will be evaluated and the mine unit operations and monitoring will be adjusted for the situation. These adjustments may include placement of the overlying or underlying monitor wells in different stratigraphic horizons within the mine unit, rather than in the separate overlying or underlying aquifer. Other adjustments could include additional operational controls, such as localized higher production rates, to help ensure none of the mining fluids migrate from the mineralized zone.

In rare circumstances, a trend well(s) may also be installed to better understand solution movement within a mine unit. These wells will be constructed and tested in the same manner as the monitor wells. Monitoring parameters and frequency will depend on the purpose for which the trend well was installed.

3.2.3 Mine Unit Installation

The projected ISR operation schedule for each of the mine units, along with the anticipated groundwater restoration schedule, is provided in **Figure 3.1-3**. The schedule generally provides two years for development of a mine unit, 1.5 to two years for uranium production, and two years for aquifer restoration. The two years provided for aquifer restoration include approximately: two months for each header house to serve as a buffer area between impacts of production and restoration, nine months for groundwater sweep; nine months for RO, and one month for homogenization. Stability monitoring will follow restoration and is not included in the total time (**Section 6.2** of this report).

The development schedule, provided in **Figure 3.1-3**, will be affected by various factors. These factors typically involve adjustments as necessary to meet production schedules and contractual agreements, longer (or shorter) than predicted mining or restoration times or delays in mine unit installations. **Figure 3.1-2** depicts the mine unit designations as currently projected for the life of the facility. The table and figure are generalized; e.g., if an area designated as undergoing restoration is directly adjacent to an area undergoing mining, all or a portion of the restoration unit could be serving as a buffer zone, or could be in stability monitoring. In addition, the development schedule may be affected by restrictions to protect wildlife such as exclusion from specific areas during nesting seasons. The current schedule reflects existing restrictions on drilling, and LC ISR, LLC will keep in contact with the BLM for updated guidance.

To account for such changes, LC ISR, LLC will include: in the Annual Report to WDEQ and NRC; a map of the Permit Area showing the mine units that are being developed, in production, and in restoration; and areas where restoration has been completed. New areas where production or restoration is expected to begin in the subsequent year will also be identified in the Annual Report. An updated schedule will be supplied with the Annual Report if the ISR operation or restoration schedule varies from **Figure 3.1-3**.

3.2.4 Well Completion

Monitor, production, and injection wells will be drilled to the target completion interval with a rotary drilling unit using native mud and a small amount of commercial drilling fluid additive for viscosity control. The well will then be cased 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 well casing will be polyvinyl chloride (PVC) pipe. A typical casing will be CertainTeed's spline-locking standard dimension ratio (SDR) 17 PVC well casing, which has a nominal 4.5 inch diameter, 0.291 inch minimum wall thickness, and is rated for 160 pounds per square inch (psi) burst pressure and 224 psi collapse pressure. The PVC casing joints normally have a length of 20 feet each. Each connection is sealed with an o-ring and spline lock. This configuration provides a seal without the installation of screws to hold each joint together and has been proven effective at other ISR facilities. Casing centralizers, located every 40 feet, are run on the casing to ensure it is centered in the drill hole and that an effective cement seal is provided.

The purpose of the cement is to stabilize and strengthen the casing and seal the well annulus to prevent vertical migration of solutions. The volume of cement used is the calculated volume required to fill the annulus and return cement to the surface. In most cases, the cement returns to the surface, at least initially. However, in some cases, the drilling may result in a larger annulus volume than anticipated and cement may not return to the surface. In these cases, the upper portion of the annulus will be cemented from the surface. In the majority of cases, where the cement fails to return to surface, the reason will be a washout or a casing failure. In the event of a casing problem, the well will not pass the Mechanical Integrity Test (MIT). In all cases, wells are required to pass an MIT test before operations approval. This will ensure that there is sufficient integrity to allow the use of the well in handling lixiviant.

After the cement has set, the well will be completed. This involves under-reaming the desired completion interval to a diameter of 9.5 to 11 inches, depending on the tool configuration and the diameter of the original annulus. The well is then air-lifted for about one hour to remove any remaining drilling mud and/or cuttings. A swabbing tool is frequently run in the well for final clean-up and sampling. If sand production or hole stability problems are expected, a slotted liner, wire-wrapped screen or similar device may be installed across the completion interval to minimize the problem.

Typical well completions are illustrated in **Figures 3.2-2**, **3.2-3**, and **3.2-4**. Completion data for installed wells will be submitted to NRC and WDEQ in the next Annual Report following the completion of the wells.

3.2.5 Well Integrity Testing

After a well (injection, production, or monitor) has been completed and before it is made operational, an MIT of the well casing will be conducted. An MIT will also be conducted on any injection well that has been damaged by surface or subsurface activity or that has had a drill bit or cutting tool inserted in the well. Any well with evidence of suspected subsurface damage will require an MIT prior to the well being returned to service. In addition, an MIT of each injection well will be done once every five years unless an alternate schedule has been reviewed and approved by WDEQ-LQD.

In the integrity test, the bottom of the casing adjacent to or below the confining layer above the zone of interest is sealed with an inflatable packer or other suitable device. The top of the casing is then sealed in a similar manner or with a cap, and a pressure gauge is installed to monitor the pressure inside the casing. The pressure in the sealed casing is then increased to a specified test pressure and will maintain 95 percent of this pressure for ten minutes to pass the test. If any well casing that fails the test cannot be repaired, the well shall be plugged and abandoned.

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

If a well casing does not meet the mechanical integrity criteria, the casing will be repaired and the well re-tested. If a repaired well passes the MIT, it will be employed in its intended service. Also, if the well defect occurs at depth, the well may be plugged back and re-completed for use in a shallower zone, provided it passes the MIT. If an acceptable test cannot be obtained after repairs, the well will be plugged. The documentation for the MITs will include the well designation, date of the test, test duration, beginning and ending pressures, and the signature of the individual responsible for conducting the test. Results of the integrity tests shall be maintained on-site and will be available for inspection by NRC and WDEQ. A list of wells receiving an MIT, the dates of those MITs, and the designation of whether those wells passed or failed will be reported as part of the Quarterly Report to WDEQ.

3.2.6 Mine Unit Piping and Instrumentation

Each injection well and production well will be connected to a specified injection or production manifold in a header house. The manifolds will route the leaching solutions to and from the Plant. Flow meters and control valves will be installed in the individual well lines to monitor and control the individual well flow rates and pressures.

Mine unit piping is expected to be high density polyethylene (HDPE) pipe, PVC pipe, stainless steel pipe, or equivalent. The mine unit piping will typically be designed for an operating pressure of 150 pound force per square inch gauge (psig); and it will be operated at pressures equal to or less than the design pressure. The typical pressure rating, for both the PVC and HDPE piping materials used, is between 160 and 200 psig. If a higher design pressure is needed, the pressure rating of the materials will be evaluated and, if necessary, materials with a higher pressure rating will be used.

The individual well lines and the trunk lines to the Plant will be buried to prevent freezing. The use of header houses and buried lines has been proven an effective method of protecting the pipelines at other ISR facilities subject to weather conditions similar to those at the Permit Area. A typical mine unit solution flow pattern is illustrated in **Figure 1.6-1**.

Instrumentation systems will be key to monitoring and maintaining the multiple processes in the field (e.g., the mine units) and in the Plant. Plant and Field Operators will use the data and information provided by the instrumentation systems to better manage the work areas. Operator control of key elements will be maintained; and instrumentation will assist in controlling pump operating levels and valve operation. When operating parameters move outside a specified normal operating range, it will cause an alarm that notifies the operator to initiate corrective action to alleviate the problem. Excessively high or low levels or pressure alarms will initiate automatic shutdown of the related equipment. The key design component of the system will be to minimize the risk of uncontrolled releases of leaching solutions or other solutions and provide maximum safety and protection to the operators, other site personnel and the environment.

Radiation detection instruments used to monitor the operation and the specifications on this equipment are included in the Health Physics Manual. The location of monitoring points and monitoring frequency for in-plant radiation safety are discussed in **Section 5** of this report.

3.2.7 Mine Unit Control

The techniques, that will be employed to ensure each mine unit is operating as efficiently as possible, will include monitoring of: production and injection rates and volumes, wellhead pressures, water levels, and water quality. These criteria may be evaluated at more than one level (e.g., by mine unit, by header house, by pattern, or by well) depending on the specific criteria.

The most basic aspect of mine unit control is the bleed system, e.g., overproduction. The bleed system will be used so the volume of injection fluid will be less than the volume of production fluid in a mine unit. The overproduction will result in an inflow of groundwater into the pattern area and help reduce the possibility of an excursion. The anticipated bleed rate is 0.5 to 1.5 percent. Overproduction will be adjusted as necessary to control the distribution of the lixiviant within the mining zone.

3.2.7.1 Header House Control

Within each mine unit, injection and production balance will be monitored in well groupings related to header houses. The production and injection wells within each header house will be monitored individually or by production or injection headers, which are groups of production or injection wells piped together, depending on the monitoring parameter. The instrumentation will allow: balancing of the flow rates in the injection and production wells piped to and from that header house, respectively; monitoring wellhead pressures; and shutdown of flows in the event of a piping failure. Other instrumentation in the header house will include automatic oxygen shut-off and leak detection.

The hydrologic balance is determined by summing the flow rates of the injection and production wells separately and controlling the rates such that each header house is receiving the same injection volume per unit time as is being produced, minus the bleed volume. In a stable operating mine unit, the well flows observed will only fluctuate minimally from day to day. Appropriately designed flow meters will be used to measure the individual flow rates of each well. As a redundant control measure, flow meters will also be installed on the main pipelines entering and exiting each header house. The individual well flows will be monitored and adjusted daily and the pipeline meter will be monitored continuously with the instrumentation system.

All production wells and each injection header will have pressure gauges; and the pressures will be recorded daily. Pressure switches will be installed on the production wells and injection header in each header house. These switches will be designed to detect a piping failure and to shut down power to the production wells. In normal operation, when one header house has an event that trips the power to that house, the pressure change is noticeable throughout the system and other header houses will alarm the operator and subsequently shutdown.

The pressure information on the injection wells is necessary to help ensure that the injection pressures do not exceed the formation fracture pressure or the rated pressure for the casing. Regional information and historical operational practices indicate that the minimum pressure that could initiate hydraulic fracturing is 0.70 psi per foot of well depth. Further, injection pressures also will be limited to the pressure at which the well was integrity tested. During mine unit operations, injection pressures shall not exceed the MIT pressures (see **Section 3.2.5**) at the injection wellheads. Not withstanding this restriction, the maximum injection operating wellhead pressures shall not exceed 90 percent of the production zone fracture pressure or 95 percent of the American Society for Testing and Materials (ASTM) maximum recommended operating pressure at 75 F for the well casing, whichever is less.

The oxygen system in each header house will have solenoid operated valves that will close in the event of a power loss or injection flow shutdown. This will prevent the continued delivery of oxygen to the pipeline when the field is not operating. Other operational safety features include, but are not limited to, a set of wet contacts or a conductivity probe installed in the sump in each header house to detect fluids on the floor of the house. If fluids are detected, the shunt will be tripped and electrical power to the production wells will be turned off. An audible and visual alarm system will be activated. Remote shutoffs for power will also be available at each of the header houses.

3.2.7.2 Pattern Control

Balanced patterns are necessary to achieve optimum production and to minimize flare of the lixiviant from the pattern areas. Increased flare from the patterns reduces production efficiencies and increases the effort required to restore the groundwater after production is concluded. Balanced patterns are also necessary to prevent excursions of production fluids from the mine units.

Patterns will be balanced by adjusting the injection and production flow rates to maintain production flow rates equal to injection rates plus the bleed rate. There are two types of operational constraints encountered in mine unit balancing: injection limitations and production limitations. Injection-limited patterns have more available production capacity than the injection wells can accept. This situation usually arises due to plugging of injection wells and can be remediated by servicing the injection wells. Production-limited patterns have a greater injection capacity than the production well can effectively produce. This is more common, as the pattern design typically has a greater number of injection wells than production wells.

The relationship between injector flow rates and producer flow rates is based on whether the pattern is production or injection limited. In the injection-limited scenario, the maximum achievable injection flow rate for a given well is divided by the number of associated recovery wells. The production well flow rate is determined and thus controlled to match the sum of the prorated injection flow rates from its associated injection wells. The determination method is reversed in the production-limited scenario.

3.2.7.3 Projected Water Balance and Water Level Changes

In addition to evaluating the operation of each mine unit individually, the overall water balance and water level changes will be taken into account to ensure all aspects of the operation (e.g., ISR and restoration) are being conducted as efficiently as possible. The overall water balance is based on the potential pumping and injection rates at the mine units and the capacity of the Plant and Class III UIC wells for production and for restoration. The water level changes, including both drawdown and mounding from production and injection, respectively, will be evaluated to minimize interference among the mine units and to determine cumulative drawdown.

Water Balance

Figure 3.2-5 shows the projected water balance of the Project. The liquid waste generated at the Plant will be primarily the production bleed, which, at a maximum scenario, is estimated at 1.5 percent of the production flow. At 6,000 gpm total operational flow, the volume of liquid waste would be 90 gpm (47,304,000 gallons per year). LC ISR, LLC proposes to manage the liquid waste primarily through the UIC Class I well(s) and supplement as necessary with the Storage Ponds.

Mine Unit Interference

Decisions about the order in which mine units will be brought on line and the rates at which they will be developed and restored will depend, in part, on the potential for interference among the mine units. Prior to operation of any new mine unit, a Hydrologic Testing Proposal and subsequent Test Report will be submitted to WDEQ-LQD for review and approval. The Test Report will detail the aquifer conditions in the mine unit, monitor well locations, pattern areas, and similar information necessary for efficient operation of the mine unit.

Cumulative Drawdown

As discussed in **Section 2.7** of this report, a regional pump test has been conducted to assess the hydraulic characteristics of the HJ Horizon and overlying and underlying confining units. Pump tests also will be performed for each mine unit in order to demonstrate hydraulic containment above and below the production zone, demonstrate communication between the pattern area and perimeter monitor wells, and to further evaluate the hydrologic properties of the HJ Horizon.

Because the HJ Horizon is a deep confined aquifer, no surface water impacts are expected; and there are no perennial streams in the vicinity of the Permit Area. As discussed in **Section 2.2** of this report, the nearest use of water from the Battle Springs Formation, other than for the Project, is wells located outside the Permit Area. Based on a map measurement, the wells are approximately two to three miles distant from the center of the Permit Area.

Based on a bleed of 0.5 to 1.5 percent, the potential impact from consumptive use of groundwater is expected to be minimal. In this regard, the vast majority (e.g., on the order of 99 percent) of groundwater used in the ISR process will be treated and re-injected (Figure 3.2-5). The potential impacts are addressed in more detail in **Section 7.1.5.**

To generally quantify the potential impact of drawdown due to ISR and restoration operations, the following assumptions were used:

- mining/restoration life: eight years;
- average net consumptive use: 174 gpm
  (60 gpm bleed from ISR; 160 gpm from groundwater sweep; 100 gpm from RO);

- location of pumping centroid: center of Section 18;
- observation radius: two and three miles radially from centroid of pumping;
- formation transmissivity 65 ft^2/d (preliminary pump test results);
- formation thickness 120 feet;
- formation hydraulic conductivity 0.54 ft/d;
- formation storativity 1.1×10^{-4} (preliminary pump test results)

The data were used to predict drawdown over time with a Theis semi-steady state analytical solution, which includes the following assumptions.

- The aquifer is confined and has an apparent infinite extent.
- The aquifer is homogeneous and isotropic, and of uniform effective thickness over the area influenced by pumping.
- The piezometric surface is horizontal prior to pumping.
- The well is pumped at a constant rate.
- No recharge to the aquifer occurs.
- The pumping well is fully penetrating.
- The well diameter is small; so well storage is negligible.

Based on these assumptions and results from the Lost Creek Pump Test, the drawdown, after eight years of operation at two-mile and three-mile radial distances from the centroid of pumping, was estimated to be 146 and 114 feet, respectively. This amount of drawdown is approximately 50 percent of the available drawdown in the HJ Sand. While this amounts to a significant portion of the available drawdown, there is little use of groundwater from the HJ Horizon in the immediate vicinity of the Permit Area (**Section 7.1.5**). In addition, the calculated drawdown is very conservative because one of the assumptions is that there is no recharge to the aquifer.

These calculations also neglect the impact of the Lost Creek Fault, which as noted above, limits groundwater flow to a significant degree. The calculated drawdowns from ISR and restoration are based on the assumption of an infinite radial system, resulting in less drawdown as compared to a system bisected by the Fault. However, it is anticipated that ISR and restoration activities will progress on alternating sides of the fault to manage the impact, so the duration of ISR and restoration on each side of the Fault would be less than the eight-year period used in these calculations. In addition, it is anticipated that LC ISR, LLC will apply for a license amendment to conduct ISR in the overlying FG and underlying KM Sands, increasing the options for management of the effects of the Fault. The drilling to refine the delineation of each mine unit and the testing performed as part of the Hydrologic Testing Proposal and Report for each mine unit will provide information on the extent of the Fault and its impact on the hydrologic characteristics of each mine unit and will allow for refinement of the drawdown calculations.

3.2.7.4 Excursion Monitoring and Control

The groundwater monitoring program is designed to: establish baseline water quality prior to mining, detect excursions of lixiviant horizontally and/or vertically from the production zone, and determine when the production zone aquifer has been adequately restored following mining. During operation, the primary purpose of the monitoring program will be to detect and correct conditions that could lead to an excursion of lixiviant or detect such an excursion, should one occur.

Water levels will be measured at the same frequency as the monitor well sampling. Sudden changes in water levels may indicate that the mine unit flow is out of balance. Increases in water levels in the overlying or underlying aquifers may be an indication of fluid migration from the production zone. Flow rates would be adjusted to correct this situation. Adjustments to well flow rates or complete shutdown of individual wells may be required to correct this situation. Increases in water levels in the overlying or underlying aquifers may also be an indication of casing failure in a production, injection or monitor well. Isolation and shutdown of individual wells can be used to determine the well causing the water level increases.

To ensure the leach solutions are contained within the designated area of the aquifer being mined, the production zone and overlying/underlying aquifer monitor wells will be sampled semimonthly during mining as discussed in **Section 5.7** of this report.

In the event that an excursion is detected, then verified by confirmation samples, excursion control would be initiated in accordance with the procedures in **Section 5.7**. With regard to the overall water balance, it is anticipated that the following procedures would be implemented to achieve control and remediation of the excursion.

If an excursion is verified, the following methods of corrective action will be instituted (not necessarily in the order given) dependent upon the circumstances.

- Conduct sampling/analysis to verify an excursion has occurred.
- Complete a preliminary investigation to determine the probable cause(s).
- Adjust production and/or injection rates in the vicinity of the monitor well(s) as necessary to increase the net process bleed; thus, forming a hydraulic gradient toward the production zone.
- Pump individual production/injection or monitor wells (and trend wells, if available) to enhance the recovery of ISR solutions.
- Suspend injection into the mine unit area adjacent to the monitor well.
- Continue recovery operations; thus, increasing the overall bleed rate and the recovery of mine unit solutions.

Assuming a total mine unit flow of 6,000 gpm, with approximately 180 production wells, the groundwater extraction per production well is 30 to 35 gpm. Conversely, the injection rate for each well pattern is also approximately 30 to 35 gpm (minus the one percent bleed). Shutting off the injection from two to four well patterns near the monitor well that has a verified excursion would result in approximately 60 to 140 gpm of additional net extraction in the area of the excursion. Based on results from the 2007 pump test, corrective pumping on the order of 60 to 140 gpm would be sufficient to quickly and efficiently control an excursion.

3.3 Plant Processes, Instrumentation, and Control

The Plant is designed for the concentration of uranium from dilute solutions by ion exchange. The Plant will house three distinct process circuits: the ion exchange circuit (also called the resin-loading circuit), the elution circuit, and the precipitation/filtration circuit. The final product will be yellowcake slurry. The slurry will be transported from the Permit Area via DOT-approved tankers to a facility licensed by NRC for processing the slurry into dry yellowcake.

The Plant will be designed to process up to 6,000 gpm of lixiviant through the ion exchange circuit. All of the uranium-laden resin will be transferred via pipe to the elution circuit. The elution circuit will be designed to accept loaded resins from satellite facilities operated by LC ISR, LLC or its affiliates and/or from third-party facilities. The elution and precipitation/filtration circuits will be designed on the basis of a two million pound-per-year processing rate, with an initial nominal operating rate of one million pounds per year to match the projected production rate from the Permit Area.

The Plant building will house all auxiliary equipment and systems required to support an operation of this type. In addition, the Plant will contain equipment and facilities capable of treating up to 1,000 gpm of groundwater from mine units that are in both production and restoration (**Figure 3.2-5**).

3.3.1 Ion Exchange (Resin-Loading) Circuit

Uranium concentrations averaging 40 to 50 parts per million (ppm) U_3O_8, are expected in the production fluid. Standard, commercially available ion exchange resins have been demonstrated to function well under conditions such as those at the Project. The ion exchange resins preferentially remove the uranyl dicarbonate or uranyl tricarbonate from the solution. The ion exchange circuit will consist of pressurized, "down-flow" vessels that are internally screened to maintain the resin in place but allow the lixiviant to flow through the vessel. Once the resin becomes loaded, the vessel is isolated from the normal process flow and the resin is transferred via piping to a separate vessel for elution.

Approximately 200 gpm of the barren lixiviant (IC fluid) will be routed through an RO unit prior to leaving the Plant. RO, at this point, allows approximately one percent of the total flow required for bleed to exit as waste brine instead of injection fluid. The RO permeate is added back to the injection stream. The solution leaving the ion exchange circuit will normally contain less than five ppm of uranium. Sodium carbonate, sodium bicarbonate, oxidants, and carbon dioxide will be added to the barren solution, as required, prior to re-injection. The resin-loading circuit is graphically represented in **Figure 1.5-2a**.

3.3.2 Elution Circuit

When resin in an ion exchange vessel is fully loaded and/or removing very little additional uranium, the vessel will be isolated from the normal process flow. The loaded resin will be transferred in 500 cubic foot lots from the ion exchange vessel to the elution circuit. In this circuit, the loaded resin will first be passed over vibrating screens with wash water to remove entrained sand particles and other fine trash. The loaded resin will then move by gravity from the screens into down-flow elution vessels for uranium recovery and resin regeneration. The Plant will also have the capability to receive loaded resin from other operations via bulk transport for processing in the elution circuit.

Once in the elution vessel, the loaded resin will be contacted with an eluate composed of approximately 90 g/L sodium chloride and 20 g/L sodium carbonate (soda ash). The eluted resin is subsequently rinsed with fresh water and returned to an empty ion exchange vessel or bulk trailer (**Figure 1.5-2b**).

In a three-stage batch elution process, a total of 45,000 gallons of eluant contact the 500 cubic feet of resin. The process generates 15,000 gallons of rich eluate with a concentration of ten to 20 g/L U_3O_8. Each elution produces 30,000 gallons of eluate that is re-used in the next elution. Likewise, 15,000 gallons of fresh eluate will be required per elution. The fresh eluate is prepared by mixing the proper quantities of a saturated sodium chloride (salt) solution, a saturated sodium carbonate (soda ash) solution, and water. The saturated salt solution is generated in commercially available salt saturators (brine generators). Saturated soda ash solution is prepared by passing warm water (greater than 105° F) through a bed of soda ash.

3.3.3 Precipitation/Filtration Circuit

From the elution circuit, the uranium-rich eluate will be sent to an agitator tank for batch precipitation. To initiate the precipitation cycle, hydrochloric or sulfuric acid will be added to the eluate to breakdown the uranyl carbonate present in the solution (**Figure 1.5-2b**). Hydrogen peroxide will then be added to the eluate to effect precipitation of the uranium as uranyl peroxide. Caustic soda solution will then be added to elevate the pH, which promotes growth of uranyl peroxide crystals and makes the slurry safer to handle in the subsequent process steps.

After precipitation, the precipitated uranium will be washed, to remove excess chlorides and other soluble contaminants, and then de-watered and filtered to form the yellowcake slurry. This slurry will then be stored in holding tanks or in transport tanks parked in a secure area in the Plant. The holding and transport tanks will be used solely for yellowcake slurry. On-site inventory of U_3O_8 in the slurry form will typically be less than 100,000 pounds. However, in periods of inclement weather or other interruptions to product shipments, there will be capacity for up to 200,000 pounds of slurry within the Plant. The yellowcake slurry will be shipped by exclusive-use, authorized transport to a facility licensed by NRC for processing the slurry into dry yellowcake.

3.3.4 Major Process Equipment and Instrumentation

The major process equipment in the Plant will include: ion exchange vessels; elution vessels; precipitation tanks; filter presses; slurry storage tanks; and the piping, pumps, valves, filters, and associated equipment required to control and move the solutions through the various process circuits. The process equipment will be installed as needed to meet the required flow rates and production levels. The ion exchange, elution, and precipitation/filtration circuits will have instrumentation designed to monitor key fluid levels, flow rates and pressures. In addition to monitoring, there will be varying levels of control, such as automatic shut-offs, for pumps, valves, and operating systems.

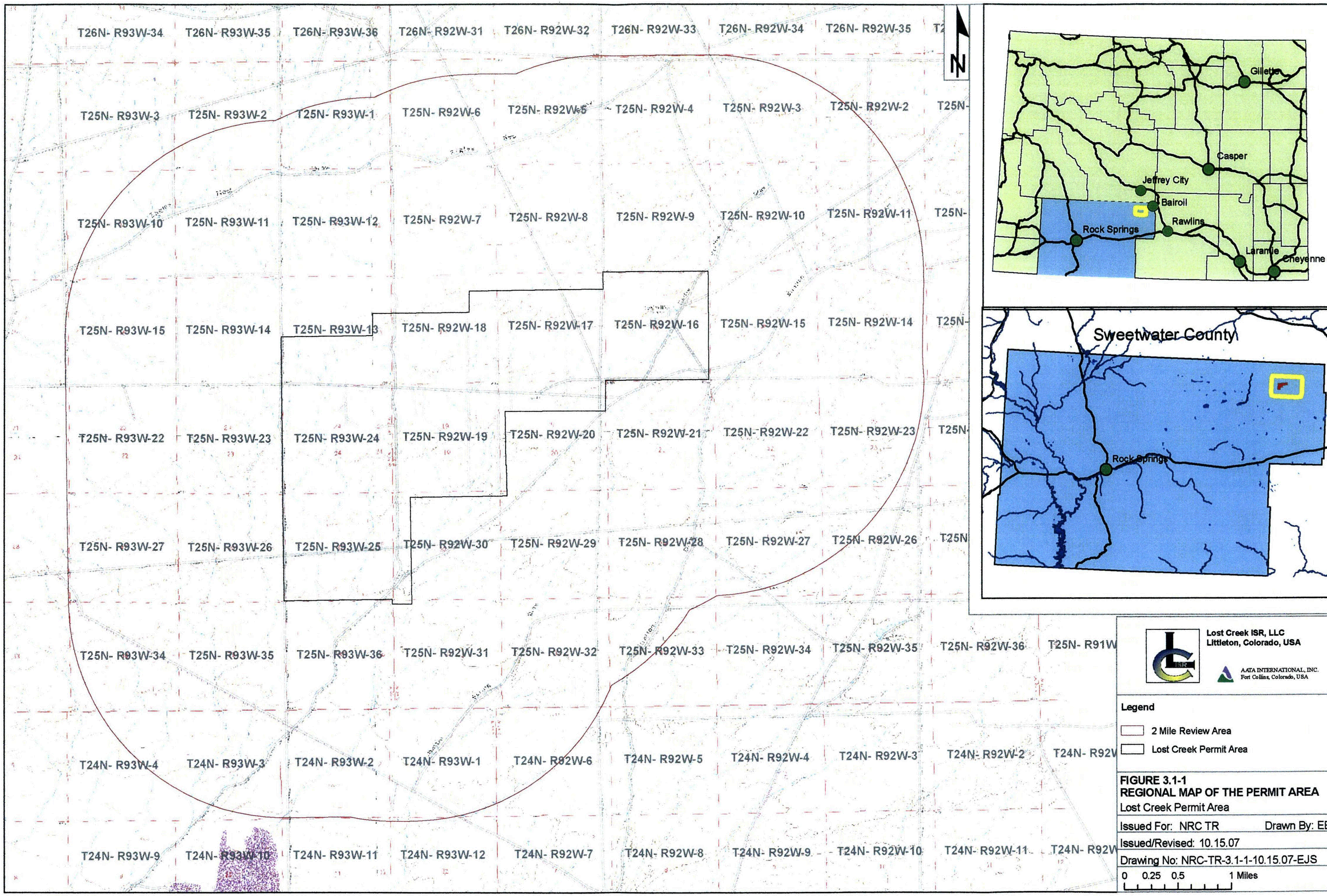

FIGURE 3.1-1
REGIONAL MAP OF THE PERMIT AREA
Lost Creek Permit Area

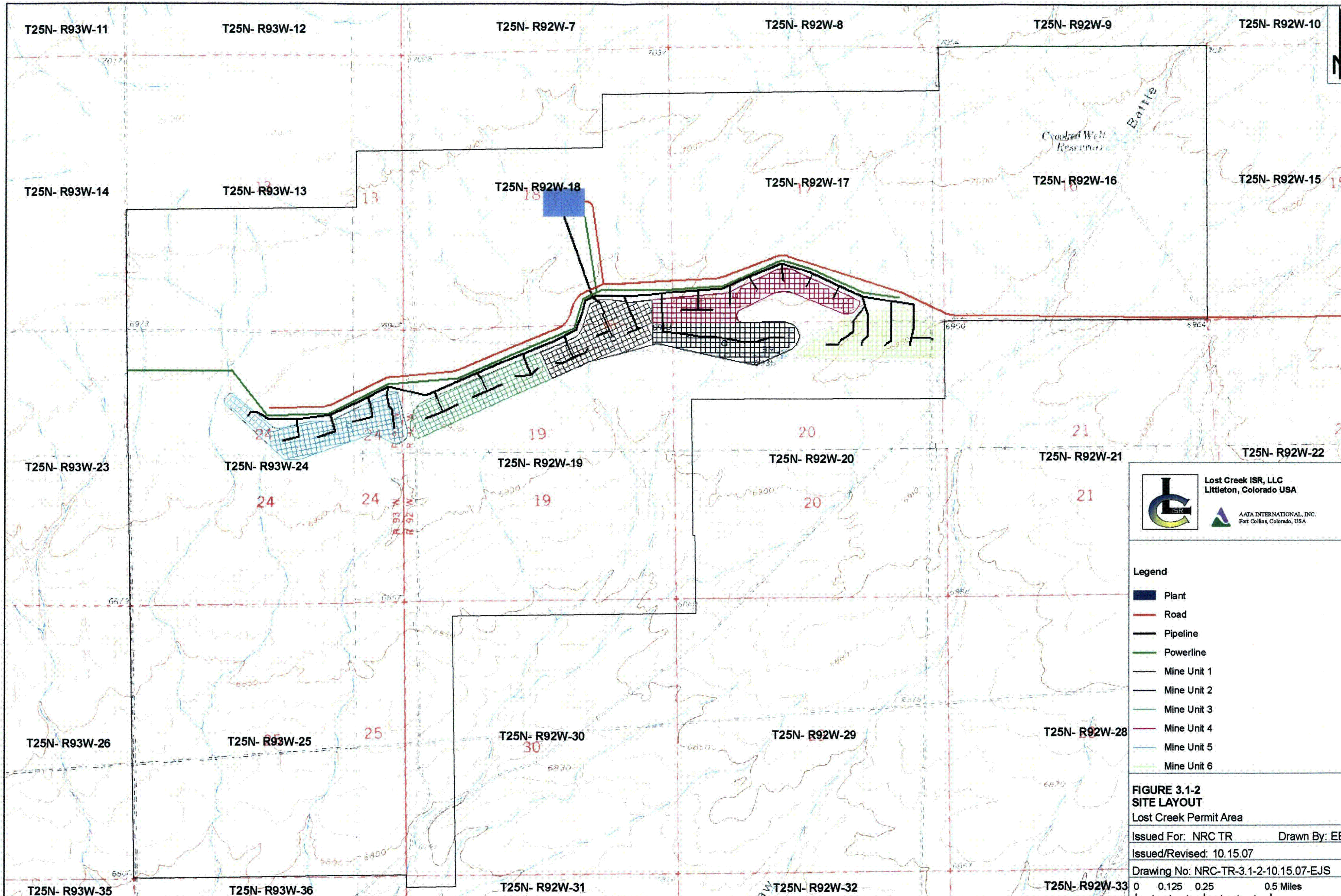

FIGURE 3.1-2
SITE LAYOUT
Lost Creek Permit Area

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Issued/Revised: 10.15.07
Drawing No: NRC-TR-3.1-2-10.15.07-EJS

FIGURE-3.1-3

Lost Creek Project Development, Production and Restoration Schedule

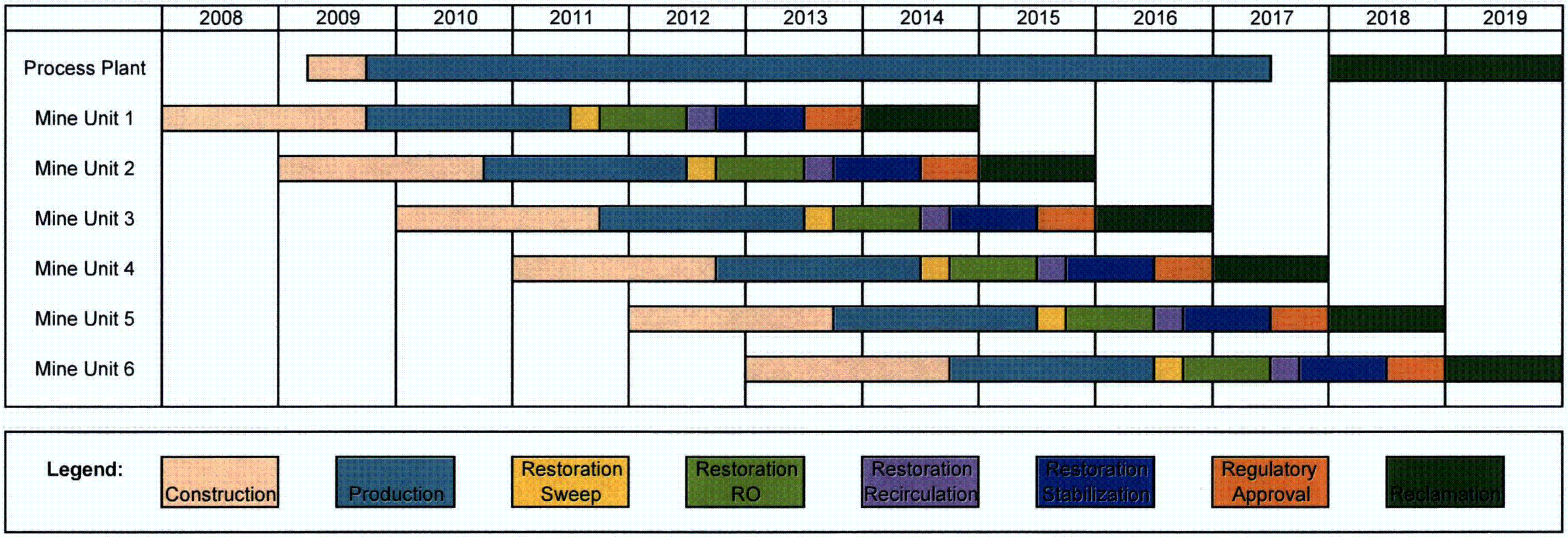


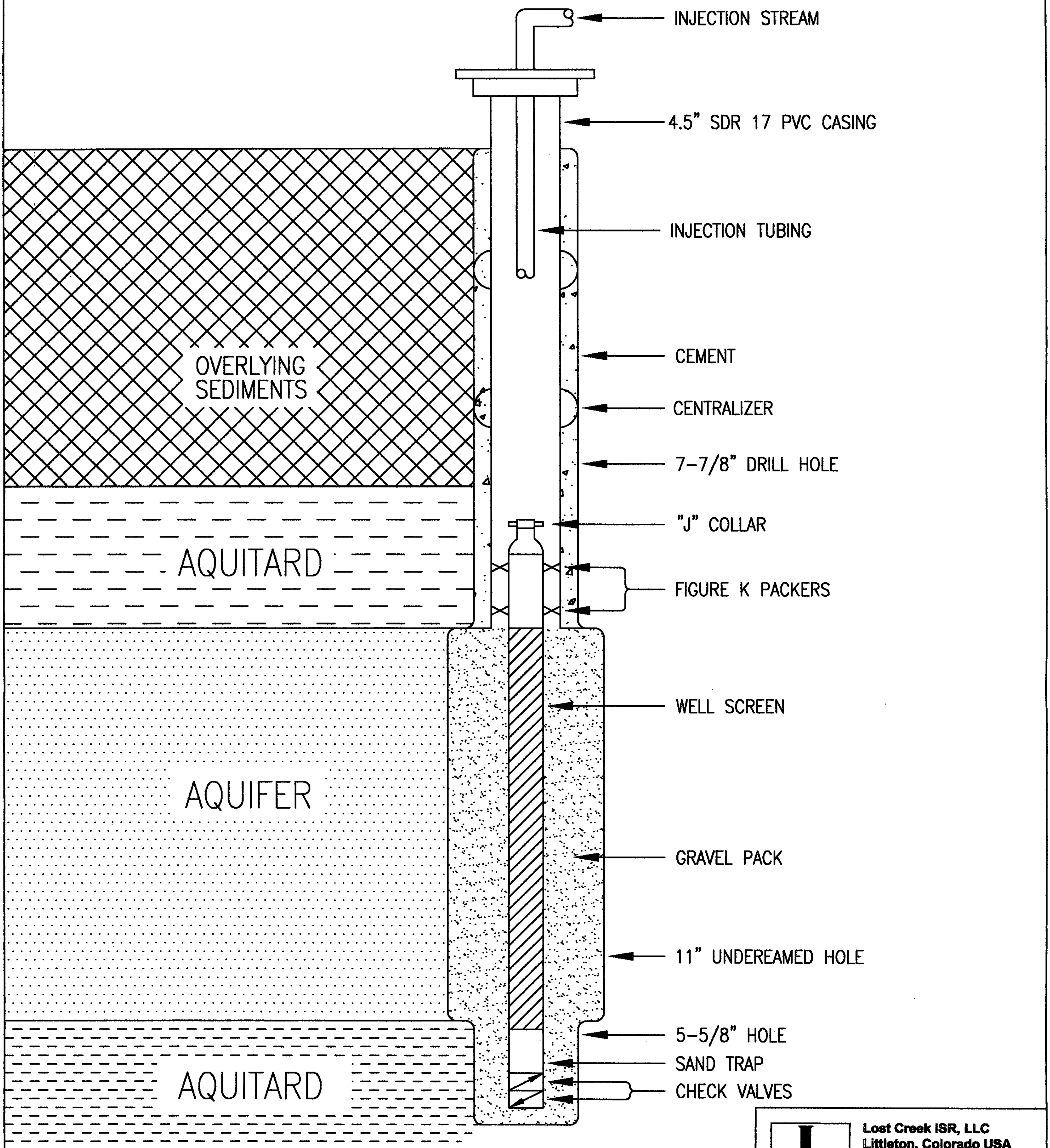
Figure 3.2-1
Alkaline Uranium Leach Chemistry In The Aquifer

$$2UO_{2(s)} + O_2 + 2H_2O \rightarrow 2UO_2{}^{+2}{}_{(l)} + 4OH^- \quad (1)$$

$$UO_2{}^{+2} + 2HCO_3{}^- + 2OH^- \rightarrow UO_2(CO_3)_2{}^{-2} + 2H_2O \quad (2)$$

Equation (1): In an aqueous environment, the oxidized uranium will form a soluble uranyl ($UO_2{}^{+2}$) cation.

Equation (2): Sodium bicarbonate and carbon dioxide gas is introduced into the injection lixiviant. The predominant uranyl dicarbonate complex forms and stabilizes uranyl ions in solution.



Lost Creek ISR, LLC
Littleton, Colorado USA

AATA INTERNATIONAL, INC.
Fort Collins, Colorado, USA

FIGURE 3.2-2
Injection Well Construction
Lost Creek Permit Area

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Issued / Revised: 10.2.2007	
Drawing No. NRCTR 1.0 FIG 3.2-2 10.2.2007 SMH	

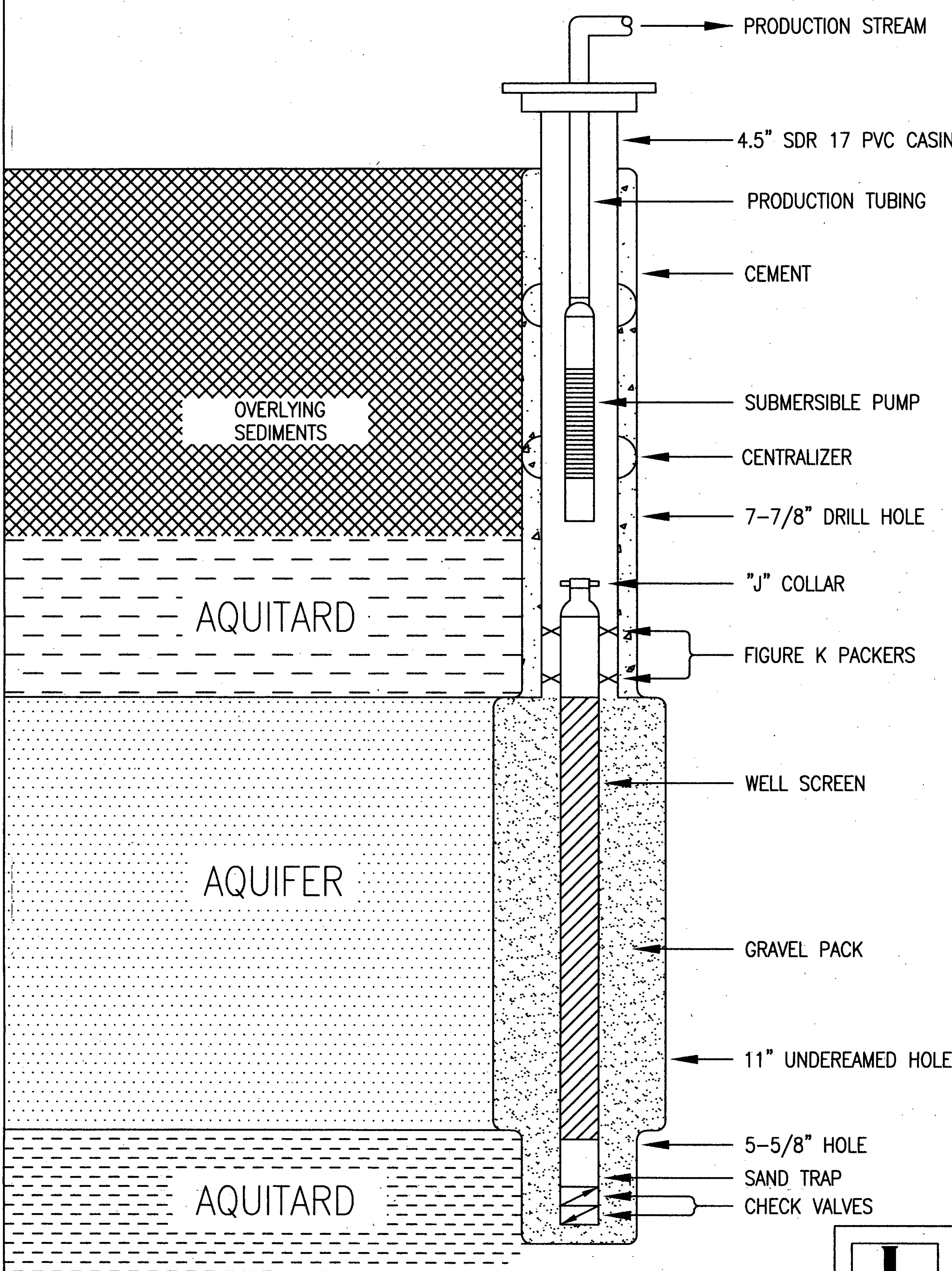

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FIGURE 3.2-3
Production Well Construction
Lost Creek Permit Area

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Issued / Revised: 10.2.2007
Drawing No. NRCTR 1.0 FIG 3.2-3 10.2.2007 SMH

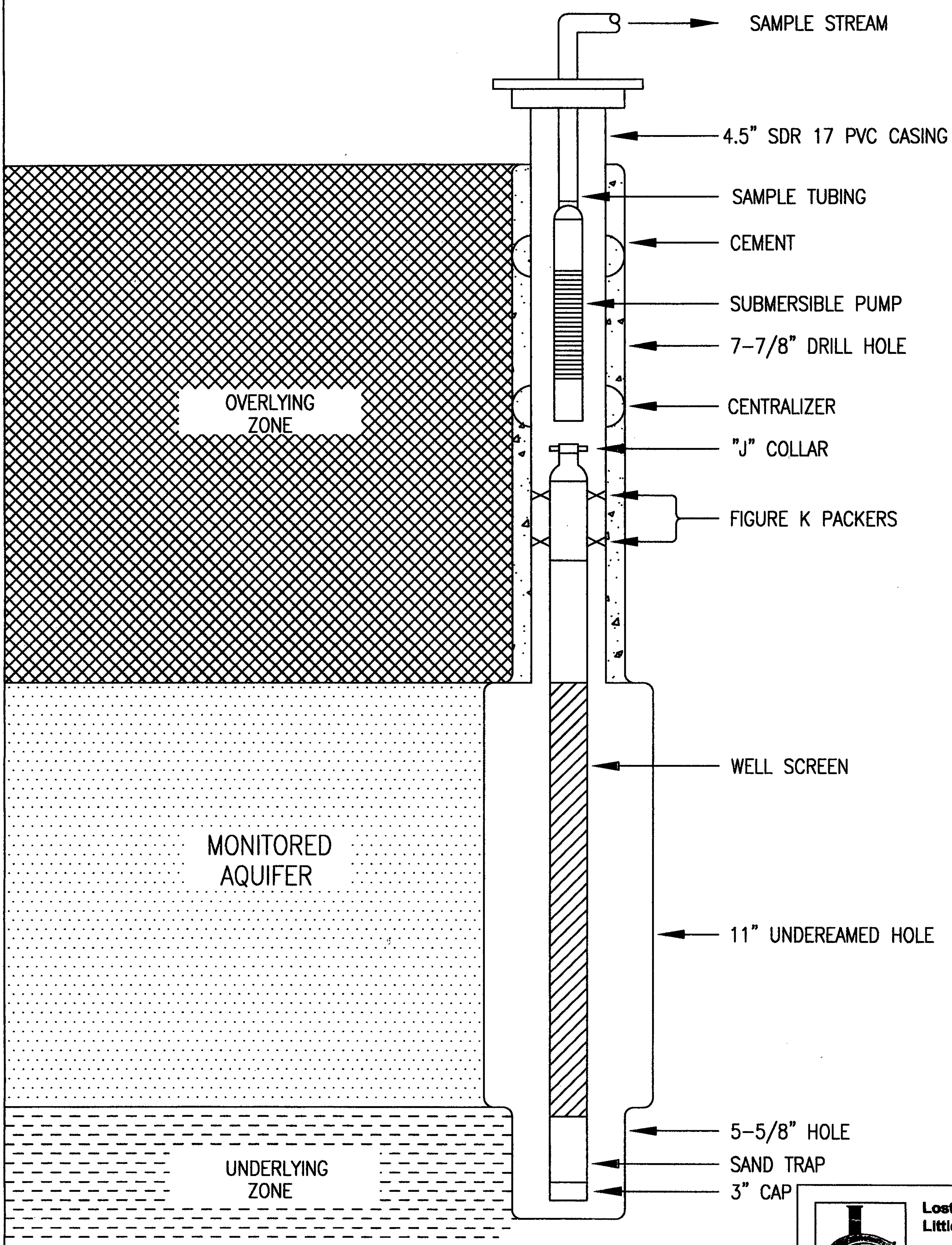

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FIGURE 3.2-4
Monitor Well Construction
Lost Creek Permit Area

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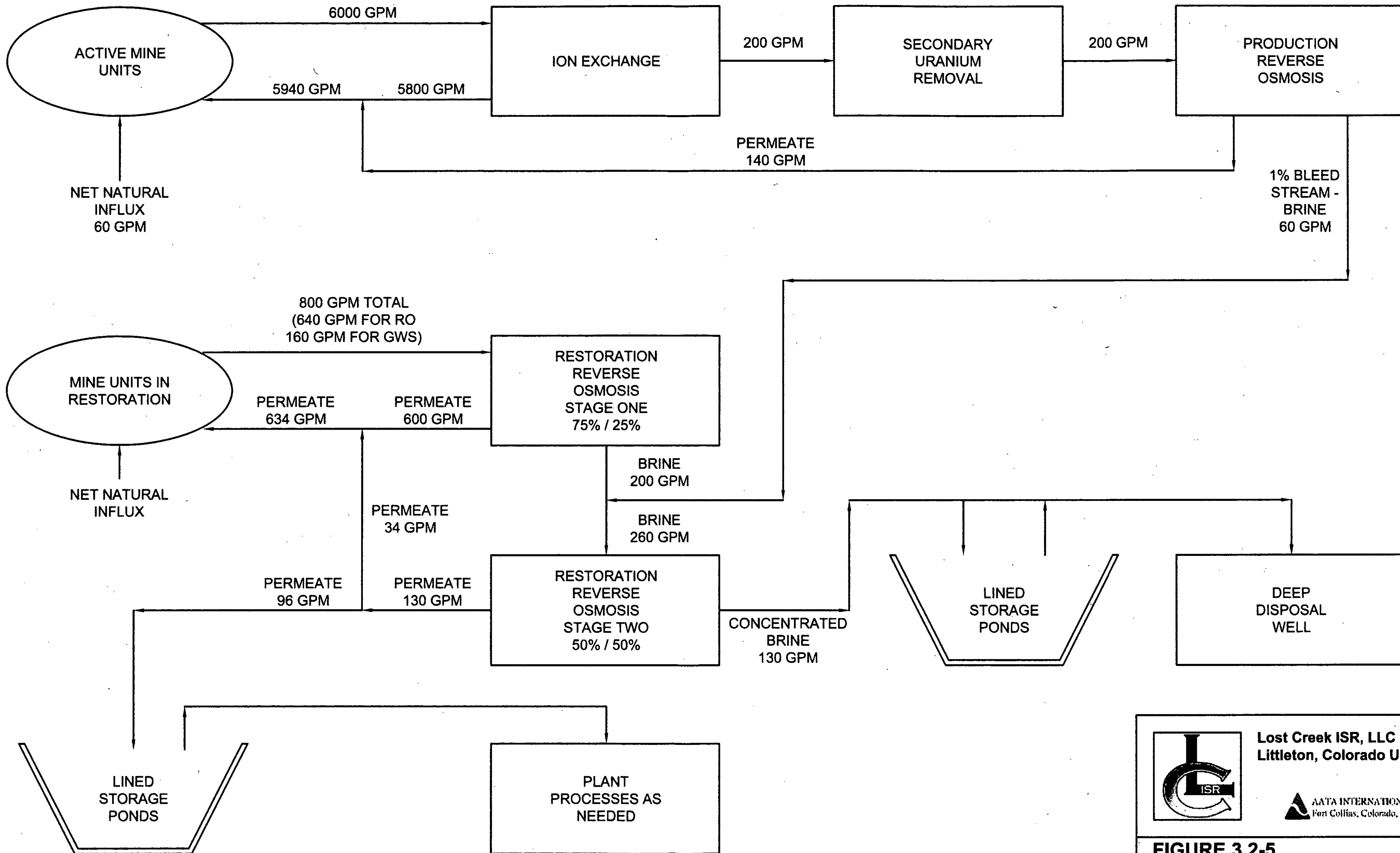
Issued / Revised: 10.2.2007
Drawing No. NRCTR 1.0 FIG 3.2-4 10.2.2007 SMH



MINE UNIT OPERATIONS AT 6,000 GPM
WITH A 1% BLEED (60 GPM)

Lost Creek ISR, LLC
Littleton, Colorado USA

AATA INTERNATIONAL, INC.
Fort Collins, Colorado, USA

FIGURE 3.2-5
Project Water Balance
Lost Creek Permit Area

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Issued / Revised: 10.12.2007
Drawing No. NRCTR 1.0 FIG 3.2-5 10.12.2007 SMH

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED:

"PLATE 3.1-1
PLANT SITE PLAN
Lost Creek Permit Area"
Drawing No. NRCTR 1.0
PLT 3.1-1 10.3.2007 SMH

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D-01

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4.0 EFFLUENT CONTROL SYSTEMS

During the Project, gaseous/airborne, liquid, and solid effluents will be produced from the processes associated with ISR operations. All the effluents are typical for ISR projects currently operating in Wyoming; and existing technologies are amenable to all aspects of effluent control in the Permit Area. Additional details about the types of effluents and storage, treatment, reuse/recycling, and disposal practices and their potential impacts are provided below.

Effluents will be reduced by minimizing disturbance and reusing/recycling materials whenever possible. On-site waste handling facilities will have proper storage to segregate the materials and signage to indicate the types of materials present. These areas will be routinely checked to ensure proper waste segregation and storage. All materials delivered to or transported from the facility, including wastes, will be packaged in accordance with US DOT requirements. Employees will receive training, guidance, and personal protective equipment (PPE) to safely handle, store, decontaminate, and dispose of waste materials. Employees will also be trained to recognize potential hazards and to perform assigned duties in a safe and healthy manner to help reduce the possibility of accidental release. Standard Operating Procedures (SOPs) will be accessible for guidance on routine activities, and for unusual circumstances, an approved work plan and/or approved Radiation Work Permit (RWP) will provide guidance for non-routine work or maintenance activities. Spill Prevention and Response Plans will also be in place to help reduce the possibility of accidental release and provide for appropriate action in the event of a release.

4.1 Gaseous Emissions and Airborne Particulates

Non-radioactive and radioactive airborne effluents are anticipated during the Project. Non-radioactive airborne effluents will be limited to gaseous emissions and fugitive dust. The radioactive airborne effluent will be radon gas. The types of effluents and the control systems that will be in place for them are summarized below.

4.1.1 Non-Radioactive Emissions and Particulates

Gaseous emissions will result from the operation of internal-combustion engines. Exhaust from diesel drilling rigs and other diesel or gasoline-fueled vehicles will produce small amounts of CO, SO_2, and other internal-combustion engine emissions. Regular maintenance, SOPs, and pollution prevention equipment will be used to reduce gaseous emissions. Bussing of employees or credit for employee car-pooling will be considered to help reduce fuel consumption and emissions.

Most of the airborne particulates will be dust from traffic on unpaved roads and wind erosion of disturbed areas, such as during installation of wells at a mine unit. Restricted vehicular access and speed limits will be used to minimize dust from roads; and additional dust control measures may include water spraying, application of gravel, or application of organic/chemical dust suppressants. Disturbance will be minimized to the extent possible; and disturbed areas will be revegetated during the first available seeding window.

Airborne particulates may also include minor amounts of salt and soda ash releases during deliveries to the Plant, and drilling mud or cement dust during the installation of wells at the mine units. Construction activities may also generate airborne particulates. Examples of this might be welding fumes or dust from grinding on steel. Standardized delivery procedures that minimize material loss (and address health and safety concerns) and efficient construction practices will be used to minimize generation of such particulates.

Carbon dioxide and oxygen will be used as part of the extraction and concentration of uranium during mining; and hydrogen sulfide may be used during groundwater restoration after mining. However, use of these gases will be controlled to prevent waste and potential adverse safety conditions. Similarly, any fumes from the limited use of liquid chemicals, such as hydrochloric or sulfuric acid, will be controlled (e.g., laboratory hoods). Pressure venting at the mine units and supporting facilities will produce some non-radioactive gaseous emissions, such as carbon dioxide, oxygen, and water vapor, but the primary effluent of concern from pressure venting is radon gas, as discussed in more detail below.

4.1.2 Radioactive Emissions

Radioactive airborne effluents will be minimal, as compared to other ISR operations in Wyoming, because yellowcake drying and packaging will not occur within the Permit Area and because the Storage Ponds will be kept wet.

Radon will be the radioactive gaseous emission from the mining and ore processing, as it is present in the orebody and concentrated in the lixiviant solution. Radon will be released occasionally from the mine unit wells as gas is vented from the injection wells. Production wells will be continually vented to the surface; however, water levels will typically be low and radon venting will be minimal. All of the well releases will be outside of buildings and are directly vented to the atmosphere. Radon will also be released during ion exchange resin transfers and subsequent ore processing steps, as described in more detail below. Potential radon exposure will be reduced or eliminated with ventilation to the outside of the buildings using high-volume exhaust fans, PPE, and limited exposure durations, in accordance with SOPs, or in the case of an unanticipated release, an RWP.

The radon will be discharged into the atmosphere, where it will disperse rapidly. Occupational and public exposures to radon emitted from the mine units and from the ore processing were analyzed using the MILDOS computer model to ensure the discharged amount will be within regulatory dose limits (see **Section 7.1.13** Public and Occupational Health for results).

The work areas of concern for radon exposure are at the vents from: the bleed storage tanks, the resin transfer points, the fluid collection sump, and the yellowcake slurry loading area, as well as low-lying areas and confined spaces. The bleed storage tanks will be used for temporary storage of the production bleed fluid. Because these tanks will be at atmospheric pressure (unlike other tanks in the ore processing circuits) and not always full, radon (as well as oxygen and carbon dioxide) present in the bleed fluid may be liberated into the headspaces of the tanks. Therefore, these tanks will be vented. Resin transfer will occur when an ion exchange vessel is fully loaded with uranium and is transferred from the Ion Exchange Circuit to the Elution Circuit. Because radon may be liberated during the transfer, ventilation will be provided at the resin transfer points and operated during the transfers. A sump will be used to collect any fluids released from the ion exchange vessels during resin processing, from tanks during maintenance procedures and from routine washdown of the area. To prevent radon accumulation, the sump will be covered and vented. The yellowcake slurry will be transferred from storage tanks into trucks for transport to a drying and packaging facility. During this transfer, radon gas will potentially escape; so ventilation will be provided in the transfer area. The UIC Class I well pumphouses will also be vented.

4.2 Liquid Wastes

The Project will generate several different types of liquid wastes, including three classified as 11(e)(2) byproduct materials by NRC. The different types of liquid wastes the Project will generate are:

- "native" groundwater generated during well development, sample collection, and pump testing;
- storm water runoff;
- waste petroleum products and chemicals;
- domestic sewage; and

- the three 11(e)(2) byproduct materials:
    - liquid process wastes, including laboratory chemicals,
    - "affected" groundwater generated during well development, and
    - groundwater generated during aquifer restoration.

Appropriate storage, treatment, and disposal methods for these wastes differ, as outlined below.

4.2.1 "Native" Groundwater Recovered during Well Development, Sample Collection, and Pump Testing

Groundwater is recovered during well installation, sample collection, and pump testing conducted prior to mining or from portions of the Permit Area not affected by mining. This "native" groundwater has not been exposed to any mining process or chemicals. During well development, sample collection, and pump testing, this water will be discharged to the surface under the provisions of a general Wyoming Pollutant Discharge Elimination System (WYPDES) permit, in a manner that mitigates erosion, or reused in the drilling process.

4.2.2 Storm Water Runoff

Procedural and engineering controls will be implemented such that storm water runoff from the area of the Plant will not pose a potential source of pollution. Per the requirements of the WYPDES, the applicable permits for runoff control during construction and operation of the Plant will be obtained from the Water Quality Division (WQD) of WDEQ.

4.2.3 Waste Petroleum Products and Chemicals

These wastes will be typical for ISR facilities, and will include items such as waste oil and out-of-date reagents, none of which will have been closely associated with the processing of 11(e)(2) byproduct materials. Any of these wastes that are non-hazardous will be stored in appropriate containers, prior to disposal by a contracted waste disposal operator, at an approved off-site waste disposal facility, such as the Carbon County Landfill.

Waste petroleum products will be clearly labeled and stored in sealed containers above ground in accordance with the requirements of the Mine Safety and Health Administration (MSHA) and EPA. These wastes will be periodically collected by a commercial business for recycling or energy recovery purposes. LC ISR, LLC will generate about 40 to 80 gallons of waste petroleum products per year, and will be a Conditionally Exempt Small Quantity Generator of hazardous wastes, per EPA definition.

Waste chemicals not closely associated with the processing of 11(e)(2) byproduct material will be clearly labeled and stored in sealed containers above ground in accordance with the requirements of MSHA and EPA. These wastes will be periodically collected by a commercial business for recycling or disposal in a licensed disposal facility. An estimated five to ten gallons of waste chemicals will be disposed of per year.

4.2.4 Domestic Liquid Waste

Domestic liquid wastes will be disposed of in an approved septic system that meets the requirements of WDEQ-WQD. A permit will be obtained for the septic system prior to construction of the system. The septic system will receive waste from restrooms, shower facilities, and miscellaneous sinks located within the office. In addition, chemical toilets may be temporarily placed in mine units and other drilling areas. An estimated 500 to 700 gallons of domestic liquid waste will be disposed of daily; and the septic system and chemical toilets will be maintained by a licensed contractor.

4.2.5 Liquid 11(e)(2) Byproduct Material

The three 11(e)(2) byproduct materials:

- liquid process wastes, including laboratory chemicals;
- "affected" groundwater generated during well development and sample collection; and
- groundwater generated during aquifer restoration,

will be treated and disposed of on-site through a system of Storage Ponds and UIC Class I wells, as described below. Procedures to prevent and remediate accidental releases will also be in place, as described below.

4.2.5.1 Liquid Process Wastes

The ore processing produces three wastes, a production bleed, and eluant bleed, and yellowcake wash water. In addition, the laboratory analyses for evaluating uranium content of the production fluid and similar operational parameters will generate waste. These wastes will be collected, treated and the waste discharged to the Storage Ponds and UIC Class I wells (**Section 4.2.5.4**).

4.2.5.2 "Affected" Groundwater Generated during Well Development and Sample Collection

It may be necessary to develop (or redevelop) wells and collect samples of groundwater that has been affected by the mining operation to the extent that surface discharge of the water is not appropriate. During well development and sample collection, this water will be collected and treated; and the waste will be discharged to the Storage Ponds and UIC Class I wells.

4.2.5.3 Groundwater Generated during Aquifer Restoration

During the various steps of aquifer restoration (**Section 6.2**), groundwater will be generated; and disposal of some or all of the water will be required. During sweep, groundwater will be pumped from the production zone, creating an area of drawdown. This will create an influx of water from outside the production zone that will "sweep" the affected mining zone. In most cases, the water produced during sweep will be processed for residual uranium content through the ion exchange circuit, and then disposed directly to the UIC Class I wells. In some cases, the groundwater pumped from the production zone may be treated by RO to reduce the waste volume; and the treated water (permeate) may be used in Plant processes or for makeup water in other restoration activities. To maintain the area of drawdown, the permeate will not be reinjected into the production zone, but will be transferred to other mine units for use as makeup water or injected into the UIC Class I wells. The concentrated byproduct material (brine) will also be injected into the UIC Class I wells.

During RO, groundwater will be pumped from the production zone. The pumped water will be treated by RO; and the permeate will be injected back into the production zone. To maintain an area of drawdown, an effective bleed will occur by adding additional permeate from other RO activities or by adding clean water to the permeate at a rate less than the produced rate. The brine from the RO treatment will be injected into the UIC Class I wells. Similarly, during other restoration steps, the amount of groundwater pumped from the aquifer will exceed the amount pumped back to the aquifer; and that excess water will be disposed of in the UIC Class I wells.

4.2.5.4 Disposal of Liquid 11(e)(2) Byproduct Materials

The liquid 11(e)(2) byproduct materials generated during the Project will be managed by deep well injection in conjunction with Storage Ponds.

Storage Ponds

Two Storage Ponds will be constructed at the site in accordance with NRC standards and equipped with leak detection systems. The primary purpose of the ponds is to allow for shut down of the UIC Class I wells for maintenance (such as MITs) or repair while the Plant remains in operation. The total pond capacity will be designed to accommodate two weeks of Plant operation, which would generate 60 gallons of liquid at peak operating capacity.

To help maintain the integrity of the ponds by reducing liner exposure to sun, wind, and freezing temperatures, water will be kept in the ponds at all times by diverting a portion of the water that would normally go to the UIC Class I wells. The exception would be during pond maintenance or repair, at which times the liquid would be piped directly to the UIC Class I wells.

Routine pond inspections and monitoring will be conducted as specified in **Section 5.3.2** of this report. The inspection reports and monitoring results will be maintained on-site and summarized in the Annual Report submitted to NRC and WDEQ-LQD. Any maintenance issues identified during an inspection will be addressed in a timely manner to reduce the chance for damage to the pond integrity or liquid release to the environment.

UIC Class I Wells

Two to four UIC Class I wells are planned in the southern portion of the Permit Area as the primary disposal method for the liquid 11(e)(2) byproduct materials. LC ISR, LLC is preparing the UIC Class I permit application for submittal to WDEQ-WQD, which has primacy in Wyoming for the UIC program. In addition to the liquid 11(e)(2) byproduct materials, other compatible liquid wastes will be disposed of in the wells (**Section 4.2.3**). The wells will be monitored in accordance with the requirements of the UIC permit; and an evaluation of the well performance will be included in the Annual Report submitted to NRC and WDEQ.

4.2.5.5 Prevention and Remediation of Accidental Releases

The significant criteria to reduce the potential for accidental releases are: appropriate engineering design, construction, and maintenance; development and implementation of SOPs, covering topics such as inspections, notification procedures, and response actions; and on-going employee training in those SOPs and general health and safety procedures. The facilities which will require specific attention are outlined below.

Storage Ponds

It is possible that a storage pond could fail, either in a catastrophic fashion or as a result of a slow leak. In addition, a pond could overflow due to excess inflow from the Plant or excessive precipitation.

The criteria for determining if a leak has been detected include both water level and water quality criteria. If there is an abrupt increase in the water level in one of the leak detection standpipes or if six or more inches of water are present in one of the standpipes, the water in that standpipe will be analyzed for specific conductance. If the specific conductance is more than half the specific conductance of the water in the pond, the water will be further sampled for chloride, alkalinity, sodium, and sulfate. In addition, the liner will be immediately inspected for damage and the appropriate agencies will be notified. Upon verification of a liner leak in one of the ponds, the water level in that pond will be lowered by transferring the contents to the other pond and/or to the UIC Class I wells.

With respect to pond overflow, SOPs will be such that neither pond is allowed to fill to a point where overflow is considered a realistic possibility. Since the primary disposal method will be the UIC Class I wells, the flow rates to the pond are expected to be minimal; and there will be sufficient time to reroute the flow to another pond, or to modify Plant operations to reduce flow for the critical period. If precipitation is excessive, the freeboard allowance of the ponds will be designed to contain significant quantities of precipitation before an overflow occurs. The freeboard allowance will also reduce the possibility of water blowing over the pond walls during high winds.

Pipelines, Fittings, Valves, and Tanks

The most common accidental release from ISR operations is from breaks, leaks, or separations in the piping that transfers mining fluids to and from the Plant and the mine units. Failures of fittings and valves at the wellheads, in the header houses, at tanks, and other junctions are also a common cause of accidental releases at ISR operations.

Pipelines will generally be buried, minimizing the possibility of freezing in adverse weather and of being damaged by surface traffic. In general, piping to and from the Plant and the mine units and within the mine units will be constructed of HDPE with butt-welded joints or the equivalent.

All pipelines, associated fittings and valves, and any tanks that will be under pressure during operations will be pressure tested before use. Flow through the pipelines will be monitored and will be at a relatively low pressure. Pressurized tanks will also be monitored for performance within specified limits. Sensors wired to automatic alarms and pipeline shutoffs will be installed to detect significant changes in flow rates or pressures in the pipelines and tanks to help prevent significant releases.

Wells

Casing and coupling failures in wells, either at the surface or in the subsurface, may release production or injection fluid. Monitoring of well construction, pressures in the ISR system, and appropriate mine unit balancing, as well as routine MIT of injection wells, will help prevent casing and coupling failures. Down-hole casing repair (with follow-up MIT) is generally sufficient to correct the problem; but well abandonment and replacement and delineation drilling may be necessary to address more serious situations.

Buildings

The buildings of most concern with respect to accidental releases include the header houses, the Plant, and the pumphouse(s) for the UIC Class I wells. Header houses and the pumphouse(s) are not considered as potential sources of pollutants during normal operations, as there will be no liquids stored within them. However, in the event of a pipeline or pump failure in a header house or pumphouse, the impact of that failure will be reduced by sumps equipped with fluid detection sensors wired to automatic alarms and shutoffs. Similarly, the Plant will be constructed with concrete containment curbing and sumps to allow for containment and recovery of any releases within the Plant.

4.3 Solid Wastes

Solid wastes, some of which will be classified as NRC 11(e)(2) byproduct materials, will be produced during construction, operation, and reclamation activities of the Project. Appropriate storage, treatment, and disposal methods for these wastes differ, as outlined below.

4.3.1 Solid Non-11(e)(2) Byproduct Materials

The solid non-11(e)(2) byproduct materials will include: non-hazardous materials typical of office facilities, such as paper, wood products, plastic, steel, biodegradable items, and sewage sludge; and hazardous materials also typical of office and ISR facilities, such as waste petroleum products and used batteries. None of these materials are closely associated with ISR and ore processing.

The non-hazardous materials, with the exception of sewage sludge, will be recycled when possible or temporarily stored in commercial bins prior to disposal by a contracted waste disposal operator at an approved off-site solid waste disposal facility, such as the Carbon County Landfill. An estimated 500 to 700 cubic yards of non-11(e)(2) byproduct materials will be generated annually. An estimated three to five cubic yards of sewage sludge will be disposed of annually off-site at an approved facility by a licensed contractor.

Hazardous wastes will be clearly labeled and stored in sealed containers above ground in accordance with the requirements of MSHA and EPA. These wastes will be periodically collected by a commercial business for recycling or energy recovery purposes. LC ISR, LLC will be a Conditionally Exempt Small Quantity Generator of hazardous wastes, per EPA definition, generating about ten to 20 pounds of batteries and similar items per year.

4.3.2 Solid 11(e)(2) Byproduct Materials

The solid 11(e)(2) byproduct materials will include process wastes, such as spent ion exchange resin, filter media, and tank sludge, generated during ISR and ore processing, and will include equipment that becomes contaminated during ISR and ore processing. These items include tanks, vessels, PPE, and process pipe and equipment. Such wastes could also include soils contaminated from spills.

Where possible, equipment will be decontaminated for disposal as non-11(e)(2) material or for re-use. Equipment that cannot be decontaminated and process wastes will be placed in clearly labeled, covered containers and temporarily stored in restricted areas with clearly visible radioactive warning signs. The solid 11(e)(2) byproduct materials will then be disposed of at an NRC-licensed facility, typically a uranium mill tailings impoundment, by personnel qualified to dispose of radioactive wastes. An estimated 80 to 100 cubic yards of solid 11(e)(2) byproduct material will be generated annually exclusive of final reclamation material. LC ISR, LLC is in the process of negotiating a written contract with an NRC-licensed facility for disposal of this material.

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5.0 OPERATIONAL ORGANIZATION, MANAGEMENT, PROGRAMS, & TRAINING

5.1 Corporate Organization and Administration

Management and operation of monitoring programs at the Project are the responsibility of the following positions within LC ISR, LLC. Those positions are:

1) President;
2) General Manager;
3) Mine Manager;
4) Manager Environment, Health, Safety (EHS) and Regulatory Affairs;
5) Site Supervisor EHS/Radiation Safety Officer (RSO); and
6) Department Heads: Site Chief Geologist, Project Engineer, and Operations Manager.

The organization of these positions is depicted in **Figure 5.1-1**. In addition, per the requirements of the US NRC, a Safety and Environmental Review Panel (SERP) will be established to integrate the various roles that support the operation and maintenance of the mine.

5.1.1 President

The President maintains the ultimate responsibility for all operations of LC ISR, LLC, including the Project and its activities. This individual is responsible for interpreting and acting upon the Managers' policy and procedural decisions. The President has the responsibility and authority to immediately suspend, postpone, or modify an action deemed threatening to human health or the environment or deemed in violation of state and federal regulations.

To provide direction to Project management and employees, the President shall develop and publish a policy which defines the organizations commitment to protection of the environment, and health and safety of employees and the public. The President shall periodically review the policy to ensure continued relevance.

5.1.2 General Manager

The General Manager is responsible for the safe operations of LC ISR, LLC including the Project. The General Manager reports directly to the President. The General Manager, with the assistance of the Manager EHS and Regulatory Affairs, shall perform and document an annual review of the Environment, Health, and Safety Management System (EHSMS). The purpose of the annual review shall be: to ensure appropriate organization of the management system; to ensure adequate resources are available to protect the health and safety of employees, the public, and the environment; and to ensure trends in regulatory and/or policy noncompliance are recognized and root causes are mitigated.

5.1.3 Mine Manager

The Mine Manager for the Project reports to the General Manager, and is responsible for implementing managerial and financial actions that affect mining operations, and the EHSMS of LC ISR, LLC. This includes implementation of the company health and safety, radiation safety, environmental compliance, and licensing programs; and ensures that they are conducted in a safe and financially responsible manner, while maintaining compliance with applicable regulations, license conditions, and corporate policy. The Mine Manager will assist in the development, administration, and enforcement of the mining safety, radiation protection, environmental, and operational monitoring programs. These programs involve the development, review, approval, and implementation of mining process and safety protocols, as well as technical review, evaluation, and participation in routine audits of QA/QC programs. The Mine Manager also provides technical guidance and assistance concerning mining operations and activities to site personnel; including development and administration of corporate radiation protection programs and applicable mine safety programs. The Mine Manager has the responsibility and authority to immediately suspend, postpone, or modify an action deemed threatening to human health or the environment or deemed in violation of state and federal permitted and licensed regulations.

5.1.4 Manager EHS and Regulatory Affairs

The Manager EHS and Regulatory Affairs will have the responsibility and authority for LC ISR, LLC's radiation safety, environmental compliance, and quality assurance programs at the Project and LC ISR, LLC's other development activities. This person will provide input to the Site Supervisor EHS/RSO to ensure that all radiation safety, environmental compliance. and permitting/licensing programs are conducted in a responsible manner, and in compliance with all applicable regulations and permit/license conditions. The Manager EHS and Regulatory Affairs reports directly to the General

Manager. The Manager EHS and Regulatory Affairs shall assist the General Manager in the annual review and resulting documentation of the EHSMS as defined above.

5.1.5 Site Supervisor EHS/RSO

The Site Supervisor EHS/RSO reports to the Manager EHS and Regulatory Affairs and is responsible for the daily supervision of the EHS Management System at the Project. This individual's responsibilities will include developing and implementing safety and environmental programs, properly maintaining and retaining records, and assisting the mine staff to comply with regulations and license conditions applicable to employee health protection.

The Site Supervisor EHS/RSO also is/will:

- the designated Site QA/QC Coordinator;
- a member of the As Low As Reasonably Achievable (ALARA) Committee and required to assist management with the annual ALARA Audit;
- required to report to the Manager EHS and Regulatory Affairs and the Mine Manager on all matters regarding environmental protection and radiation and worker safety;
- conduct routine training programs for the supervisors and employees with regard to the proper application of radiation protection, emergency response, and environmental control programs;
- inspect the facilities to verify compliance with all applicable radiological health and safety requirements and the QA/QC program;
- annually review all operating procedures to ensure that radiation exposures will be maintained ALARA;
- authorized to terminate immediately any activity that may be a threat to the employees, public health, or the environment;
- coordinate implementation of the health physics programs with other departments within the facility to ensure compliance with regulations;
- responsible for ensuring that all health physics samples and records are complete, accurate, and properly filed and stored;
- responsible for routinely auditing all operational and monitoring procedures and the QA/QC programs;
- responsible for administering the Radiation Safety Program;
- monitor relative attainment of radiation exposure ALARA;
- receive 40 hours of applicable refresher radiation safety training from qualified instructors on a biennial basis;
- ensure that any non-routine work not covered by a SOP will be conducted in accordance with a RWP as reviewed;

- ensure that the use, handling and transport of radioactive materials is restricted to qualified individuals that have received all proper training and approval from the RSO to perform these functions;
- make certain that transport of any radioactive materials generated at the site complies with all state and federal regulatory requirements for transport of applicable radioactive materials;
- ensure that all employees wear approved personal dosimetry radiation monitoring badges in areas as required;
- provide an annual dose report to all monitored individuals;
- coordinate and implement the calibration and maintenance of site radiation detection and survey instruments with the manufacturer at intervals recommended by the manufacturer, and ensure that all radiation survey instruments are in current calibration and proper working condition;
- ensure that all site personnel have read, understand and comply with all radiation safety program requirements;
- assist Department Heads with the development and revision of SOPs; and
- maintain the EHS Management System, including SOPs, in such a manner that all employees have access to the most recent information regarding all relevant facets of environmental, health, and safety issues.

5.1.5.1 Health Physics Technician

The Health Physics Technician (HPT) shall assist the RSO with the implementation of the radiological safety program by collecting, documenting, and interpreting data. The HPT shall also help maintain radiation safety equipment such as survey meters. The HPT reports directly to the RSO.

5.1.6 Department Heads

The Department Heads include the Site Chief Geologist, the Project Engineer, and the Operations Manager. They are responsible for the site's operational and maintenance activities and procedures. Department Heads shall review the tasks that their respective employees will be performing and develop, with input from the Site Supervisor EHS/RSO, SOPs (for any task which may present a hazard to the employee), public, environment, or operation. Department Heads will subsequently use the SOPs as training documents to ensure employees receives consistent and thorough training. Department Heads shall enforce compliance with all facets of the EHS Management System, including SOPs, in order to minimize risks. Department Heads or their designee shall perform and document an annual review of each SOP within their area to ensure continued accuracy and relevance. These individuals report to the Mine Manager.

Development and review of procedures involving radiological safety concerns will be coordinated with the Site Supervisor EHS/RSO.

5.1.7 Uranium Recovery Workers

Because a radiation protection and ALARA program is only as effective as the workers' adherence to the program, all workers at the facility, especially those involved in daily uranium processing activities such as Plant and Mine Unit Operators and maintenance crews, will be responsible for the following:

- adhering to all rules, notices, and operating procedures for radiation safety established by management and the RSO;
- reporting promptly to the RSO and license management equipment malfunctions or violations of standard practices or procedures that could result in increased radiological hazard to any individual; and
- suggesting improvements for the radiation protection and ALARA program.

5.2 Management Control Program

In order to provide the highest level of protection to employees, public, environment, and operation, site management including the Manager EHS and Regulatory Affairs, Mine Manager, Site Supervisor EHS/RSO, and Department Heads shall develop and implement an EHSMS.

An important aspect of the EHSMS is the development of SOPs. SOPs will be developed for all routine tasks which may present a hazard to employees, the public, environment, or the operation. Department Heads shall be responsible for initiating the development of SOPs for all routine tasks within their area which may generate a hazard. The Site Supervisor EHS/RSO shall assist with the development of SOPs and may also initiate SOPs when the need arises. SOPs may be considered final when they have been approved by the respective Department Head and the Site Supervisor EHS/RSO. SOPs developed in response to SERP findings must be approved by the SERP before implementation. SOPs related to handling, processing, storing, or transporting radioactive materials will be annually reviewed by the RSO. The RSO and the management team will be responsible for seeing that employees are trained and provided guidance to ensure adherence to SOPs. Hard copies of SOPs will be readily accessible to personnel at work areas and will be part of the radiation safety training (**Section 5.5**) and on-the-job training.

Non-routine procedures or maintenance activities that may result in significant occupational exposure to radioactive materials and for which no SOP exists will be performed in accordance with a RWP. An RWP will be issued by the RSO or the HPT. Each RWP will, at a minimum, describe the:

- scope of work to be performed;
- precautions necessary to reduce radiation exposure; and
- necessary supplemental radiological monitoring and sampling prior to, during, and following completion of the work.

All RWPs will be reviewed and approved prior to performing the non-routine activities, and will be documented and filed. Throughout the duration of the license, records will be kept and retained concerning:

- materials control and tracking,
- the Radiation Safety Program,
- sampling,
- the survey and calibration programs,
- planned special exposures,
- occupational and public dosage tracking,
- disposal source, and
- decommissioning.

Records will be maintained as original hard copies, as copies on microfiche, or will be electronically protected, and will be readily retrievable for regulatory inspection. Records may be transferred to a new owner or licensee in the event that the property or license is transferred. Records may also be transferred to NRC after license termination.

LC ISR, LLC will track, control, and demonstrate control of the source and byproduct material at the site, such that on-site and off-site dose limits will not be exceeded. For the period identified in the license conditions or until license termination, records will be maintained and retained relating to the receipt, transfer, and disposal of any source or byproduct material processed or produced. In an identifiable, separate file, decommissioning records will include documentation of spills and unusual occurrences involving the spread of contaminants, the cleanup actions taken and the location of remaining contaminants.

With adequate safeguards against tampering and loss, the following records will be permanently maintained and retained until license termination.

- Records of waste management for any "Naturally Occurring and/or Accelerator-produced Radioactive Material" (NARM), specifically, radioactive materials that are naturally occurring and are not source, special nuclear, or byproduct materials. These records will include:

- o descriptions of any radiological spills, excursions, contamination events or unusual occurrences that have the potential to exceed site cleanup standards or that leave the site (These descriptions will address: the dates, locations, areas, or facilities affected; assessments of hazards; corrective and cleanup actions taken; assessment of cleanup effectiveness; the location of any remaining contamination; nuclides involved; quantities, forms, concentrations, and descriptions of hazardous constituents; descriptions of inaccessible areas that cannot be cleaned up; and sketches, diagrams, or drawings marked to show areas of contamination and places where measurements were made); and
- o information related to site characterization; residual soil contamination levels; on-site locations used for burial of radioactive materials; hydrology and geology, with an emphasis on conditions that could contribute to groundwater or surface-water contamination; and locations of surface impoundments, Storage Ponds, lagoons, and mine unit aquifer anomalies;

- Records of the results of measurements and calculations used to evaluate the release of radioactive effluents to the environment, including those used to evaluate the release of radioactive effluents to the environment required under the standards for protection against radiation in effect prior to January 1, 1994.
- Records containing information important to decommissioning and reclamation, including:
  - o as-built drawings or photographs of structures, equipment, restricted areas, mine units, areas where radioactive materials are stored, and any modifications showing the locations of these structures and systems through time;
  - o drawings of areas of possible inaccessible contamination, including features such as buried pipes or pipelines; and
  - o pre-operational background radiation levels at and near the site.
- Records of disposal of NARM low-level radioactive waste at a licensed low-level radioactive waste disposal facility (LLRWDF) disposal facility, in accordance with Title 10 of the CFR, Part 61 or NRC Agreement State equivalent regulations; and
- Records of management and disposal actions for the UIC Class I wells, based on WDEQ requirements.

5.2.1 Safety and Environmental Review Panel (SERP)

Based on NUREG/CR-6733, "A Baseline Risk-Informed Performance-Based Approach for In-Situ Uranium Extraction Licenses," LC ISR, LLC will develop a SERP to review proposed changes, tests, or experiments to determine whether they require a license amendment. Changes, tests, or experiments may be conducted without prior NRC approval if:

- they do not conflict with any requirements specifically stated in the license or impair the licensee's ability to meet all applicable NRC regulations;
- there is no degradation in the essential safety or environmental commitments in the license application or those provided in an approved reclamation plan; and
- they are consistent with NRC conclusions regarding actions analyzed and selected in the facility environmental assessment.

A license amendment and/or NRC approval must be sought and received before implementation if the proposed change, test, or experiment would:

- result in any appreciable increase in the frequency of occurrence of an accident previously evaluated in the license application (as updated);
- result in any appreciable increase in the likelihood of occurrence of a malfunction of a structure, system, or component (SSC) important to safety previously evaluated in the license application (as updated);
- result in any appreciable increase in the consequences of an accident previously evaluated in the license application (as updated);
- result in any appreciable increase in the consequences of a malfunction of an SSC previously evaluated in the license application (as updated);
- create a possibility for an accident of a different type than any previously evaluated in the license application (as updated);
- create a possibility for a malfunction of an SSC with a different result than previously evaluated in the license application (as updated); or
- result in a departure from the method of evaluation described in the license application (as updated) used in establishing the final safety evaluation report (FSER), or the environmental assessment (EA). or TERs or other analysis and evaluations for license amendments."

5.2.1.1 Organization of the SERP

The SERP will consist of at least three individuals. One member will have expertise in management and will be responsible 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 equivalent, with the 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 technical issues such as health physics, groundwater hydrology, surface-water hydrology, or other technical disciplines. Temporary members may include consultants. Additional members may be included in the SERP when the magnitude of the project or technical complexity merit.

5.2.1.2 SERP Responsibilities

This procedure will be used for the evaluation of all major changes to the Project's operations. The changes may be derived from operational, economic, or regulatory requirements. The following reviews shall be carried out by the SERP:

Operations/Technical Review

- Review operating criteria and critical equipment and determine the following.
  - Does the proposed change impact the operations as described in the license application?
  - Does the proposed change significantly change the processes used at the facility as described in the license application?
- Review the SOP for the proposed change and determine the impact on existing SOP's. Make the necessary changes to the existing SOP's.
- If applicable, review the emergency response plan and determine compatibility with the proposed change.

Environmental / Health Physics / Safety Review

- Review the proposed change to determine if any changes in monitoring and record keeping are required to ensure compliance with existing programs.
- Review the proposed changes and determine the need for additional training.
- Review key personnel training records and determine training needs as required by the proposed change.

Compliance Review

- Review the proposed change and determine whether it will conflict with Project policies regarding training and safety.
- Review the proposed change and determine compliance with Project license.

- Review the proposed change and determine compliance with US NRC regulations and other Federal and State regulations.
- Review the proposed change to determine if any adjustment to the financial surety would be necessary. If the surety will increase as a result of implementing the proposed action, the surety must be updated through a license amendment or the annual surety update before the proposed change takes place.

Based upon the criteria listed in **Section 5.2.1**, the SERP will determine whether to seek a license amendment for the proposed change, test or experiment or proceed with implementation.

5.2.1.3 Record Keeping and Reporting

Detailed records of all SERP proceedings and findings will be maintained until license termination. The records will include:

- a description of the proposed change, test or experiment;
- the names and titles of each SERP member;
- the findings of each point outlined in **Section 5.2.1.2**; and
- conclusions and recommendations of the SERP including required actions, deadlines, and assignment of responsibility.

These records shall be maintained by the RSO with copies distributed to the Mine Manager and the Manager of EHS and Regulatory Affairs.

5.3 Management Audit and Inspection Program

A variety of inspections and audits will be performed at defined intervals in order to ensure continual protection of employees, the public, environment, and operation. The inspections and audits are to be as follows.

5.3.1 Radiation Safety Inspections

5.3.1.1 Daily Inspections

The RSO, HPT, or a qualified operator designated by the RSO will conduct a daily inspection of all plant areas that may be potentially contaminated. A qualified operator shall have a working knowledge of relevant radiation safety regulations, SOPs, and the ALARA principle. The areas inspected will include but shall not be limited to the Plant, header houses, byproduct storage area, UIC Class I wells, and Storage Ponds. The inspector will look for and report to the Operations Manager, Site Supervisor EHS/RSO and Mine Manager all non-conformances with regulations, SOP's, and ALARA principles. The inspector shall record the date, his name, areas inspected, and findings for each inspection. Documentation shall be maintained until license termination.

5.3.1.2 Weekly Operations Inspections

The RSO and Operations Manager, or their designees in their absence, shall perform a weekly inspection of all areas of the mine potentially exposed to contamination from radionuclides. The inspectors shall ensure that all regulations, SOPs and ALARA principles are being followed. The inspectors shall also look for ways to improve the operation in order to minimize exposure to radionuclides. The RSO or their designee shall document the weekly inspection by listing the date, areas visited, names of inspectors, and inspection findings. Inspection findings shall be reported to the Mine Manager, RSO, and Manager EHS and Regulatory Affairs. Documentation shall be maintained until license termination.

5.3.2 Storage Pond Inspections

Storage Ponds will be installed at the facility to act as surge capacity. The Storage Ponds will be constructed and inspected in accordance to applicable guidance found in NRC Regulatory Guide 3.11.1. In the event of a significant occurrence such as a flood, tornado, earthquake, or intense rain, the Manager EHS and Regulatory Affairs may have additional Special Inspections performed to ensure the continued stability of the Storage Ponds.

5.3.2.1 Daily Storage Pond Inspections

The following inspection will be performed by a trained employee with the results documented on an official form. Documentation will be maintained by the Site Supervisor EHS/RSO until license termination. The Operations Manager and Manager EHS and Regulatory Affairs shall review the results of the daily inspection.

- Visually inspect condition of inlet and outlet piping and associated valving to ensure it is correctly positioned and in good operating condition with no obvious damage.
- Water levels will be recorded and referenced against allowable freeboard to ensure safe levels are maintained.
- The retention dam and diversion ditches shall be visually inspected for signs of cracking, movement, erosion and seepage.

- When in use, enhanced evaporation system shall be inspected for proper operation daily.

5.3.2.2 Weekly Storage Pond Inspections

The following inspection will be performed by a trained employee with the results documented on an official form. Documentation will be maintained by the Site Supervisor EHS/RSO until license termination. The Operations Manager and Manager EHS and Regulatory Affairs shall review the results of the weekly inspection.

- The perimeter fence and associated signage shall be inspected to ensure adequate protection from wildlife intrusion and warning of potential hazards respectively.
- The leak detection system shall be checked for potential signs of leakage.
- Diversion channels shall be inspected for erosion.
- Ensure emergency ropes are in place and in good working condition.
- The pond liner shall be inspected for holes and signs of stress.

5.3.2.3 Quarterly Storage Pond Inspections

The following inspection will be performed by the Site Supervisor EHS/RSO with the results documented on an official form. Documentation will be maintained by the Site Supervisor EHS/RSO until license termination. The Operations Manager and Manager EHS and Regulatory Affairs shall review the results of the weekly inspection.

- Examine the top of the embankment and toe areas to look for evidence of settlement, seepage, erosion, or depression.
- Water quality results from the leak detection standpipes and surface water will be reviewed to look for evidence of leakage.
- Embankments will be inspected for cracks, movement, irregularities in alignment, and erosion.

5.3.2.4 Annual Technical Evaluation of Storage Ponds

The following inspection will be performed by the Manager EHS and Regulatory Affairs who may elect to receive assistance from outside technical experts. Documentation of the inspection findings and potential corrective actions will be maintained by the Site Supervisor EHS/RSO until license termination. The Operations Manager and Manager EHS and Regulatory Affairs shall review the results of the Annual Technical Evaluation and ensure all necessary corrective actions are completed.

- The findings from the previous year's daily, weekly, and quarterly inspections will be reviewed to ensure they are thorough, properly documented, and that findings have been appropriately corrected.
- An assessment of the hydraulic and hydrologic capacities will be made to ensure the proper infrastructure is in place.
- The embankment will be surveyed to ensure movement is within acceptable ranges.
- The inspector shall visually inspect the embankments, embankment toes, and diversion ditched to ensure there is no seepage, undesirable movement, or erosion.
- The water quality of the Storage Ponds shall be determined and compared against any trends in ground and surface water quality.

5.3.3 Annual ALARA Audit

An annual audit of the radiation safety and ALARA programs will be performed by the Manager EHS and Regulatory Affairs, General Manager, and the Operations Manager. The Manager EHS and Regulatory Affairs may also call on outside technical expertise to complete the audit. A technical expert for the purposes of this section shall be an individual who meets the qualifications of an RSO and who has at least five years of experience in applied radiation safety. The Site Supervisor EHS/RSO may be called upon to provide data but shall not be involved in audit findings or the writing of the Annual ALARA Audit Report.

The purpose of the audit shall be to: 1) determine the effectiveness of the radiation safety and ALARA programs and ensure the veracity of radiation measurements and calculations; 2) ensure compliance with applicable regulations, procedures, and policies; 3) ascertain trends in employee and public exposure and potential reasons for trends; and 4) look for methods to further mitigate employee and public exposure to radionuclides. The Annual ALARA Audit shall be conducted in accordance with US NRC Regulatory Guide 8.31. A written report of the audit findings will be submitted to the President, General Manager, Mine Manager, and all Department Heads. Additionally, the report findings and their implications shall be discussed with all employees during annual radiation safety training.

The Annual ALARA Audit Report shall contain:

- employee exposure records (external and time-weighted calculations);
- bioassay results;
- inspection log entries and summary reports of daily, weekly, and monthly inspections;
- documented training program activities;

- radiation safety meeting reports;
- radiological survey and sampling data;
- reports on overexposure of workers submitted to the NRC and other applicable regulatory agencies; and
- operating procedures that were reviewed during this time period.

The report shall specifically address the following:

- trends in personnel exposures for identifiable categories of workers and types of operational activities;
- whether equipment for exposure control is being properly used, maintained, and inspected; and
- recommendations on ways to further reduce personnel exposures from uranium and its daughters.

5.4 Qualifications for Personnel Conducting Radiation Safety Program

The minimum qualifications and experience levels required of personnel assigned the responsibility of developing, conducting, and administering the Radiation Safety Program are described below.

5.4.1 Mine Manager

The position of Mine Manager requires a bachelor's degree in engineering or associated science from an accredited college or university, plus a minimum of five years of managerial experience and directing operational functions.

5.4.2 Manager EHS and Regulatory Affairs

This position requires a bachelor's degree in an engineering or science field degree from an accredited college or university, or an equivalent level of work experience. Additionally, a minimum of five years in senior management and operations functions will be required as well as the ability to meet the requirements of the position of RSO.

5.4.3 Site Supervisor EHS / RSO

The Site Supervisor EHS/RSO must demonstrate a working knowledge and proper understanding of the operation of radiation health physics instruments and equipment used during uranium recovery, surveying and sampling techniques, and personnel dosimetry requirements. In accordance with US NRC Regulatory Guide 8.31, the position of RSO requires:

- a bachelor's degree in physical science, industrial hygiene, or engineering from an accredited college or university or an equivalent combination of training and relevant experience in radiation protection related to uranium recovery (Two years of relevant experience are generally considered equivalent to one year of academic study.);
- at least one year of work experience relevant to uranium recovery operations in applied health physics, radiation protection, industrial hygiene, or similar work (This experience should involve actually working with radiation detection and measurement equipment, not strictly administrative or "desk" work.);
- at least four weeks of specialized classroom training in health physics specifically applicable to uranium recovery (In addition, the RSO should attend refresher training on uranium recovery health physics every two years.); and
- a thorough knowledge of the proper application and use of all health physics equipment used during uranium recovery activities, the chemical and analytical procedures used for radiological sampling and monitoring, methodologies used to calculate exposure to uranium and its daughters, and a thorough understanding of the uranium recovery process and equipment used and how the hazards are generated and controlled during the uranium recovery process.

5.4.3.1 Health Physics Technician

The HPT will have one of the following combinations of education, training, and experience.

Option I:

- an associate degree or two or more years of study in the physical sciences, engineering, or health related field;
- at least a total of four weeks of generalized training (up to two weeks may be on-the-job training) in radiation health protection applicable to uranium recovery facilities; and

- one year of work experience using sampling and analytical laboratory procedures that involve health physics, industrial hygiene, or industrial safety measures to be applied in a uranium recovery facility; or

Option II:

- a high school diploma;
- a total of at least three months of specialized training (up to one month may be on-the-job training) in radiation health protection relevant to uranium recovery facilities; and
- two years of relevant work experience in applied radiation protection.

5.4.4 Department Heads

These positions requires a bachelor's degree in engineering or associated science degree from an accredited college or university or an equivalent level of work experience, plus a minimum of two years of managerial experience in engineering, geology, or operational functions.

5.5 Radiation Safety Training

Employee training will be designed to familiarize employees with all of the necessary precautions to be taken when performing their assigned duties, and radiation safety constitutes a significant portion of this training. New and experienced employees alike will be provided written copies of radiological safety instructions, and will take training courses that address the fundamentals of radiation exposure protection and inherent risks of radiation exposure.

The radiological protection program for LC ISR, LLC uranium recovery operations will, in general, include annual worker training to insure that site personnel will, at all times, have sufficient awareness and continuity of knowledge regarding:

- general safety regulations, principals, and procedures;
- the fundamentals of health protection, personal hygiene, and housekeeping requirements;
- basic radiation science and radiation safety principals;
- the Radiation Safety Program for ISR operations at the Permit Area, including all site-specific and operation-specific radiation safety procedures, and radiation protection regulations;

- dose monitoring requirements and procedures and health protection measurements;
- worker rights, responsibilities and notifications, and facility-provided protection;
- contamination and spill control; and
- security and emergency procedures.

Additionally, radiation safety training for female employees will address:

- risks associated with prenatal radiation exposure, and
- the LC ISR, LLC policy for declared pregnant women, including dose limits and rates.

Managers will also receive additional specialized occupational radiation protection training on their supervisory responsibilities. Each permanent employee that has completed the new employee radiation safety training will annually attend an abbreviated retraining course.

The refresher course will discuss:

- relevant information that has become available during the past year;
- a review of safety problems that have arisen during the past year including results from the ALARA report;
- changes in regulations and license conditions;
- exposure trends; and
- other current topics.

A written or oral test will be conducted following radiation safety training for new employees and annual refreshers. Incorrect answers to test questions will be discussed to ensure a correct understanding of the material. If an employee fails to pass the test (less than 70 percent of the answers being correct), additional training will be provided prior to re-testing. Tests and results will be maintained on file until license termination.

Continual training will be conducted to ensure that personnel maintain awareness of events and issues that could affect the quality of program performance. At least quarterly, employees will be updated on radiation safety issues that arise during the Project.

Specific, detailed worker radiation training materials will be presented in the Radiation Safety Manual which will include materials for initial employee training (eight hours) as well as for ongoing refresher training (four hours), which will occur on an annual basis for each employee. The RSO and HPT will complete 40 hours of appropriate radiation safety refresher training by qualified instructors on a biennial basis. Training of all personnel will be documented with records maintained by the RSO until the license is terminated.

Visitors and contractors will be required to sign in at the office in the Plant and receive appropriate hazard recognition and safety training. Visitors will be instructed on radiological and non-radiological hazard prevention specific to the areas of visitation. Contractors who handle contaminated equipment will receive the same training and radiation safety instruction required of permanent employees. Contractors, who have previously completed the full training for the Project or who have evidence of recent and relevant training elsewhere, will receive job-specific radiation safety instruction. All visitors and contractors that have not received proper training must be escorted by an employee with proper training and knowledge of potential hazards.

5.6 Permit Area Security

LC ISR, LLC is committed to:

- maintaining control of NRC licensed material;
- providing a safe and secure workplace;
- managing records that may contain sensitive and/or confidential information; and
- ensuring safe and secure transportation of NRC licensed material in accordance with applicable DOT and NRC regulations and guidance.

5.6.1 Mine Unit and Storage Pond Security

Each mine unit and Storage Pond will be fenced and posted to prevent accidental entry by members of the public. Additionally, during production, active mine units will be inspected by operations personnel at least once per shift. Employees are instructed to inform their supervisor if any unauthorized individual gains access to the mine units. The supervisor will request the entrant to leave. If the entrant refuses to leave, the supervisor will request assistance from the County Sheriff and notify the Mine Manager. Employees shall not confront trespassers if they feel their safety may be in jeopardy.

Visitors to the mine units will be required to register at the office so appropriate training can be completed and any necessary supervision assigned. Visitors will only be accepted during normal business hours unless approved by a member of management.

5.6.2 Plant Security

The Plant, including areas of byproduct storage and handling, shall be fenced with access controlled by a locked gate. Signage will warn employees and members of the public of the potential for exposure to radionuclides and the necessity for members of the public to register at the office before entering. Security cameras will be placed at strategic locations throughout the plant including the security gate and locations where source and by-product materials are stored.

The Plant will normally operate 24 hours per day, seven days per week. During operations, employees will be continuously on-site to monitor security cameras and account for licensed material. At the beginning of each shift, the Plant Operator will account for the quantity and location of all source material in storage. The Plant Operator will document his/her findings so the next shift can make an accurate account.

Employees are instructed to inform their supervisor if any unauthorized individual gains access to the Plant. The supervisor will request the entrant to leave. If the entrant refuses to leave, the supervisor will request assistance from the County Sheriff and notify the Mine Manager. Employees shall not confront trespassers if they feel their safety may be in jeopardy.

Visitors to the Plant will be required to register at the office so appropriate training can be completed and any necessary supervision assigned. Visitors will only be accepted during normal business hours unless approved by a member of management.

The Operations Manager shall minimize the quantity of by-product material stored at the site in order to minimize any potential security threat.

5.6.3 Transportation Security

Licensed material is most vulnerable to security threats while it is being transported. Therefore, LC ISR, LLC commits to the following practices involving the transportation of licensed material:

- all individuals involved in the packaging, labeling, and handling of licensed material will be trained in applicable DOT regulations, including the Security Plan as well as the facilities radiation safety SOP's and policies;
- licensed material will be packaged, labeled, placarded and be adequately described in shipping papers in accordance will applicable DOT and NRC regulations;

- shipments of licensed material shall be kept within the controlled area of the plant and shall remain locked prior to shipping;
- bulk shipments of licensed material shall be secured by locking trailers and vehicles when they are not occupied;
- bulk shipments of licensed material will only be sent on exclusive use carriers; and
- all drivers transporting bulk quantities of licensed material will be familiar with the hazards of the shipment and how to properly respond to accidents involving the material.

5.7 Radiation Safety Controls and Monitoring

5.7.1 Effluent Control Techniques

During the Project, gaseous/airborne, liquid, and solid effluents will be produced from the processes associated with ISR operations. The only gaseous emission of concern due to radiation is radon gas, which will be vented to the atmosphere. No yellowcake drying and packaging will occur within the Permit Area, and the Storage Ponds will be kept wet, reducing the potential for radioactive particulate emissions as compared to other ISR projects in Wyoming.. The three liquid 11(e)(2) byproduct materials generated will be: process wastes; groundwater, affected by ISR, and pumped out for purposes such as sample collection; and groundwater generated during aquifer restoration. These liquids will be treated and disposed of on-site through a system of Storage Ponds and UIC Class I wells. The solid 11(e)(2) byproduct materials will include process wastes, such as spent ion exchange resin, and will include equipment that becomes contaminated during ISR operations and ore processing. Where possible, equipment will be decontaminated for disposal as non-11(e)(2) material or for re-use. Equipment that cannot be decontaminated and process wastes will be disposed of at an NRC-licensed facility. Detailed information about all of the effluents generated during ISR operations, including those described above that are of additional concern due to radiation, is provided in **Section 4.0.**

5.7.2 External Radiation Exposure Monitoring Program

The commitments outlined in this Section are intended to be minimum practices. The RSO shall retain the authority to increase sampling and monitoring frequency and locations as necessary to ensure adequate protection of all workers and the public. The RSO may determine that increased sampling and monitoring may be needed at the beginning of operations to quickly develop an understanding of baseline values and to help anticipate where additional engineering or administrative controls may be required. All radiation instrumentation shall be maintained in accordance with manufacturer recommendations. See **Attachment 5.7-1** or NRC Guidance; whichever is more restrictive.

5.7.2.1 Personal External Dosimetry

External doses to workers at the site will be monitored by the implementation of an external dosimetry program. As per US NRC regulations found in 10 CFR 20.1502a, any individual exposed to radiation sources and meeting the following conditions will be required to wear a dosimeter that is capable of accurately measuring doses associated with beta and gamma forms of radiation:

- adults likely to receive, in one year from sources external to the body, a dose in excess of ten percent of the limits in § 20.1201(a);
- minors likely to receive, in one year, from radiation sources external to the body, a deep dose equivalent in excess of 0.1 roentgen equivalent in man (rem) (one millisievert [mSv]), a lens dose equivalent in excess of 0.15 rem (1.5 mSv), or a shallow dose equivalent to the skin or to the extremities in excess of 0.5 rem (five mSv);
- declared pregnant women likely to receive during the entire pregnancy, from radiation sources external to the body, a deep dose equivalent in excess of 0.1 rem (one mSv); or
- individuals entering a high or very high radiation area.

The RSO will be responsible for managing the external dosimetry program including determining who will be involved in the program. All of the types of dosimeters used at the Permit Area will be approved by the National Voluntary Laboratory Accreditation Program (NVLAP) and have a minimum range of 1 millirem (mrem) to 500 rem with an accuracy of at least plus or minus 15 percent. Dosimeter badges will be worn on the torso, between the waist and neck. When not in use, dosimeter badges and the control supplied by the vendor will be stored in an appropriate, routinely accessible background location away from radioactive source materials or excessive heat as determined by the RSO.

Badges must be checked out by workers and monitored contractors at the beginning of the shift, and checked back in at the end of the shift. Personnel may only wear the badge assigned to them by the RSO. Dosimeter badges will be exchanged once every three months for new badges.

A permanent radiation dose record for each worker will be maintained by the RSO in a format compliant with US NRC Regulatory Guide 8.7, Instructions for Recording and Reporting Occupational Radiation Exposure, Revision 1." Copies will be provided annually to the authorized worker and upon termination of employment. Results from personnel dosimetry will be used to determine Deep Dose Equivalent (DDE) for use in determining Total Effective Dose Equivalent (TEDE). Worker doses shall be maintained below levels listed in US NRC regulations found in 10 CFR 20 Subpart C. If a worker receives greater than ten percent of the occupational dose limits in 10 CFR 20 Subpart C, the RSO shall perform an investigation to determine the cause and possible methods for lowering the exposure rate. The investigation findings and results of any corrective actions will be documented by the RSO.

5.7.2.2 Direct Readings for External Exposure

Direct gamma readings will be collected at least semi-annually at all employee work stations and near processing equipment that could be a source of gamma radiation (e.g. tanks and filters). Readings will be taken using a Ludlum Model 2350-1 counter with Model 44-10 2" sodium iodide detector or Ludlum Model 19 or equivalent instrument. If a direct gamma reading exceeds the action level of five mrem the area will be designated as a radiation area and clearly posted as in accordance with US NRC regulations found in 10 CFR 20.1902(a). The frequency of gamma surveys at radiation areas will be increased to quarterly. An investigation will be performed each time a new area becomes a radiation area to determine the cause of the increased gamma levels. The findings of the inspection will be maintained until license termination. In keeping with the ALARA principle, efforts will be made to lower the gamma levels at all radiation areas. If it is determined the gamma levels cannot be reduced, then exposures will be minimized by implementing engineering and/or administrative controls. The RSO may remove the radiation area designation after determining that the cause of the elevated gamma readings has been mitigated and gamma levels are demonstrated to be below five mrem per hour.

External gamma surveys will be performed with instrumentation with a low range of at most 100 μR/hr full-scale and a high range of at least five milliRoentgens per hour full scale. Gamma survey instruments will be calibrated as per the manufacturer's recommendations or at least annually. Gamma meters will be operated according to manufacturer specifications and shall be checked for proper operation each day of use. Gamma measurements will be made following guidance contained in US NRC Regulatory Guide 8.30. Records of all measurements and calibrations shall be maintained until license termination and in a form compliant with US NRC Regulatory Guide 8.7, "Instructions for Recording and Reporting Occupational Radiation Exposure, Revision 1."

As a minimum, gamma surveys will be completed in the following locations (approximate number of tanks in parenthesis):

- each ion exchange vessel (14);
- each elution vessel (two);
- each resin shaker deck (four);
- each yellowcake slurry storage tank (two);
- all four sides of each bank of accessible reverse osmosis tubes (four);
- each waste water tank (two);
- each precipitation cell (four);
- each eluant mixture tank (six); and
- office areas next to the plant (three).

The proposed number of gamma survey points during operations will be approximately 41 points.

Beta radiation is not expected to be a problem since dried yellowcake will not be stored at the site and storage periods for yellowcake slurry should be short. However, to ensure exposures remain below limits, upon initiation of operations, the RSO shall perform and document an evaluation as outlined in US NRC Regulatory Guide 8.30 Section 2.4. If Beta surveys are necessary, the RSO shall develop a monitoring program detailing frequency, acceptable equipment, calibration, methodology, and location.

Worker doses shall be maintained below levels listed in US NRC regulations found in 10 CFR 20 Subpart C.

5.7.3 In-Plant Airborne Radiation Monitoring Program

5.7.3.1 Airborne Uranium Particulate Monitoring

Surveys for airborne uranium dust will be performed to:

- demonstrate compliance with the occupational dose limits for workers specified in US NRC Regulation 10 CFR 20.1201;
- determine if an area needs posted in accordance with US NRC Regulations found in 10 CFR 20.1902(d);
- Determine whether additional precautionary measures are required to comply with US NRC Regulations 10 CFR 20.1701 and 20.1702; and
- Determine whether occupational exposures to radioactive materials are being maintained ALARA.

All of the processing at the Plant will occur in the form of water based solutions or wet slurry. Therefore, airborne uranium concentrations should be very low. To ensure airborne levels are below regulatory limits found in US NRC Regulations 10 CFR Part 20.1201, monthly air quality samples will be collected at the slurry storage tanks and filter press since these areas have the highest potential for exposure. Sampling will be performed in accordance with US NRC Regulatory Guide 8.25. The regulated air sampler will be calibrated according to manufacturer specifications or at least semi-annually with a mass flowmeter or primary calibration standard. Documentation of calibrations and readings shall be maintained by the RSO until license termination and in a form compliant with US NRC Regulatory Guide 8.7, "Instructions for Recording and Reporting Occupational Radiation Exposure, Revision 1."

Breathing zone sampling will occur as defined in SOPs, at the RSO's discretion when an RWP is used, and anytime a worker is performing a special high-exposure task and may be exposed to more than 12 derived air concentration (DAC)-hours in any one week. Breathing zone samples will be collected in the vicinity of the user's upper torso so it accurately reflects the air quality being inhaled. Air samplers shall be calibrated as per the manufacturer's recommendation or at least semi-annually. Documentation of calibrations shall be maintained by the RSO.

The RSO shall perform an investigation to determine the cause and develop corrective actions if a worker receives greater than ten percent of the allowable dose in 10 CFR 20 Subpart C.

The quantity of air sampled and the method for analysis should allow a lower limit of detection of at least 3×10^{-12} microCuries per milliliter (μCi/ml) (ten percent of the Appendix B to 10 CFR Part 20 concentration for natural uranium). The calculation of the LLD shall be performed in accordance with Appendix B of US NRC Regulatory Guide 8.30. Due to the importance of breathing zone samples in detecting potentially elevated areas of airborne radioactivity, samples will normally be analyzed within two days of sample collection. A Ludlum Model 2221 counter and Model 43-1 alpha counter with a Model 180-16 sample holder or equivalent will be used to measure activity on filters. The results of area and breathing zone sampling shall be used to calculate employee exposures to airborne radioactivity.

5.7.3.2 Surveys for Radon-222 and Its Daughters

Rn-222 and its daughters can be generated and released at an in situ mine anywhere mining lixiviant or ore is open to the atmosphere. Measurements of Rn-222 daughters will be used versus direct measurements of Rn-222 because they are easier to take and because they are the best indicator of worker dose.

Measurements of Rn-222 daughters will be taken on a monthly schedule in areas where Ra-222 daughters routinely exceed ten percent of the limit or 0.03 working level above background. Rn-222 daughter measurements will be taken in at least the following locations:

- near center of reverse osmosis bank;
- near center of the commercial ion exchange columns;
- near the center of the elution circuit tankage; and
- near the center of the yellowcake storage tankage.

If Rn-222 daughter concentrations are greater than 0.08 working level (25 percent of limit of 0.33 working level as per US NRC Regulations found in Appendix B to 10 CFR Part 20.1001 through 20.2402), sampling frequency will increase to weekly until four consecutive weekly samples indicate the concentrations of Rn-222 daughters are below 0.08 working levels. Any time the Rn-222 daughter concentration exceeds 0.08 working level, a documented inspection shall be performed by the RSO to determine and mitigate the cause of the increased concentration.

Quarterly sampling for Rn-222 daughters will also occur in areas where previous measurements have shown the daughters are not normally present in concentrations exceeding 0.03 working level (ten percent of limit) but where proximity to sources of Rn-222 may allow them to be present. As a minimum, quarterly Rn-222 daughter sampling will occur in the following locations:

- office area,
- shop area,
- lab area, and
- raw water storage tanks.

When collecting a sample, the date, time, and status of major equipment and processes in the area will be recorded. The lower limit of detection (LLD) for Rn-222 daughter measurements will be no greater than 0.03 and shall be calculated using guidance found in Appendix B of US NRC Regulatory Guide 8.30. Measured values less than the LLD, including negative values, will be recorded on data sheets. The LLD is set high enough to provide a high degree of confidence that 95 percent of the measured values above the LLD are accurate and do not represent false positive values. A Ludlum Model 2221 counter and Model 43-1 alpha counter with Model 180-16 sample holder or equivalent will be used to count filters.

The modified Kusnetz method will be used for measuring Rn-222 working level. This method involves collecting an air sample for five minutes on a high efficiency glass filter.

Alpha counts on the filter will be determined by counting with an alpha scalar for one minute after a decay time of 40 to 90 minutes. Even though a high efficiency glass filter is used, a correction factor will be applied to account for any absorption into the media.

Air samplers will be calibrated as per manufacturer recommendations or at least semiannually with a mass flowmeter or other primary calibration standard. A record shall be kept of all radon surveys by the RSO until license termination and in a form compliant with US NRC Regulatory Guide 8.7, "Instructions for Recording and Reporting Occupational Radiation Exposure, Revision 1."

5.7.4 Exposure Calculations

Worker exposures will be calculated annually based on the personal dosimeter data and the airborne radionuclide concentration measurements, if the TEDE is likely to exceed ten percent of the annual dose limit as specified in Title 10 CFR, Part 20. Worker doses may be calculated at levels below the ten-percent threshold at the discretion of the RSO. US NRC Regulatory Guide 8.30 will be used to assist with worker exposure calculations. Calculations will be based on worker exposure to both Rn-222 daughters and natural uranium.

The dose from airborne particulate radionuclides may be calculated by the DAC-hour method. The number of DAC hours is calculated by multiplying the ratio of the gross alpha concentration in the air to the U-nat DAC (2×10^{-11} μCi/mL) by the number of hours of exposure at that concentration. The number of DAC-hours is multiplied by a factor of 0.0025 rem per DAC-hour.

Alternatively, the dose may be calculated by estimating the intake of specific radionuclides and multiplying by the dose coefficients of the International Commission on Radiological Protection's (ICRP) Publication 68 (ICRP, 1995). The intake is calculated by multiplying a standard breathing rate by the average concentration of radionuclides in the air to which the worker is exposed.

Calculations for prenatal and fetal exposures will be in accordance with US NRC Regulatory Guide 8.36, "Radiation Dose to the Embryo/Fetus" NRC, (1992b) and US NRC Regulatory Guide 8.13, "Instructions Concerning Prenatal Radiation Exposure" (NRC, 1999).

The results of all exposure calculations will be maintained by the RSO until license termination and in a format compliant with US NRC Regulatory Guide 8.7 (NRC, 1982) and 10 CFR 20.2103.

5.7.5 Bioassay Program

LC ISR, LLC will maintain a urinalysis bioassay program to ensure the adequacy of the airborne sampling program and to ensure worker exposure to airborne uranium is not in excess of regulatory limits. The Bioassay Program will follow guidelines set forth in US NRC Regulatory Guide 8.22. Urinalysis was selected as the method of bioassay due to the relatively high solubility of yellowcake.

Each new worker will provide a sample for an initial urinalysis. Upon termination, each worker will be requested to provide an exit bioassay. All workers who routinely work in the plant, mine unit or laboratory will provide quarterly urine samples. Workers near the Processing Circuits, where the uranium is precipitated, will be required to submit samples monthly if the uranium concentration in the air exceeds ten percent of the DAC or at the discretion of the RSO. Samples should only be collected from workers who have not been potentially exposed to uranium for at least 36 hours and in an area free from contamination. The samples, along with a spiked and blank sample, shall be sent for analysis at a laboratory that can detect at least five micrograms (μg) uranium per liter of urine. The quality control samples will comply with recommendations found in US NRC Regulatory Guide 8.22. Urinalysis results should be available to the RSO within 20 days after specimen collection. The contracted laboratory must report by telephone results exceeding 35 μg within 20 days after specimen collection. The RSO will be responsible for documenting compliance with the Table 1 "Corrective Actions Based on Monthly Urinary Uranium Results" found in US NRC Regulatory Guide 8.22. The corrective actions shall be included in the Annual ALARA Report. A record shall be maintained of bioassay results and associated QA/QC until license termination and in a form compliant with US NRC Regulatory Guide 8.7, "Instructions for Recording and Reporting Occupational Radiation Exposure, Revision 1."

5.7.6 Contamination Control Program

LC ISR, LLC will designate and post the Plant processing area as restricted and limit access to only those individuals who have received appropriate training and/or are escorted by an experienced employee. Signage will read "ANY AREA WITHIN THIS FACILITY MAY CONTAIN RADIOACTIVE MATERIAL." Before leaving the restricted area, all individuals must perform and document an alpha survey. Individuals who have been in the mine unit or byproduct storage area or near the deep well or storage ponds will perform and document an alpha survey immediately upon returning to the office, before eating, or before leaving the mine site; whichever comes first. All workers shall receive training regarding how to properly perform and document alpha surveys. The RSO or HPT shall post by each alpha survey meter the personnel release limits in counts per second. The release limit will be calculated based upon the efficiency of the meter and the legal limit of 1,000 disintegrations per minute (dpm) per cubic centimeter.

The RSO or HPT will survey potentially contaminated items before they are released from the mine site. The RSO and HPT shall use Table 1 of US NRC *"Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material,"* August 1987, to determine if equipment can be released for unrestricted use. Items which cannot be representatively surveyed due to geometry or any other reason, may not be released for unrestricted use.

A Ludlum Model 2224 counter and Model 44-9 pancake GM probe or equivalent will be used for release surveys. Survey equipment shall be calibrated as per manufacturer specifications and at least annually. Surface contamination instruments shall be checked for proper response each day of use. Alpha survey instruments used for personnel surveys shall be response checked before each survey to ensure they are in working order. Other checks on alpha meters shall be performed weekly.

An inspection shall be performed of the Plant every day of operation by the RSO, HPT, or trained worker to check for proper containment of yellowcake and mining solutions, proper storage of PPE, radiation protection signage, access control, and security measures. All visible uncontained yellowcake shall be cleaned up immediately.

Weekly inspections of rooms where work with uranium is not performed shall be conducted at least weekly. Smear samples will be collected in at least the control room, lunchroom, and change rooms and surveyed for alpha contamination. The RSO shall perform and document the findings of an inspection if the surface contamination in these areas exceeds those listed in Table 2 of US NRC Regulatory Guide 8.30.

SOPs will be developed for each piece of equipment and process which may present a hazard to the worker, the environment, or the operation if performed incorrectly. SOPs for processes involving radionuclides must be approved by the RSO and will include a section discussing appropriate personal protection equipment such as gloves, coveralls, boots, etc.

LC ISR, LLC will ship yellowcake slurry to other facilities for drying and packaging. Prior to the release of packages containing yellowcake, the packages shall be washed and surveyed to ensure compliance with DOT release standards found in 49 CFR 173.43(a) and (b).

5.7.7 Airborne Effluent and Environmental Monitoring Programs

As noted in Title 10 CFR Part 20, Subpart L, Section 20.2103, "Records of surveys", the Airborne Effluent and Environmental Monitoring Programs will:

- maintain records showing the results of surveys and calibrations required by Title 10 CFR Part 20, Subpart L, Sections 20.1501 and 20.1906, and
- retain these records until license termination.

These retained records will include:

- the results of surveys to determine the dose from external sources and used in the assessment of individual dose equivalents;
- the results of measurements and calculations used to determine individual intakes of radioactive material and used in the assessment of internal dose;
- the records showing the results of air sampling, surveys, and bioassays required pursuant to Title 10 CFR Part 20, Subpart L, Sections 20.1703(c)(1) and (2); and
- the results of measurements and calculations used to evaluate the release of radioactive effluents to the environment.

Airborne effluent and environmental monitoring programs will be carried out as recommended in the NRC Regulatory Guide 4.14.

- Radon gas will be monitored continuously with quarterly analysis at the same locations as for the baseline passive radiological sampling as described in **Section 2.5.5** using alpha track etch detectors or equivalent. The device shall be able to accurately detect down to 0.33 pCi/l based on a 90-day sample. At least one location shall have two monitoring devices as part of QA/QC.
- Direct gamma radiation measurements will be measured quarterly at the baseline passive radiological sampling sites discussed in **Section 2.5.5** using a passive integrating device or equivalent. The device shall have a range of at least one mrem to 500 rem with an accuracy of at least plus or minus 15 percent. At least one location shall have two monitoring devices as part of QA/QC.

The results of the Airborne Effluent and Environmental Monitoring Program shall be reported to the NRC semiannually as required by 10 CFR 40.65.

LC ISR, LLC will establish and execute a QA program in accordance with Appendix B of Title 10 CFR, Part 50. The QA program will be established and managed internally, with delegated duties to others (such as contractors, agents, or consultants). LC ISR, LLC will establish written authorities and duties of persons and organizations that perform activities affecting the safety-related functions of mining process structures, systems, and components. The QA functions will include:

- the development of a QA program;
- assurance that a QA program is effectively executed; and
- implementation of actions to conduct checks, audits, and inspections to verify that specified activities affecting the safety-related functions have been correctly performed.

5.7.8 Groundwater and Surface-Water Monitoring Programs

Sampling to evaluate the radiological impacts of ISR is part of the overall operational program (**Section 3.0**). Baseline conditions have been assessed on both a regional and site-specific basis to provide information on the overall quantity and quality of water in the Permit Area and its vicinity (**Section 2.7**). Operational monitoring has been designed to identify any potential impacts to hydrology of the Permit Area and its vicinity during both ISR activities and groundwater restoration. This operational monitoring includes sampling of private wells and monitor wells specific to individual mine units. This sampling information augments the information on production and injection control, such as injection rates and pattern balance, which is instrumental to efficient ISR (**Section 3.2.7**).

5.7.8.1 Baseline Conditions

Groundwater and surface water monitoring have been conducted to establish baseline conditions, including the types of radionuclides present, if any, and their concentrations. The results and analysis of the baseline monitoring are presented in detail in **Section 2.7** and are summarized here.

Quarterly water level measurements and water quality samples have been collected in 17 monitor wells and one water supply well (completed in the DE, LFG, HJ and UKM Horizons). Sampling of all the wells began in September 2006, with four exceptions (beginning date noted in parentheses):

- DE Monitor Wells: LC29M, LC30M and LC31M;
- LFG Monitor Wells: LC15M (11/07), LC18M, LC21M, LC25M;
- HJ Monitor Wells: LC16M (3/07), LC19M, LC22M, LC26M, LC27M (11/07), and LC28M; and
- UKM Monitor Wells: LC17M (11/07), LC20M, LC23M and LC24M.

The water samples were submitted to a contracted laboratory; and the analytical results were evaluated for QA and then input into the Lost Creek digital analytical water quality database for evaluation The sample results from these 17 wells indicate that the groundwater within the shallow Battle Spring aquifers beneath the Permit Area is a calcium-sulfate to calcium-bicarbonate type. There appears to be some variability in water chemistry; but, overall, there is no significant difference in the major water chemistry between the production zone and the overlying and underlying aquifers.

In general, groundwater in the shallow Battle Spring aquifers within the Permit Area tends to have a relatively good water quality, with the exception of the presence of radionuclides. Ra-226 plus radium-228 (Ra-228) exceed the EPA MCL in over two-thirds of the samples collected; and the average uranium concentration is an order of magnitude greater than the EPA MCL for that constituent. These elevated radionuclide concentrations are consistent with the presence of naturally occurring uranium ore within the aquifer.

5.7.8.2 Operational Monitoring

Surface Water Monitoring

Because there are no surface water channels or surface water bodies that could be impacted in the Permit Area, no surface water will be monitored during normal operations.

Private Well Monitoring

There are no drinking water wells or agricultural water wells within the Permit Area or within 1.24 miles (two km) of the Permit Area. There are also no stock wells within the Permit Area. The operational BLM stock wells within 0.62 miles (one kilometer) of the Permit Area (**Section 2.2**) will be sampled on a quarterly basis with BLM's consent. Groundwater samples will be collected in accordance with the instructions contained in LC ISR, LLC's Environmental Manual. Samples will be analyzed for U-nat and Ra-226, and records of the sampling results will be maintained until license termination.

Life-of-Mine Wells

The 17 wells listed in **Section 5.7.8.1** that were used to establish baseline conditions, will be available life-of-mine. Water level measurements will be taken in these wells quarterly, and other samples may be collected from these wells depending on the development of mine units near or encompassing the wells.

Monitoring Specific to Mine Units

During ISR, the monitoring program for each mine unit is designed to detect excursions of lixiviant from the pattern area, and it includes the monitor ring wells completed in the same sand as the pattern area and monitor wells in overlying or underlying water-bearing strata. Excursion detection is based on comparison of concentrations of specific parameters with the Upper Control Limits (UCLs) for those parameters, which are calculated from the baseline concentrations of those parameters. During restoration, the monitor program is designed to ensure restoration activities are proceeding as planned. Restoration success is based on comparison of concentrations of specific parameters with class-of-use standards and baseline concentrations for those parameters.

Mine Unit Baseline Water Quality and Upper Control Limits (UCL's)

After delineation of a pattern area, monitor wells will be installed around that area as described in **Section 3.2.2**. A pump test will be used to verify communication between monitor wells in the monitor ring and the pattern area and lack of communication between the pattern area and overlying and underlying monitor wells. Baseline groundwater samples will be collected in accordance with the instructions contained in LC ISR, LLC's Environmental Manual.

All the mine unit monitor wells will be sampled at least four times at least 14 days apart. One round of samples will be analyzed for the parameters listed in **Table 5.7-1** and three round will be analyzed for just the UCL parameters. UCLs will be set for parameters that would be indicative of a migration of lixiviant from the mine unit, and it is anticipated that these parameters will be chloride, conductivity, and total alkalinity. Chloride is a common UCL in Wyoming due to its low natural levels in the native groundwater and because chloride is introduced into the lixiviant from the ion exchange process (uranium is exchanged for chloride on the ion exchange resin). Chloride is also a very mobile constituent in the groundwater and will show up quickly in the case of a lixiviant migration to a monitor well. Conductivity is another common UCL because it is an excellent general indicator of overall groundwater quality. Total alkalinity concentrations should be affected during a potential excursion, as bicarbonate is the major constituent added to the lixiviant during mining. UCLs will be set at five standard deviations to the baseline average for the indicator.

Excursion Detection

Excursion detection will consist of sampling the monitor wells at least twice per month, and no less than ten days apart, and analyzing the samples for the UCL parameters. The monitor wells will be sampled as per the above schedule except in the event of certain situations. These situations include inclement weather, mechanical failure, holiday scheduling, or other factors that may result in placing an employee at risk or potentially damaging the surrounding environment. In these situations, LC ISR, LLC will document the cause and the duration of any delays. In no event shall a delay be greater than five days. Records of UCL monitoring, including chemical assays, shall be maintained until license termination. Although not an excursion indicator, water levels will be obtained and recorded prior to each well sampling

Excursion Verification and Corrective Action

During routine sampling, if two of the three UCL values are exceeded in a monitor well, or if one UCL value is exceeded by 20 percent, the well will be re-sampled within 24 hours and analyzed for the excursion indicators. If the second sample does not exceed the UCLs, a third sample will be taken within 48 hours. If neither the second or third sample results exceed the UCLs, the first sample will be considered in error.

If the second or third sample verifies an exceedance, the well in question is placed on excursion status. Upon verification of the excursion, the NRC Project Manager is notified by telephone or email within 48 hours and notified in writing within 30 days.

If an excursion is verified, the following methods of corrective action will be instituted (not necessarily in the order given), dependent upon the circumstances.

- A preliminary investigation will be completed to determine the probable cause.
- Production and/or injection rates in the vicinity of the monitor well will be adjusted as necessary to generate an effective net process bleed, thus forming a hydraulic gradient toward the production zone.
- Individual wells will be pumped to enhance recovery of ISR solutions.
- Injection into the pattern area adjacent to the monitor well may be suspended. Recovery operations will continue, thus increasing the overall bleed rate and the recovery of the ISR solutions.

In addition to the above corrective actions, the sampling frequency of the monitor well on excursion status will be increased to weekly. An excursion will be considered resolved when the concentrations of excursion indicators do not exceed the criteria defining an excursion for three consecutive one-week samples and NRC has been notified by mail. If an excursion is not corrected within 30 days, a sample will be collected and analyzed for parameters listed in WDEQ-LQD Guideline 8 Appendix I Sections IV and VA(1) and the applicable EPA MCLs. Once parameters no longer exceed the UCLs, a final sampling and analysis of the WDEQ-LQD Guideline 8 parameters will be performed.

Restoration Criteria

During restoration activities, monitoring for excursion detection will continue as outlined above to ensure that none of the restoration activities, such as reinjection of RO permeate, result in unanticipated migration of fluids from the pattern area.

Once restoration activities are near completion, sampling to verify restoration success will be initiated. The applicable restoration criteria for each mine unit and the sampling necessary to verify restoration success are described in **Section 6.2.**

5.7.8.3 Storage Pond Leak Detection Monitoring

The Storage Ponds will be lined and equipped with a leak detection system. During operations, the leak detection standpipes will be checked for evidence of leakage. Visual inspection of the pond embankments, fences and liners and the measurement of pond freeboard will also be performed during normal operations. A Pond Inspection Program will be developed for the Project and will meet the guidance contained in NRC Regulatory Guide 3.11 and commitments made in **Section 5.3.2** of this application.

A minimum freeboard of three feet will be maintained for any Storage Pond during normal operations. Anytime six inches or more of fluid are detected in a leak detection system standpipe, it will be analyzed for specific conductivity. Should the analyses indicate that the liner is leaking (by comparison to chemical analyses of pond water), the following actions will be taken.

- NRC will be notified by telephone or email within 48 hours of leak verification.
- The level of the leaking pond will be lowered by transferring its contents into an adjacent pond. While lowering the water level in the pond, inspections of the liner will be made to determine the cause and location of the leakage. The area of investigation first centers on the pond area specific for the particular standpipe that contains fluid.
- Once the source of the leakage is found, the liner will be repaired and water may be reintroduced to the pond.
- A written report will be submitted to NRC within 30 days of the leak verification. The report will include analytical data and describe the cause of the leakage, corrective actions taken, and the results of those actions.

5.7.9 QA Program for Radiological Monitoring Programs

The operations plan follows a prescribed radiological monitoring program that will generate reasonably valid data of a defined quality. The QA Program will be designed to:

- identify sampling and measurement processes with deficiencies and report them, and
- obtain confidence in the monitoring program results to determine valid data.

Steps of the monitoring process will involve QA for:

- analytical sampling, sample shipments, chain-of-custody documentation and laboratory QA, and
- radiological measurement data reduction, data evaluation, and reporting.

QA records will also be maintained for the following activities: operating logs, results of reviews, inspections, tests, audits, work performance monitoring, and materials analyses. The records will also include data such as qualifications of personnel, procedures, and equipment. Testing and inspection records will identify the inspector or data recorder, the type of observation, the results, the acceptability, and any actions taken regarding deficiencies noted. Operational records will be identifiable and retrievable, and be retained by the RSO until licenser termination at the mine site.

Management of the QA Program (EPA QA/G-5-2002, Ref. 19). will take into account the following applicable items.

- Data Quality Objectives (DQO) for a specific monitoring program, as noted in EPA QA/G-4-2006, Ref. 18, that provides development examples to define acceptance and performance criteria.
- A Quality Assurance Project Plan (QAPP) that documents data collection, analysis, assessment, and how to achieve expected data quality.

5.7.9.1 Organizational Structure and Responsibilities of Managerial and Operational Personnel

The following QA program elements will be developed and implemented to ensure the quality of data/results for radiological effluent and environmental monitoring programs.

LC ISR, LLC organization structure relating to:

- management and operation of the monitoring programs;

- QA policy and functions, definition and documentation; and
- authorities, duties, and responsibilities of the organizational positions.

LC ISR, LLC personnel or contracted organizations conducting QA functions will be given sufficient authority and organizational freedom: to identify quality problems; to initiate, recommend, or provide solutions; and to verify implementation of solutions. Reporting will be at the managerial level, independent of activity performance, costs, and schedule. Applicable organizational structure guidance from Section 2.1.1 of American National Standards Institute (ANSI)/American Society for Quality Control (ASQC) E4-1994 (Ref. 21) and Section 5.2.1 of ANSI N42.23-2003 (Ref. 22) will be reviewed regarding the organizational responsibilities for radiological effluent and environmental monitoring programs.

5.7.9.2 Specification of Qualifications of Personnel

Qualified LC ISR, LLC personnel will carry out assigned radiological monitoring functions per their background and job description. Qualified and responsible individuals will be trained in the principles and techniques of the activities to be performed, including maintaining proficiency by retraining, reexamining, and recertifying or by periodic performance reviews, as appropriate. Applicable guidance and criteria in Section 2.3.1 of ANSI/ASQC E4-1994 (Ref. 21) and in Rev. 2 of RG 4.15, Page 7, will be evaluated regarding personnel development, training and qualification specifications.

5.7.9.3 SOPs and Instructions

Monitoring programs should have written procedures for all activities that generate data, such as dose calculations and measurements, sample collection, sample management and chain-of-custody documentation, sample preparation and analysis, data reduction and recording, data assessment and reporting, and final sample disposal. Procedures are also needed for addressing support functions (such as operation of process monitors, training, and preparation of quality control samples) and collection of meteorological data, corrective actions, audits, and records. Qualified individuals will participate in preparation, review, and revision of these procedures.

5.7.9.4 Records

LC ISR, LLC will maintain a system that produces unequivocal, accurate records that document all monitoring activities, such as:

- procedure revision;
- personnel training and qualification records;
- analytical results;
- audits;
- corrective actions;
- intermediate activities or calculations (as may be needed to validate or substantiate final results);
- records of tracking and control (e.g., chain-of-custody documentation) throughout all processes from sample collection;
- thorough analysis and reporting of results, including unique identifiers, descriptions, and sources;
- dates/times, packaging/preparation/shipping, and required analyses;
- field logs and records with sufficient information that describe environmental conditions;
- information and data that document the nature of the sample and where and how it was taken;
- electronic data collection and algorithms and QA documentation;
- calculations (including data reduction, analysis, and verification) Rev. 2 of Regulatory Guide 4.15, Page eight;
- QC records for radiation monitoring equipment, including the results of the radioactive source;
- checks, calibrations, instrument background determinations, and maintenance activities affecting equipment performance; and
- notifications to qualified staff of any approved procedural changes affecting data quality.

Records will be legible and identifiable, retained at the mine site, and will be protected against damage, deterioration, or loss. These records will be maintained in a format that is easily retrievable, physically or electronically, and can be reviewed in an uncorrupted form.

LC ISR, LLC will use the appropriate guidance from applicable sections in:

- ANSI/ASQC E4-1994 (Ref. 21);
- Basic Requirement 17 of American Society of Mining Engineers (ASME) National Quality Assurance (NQA)-1-1994 (Ref. 11);
- Section 4.13 of International Organization for Standardization (ISO)/ International Electrotechnical Institute (IEC) 17025-2005 (Ref. 17), and
- Nuclear Information and Records Management Association (NIRMA) TG11-1998 (Ref. 23), TG15-1998 (Ref. 24), TG16-1998 (Ref. 25), and TG21-1998 (Ref. 26).

Figure 5.1-1 Lost Creek ISR, LLC Organization Chart

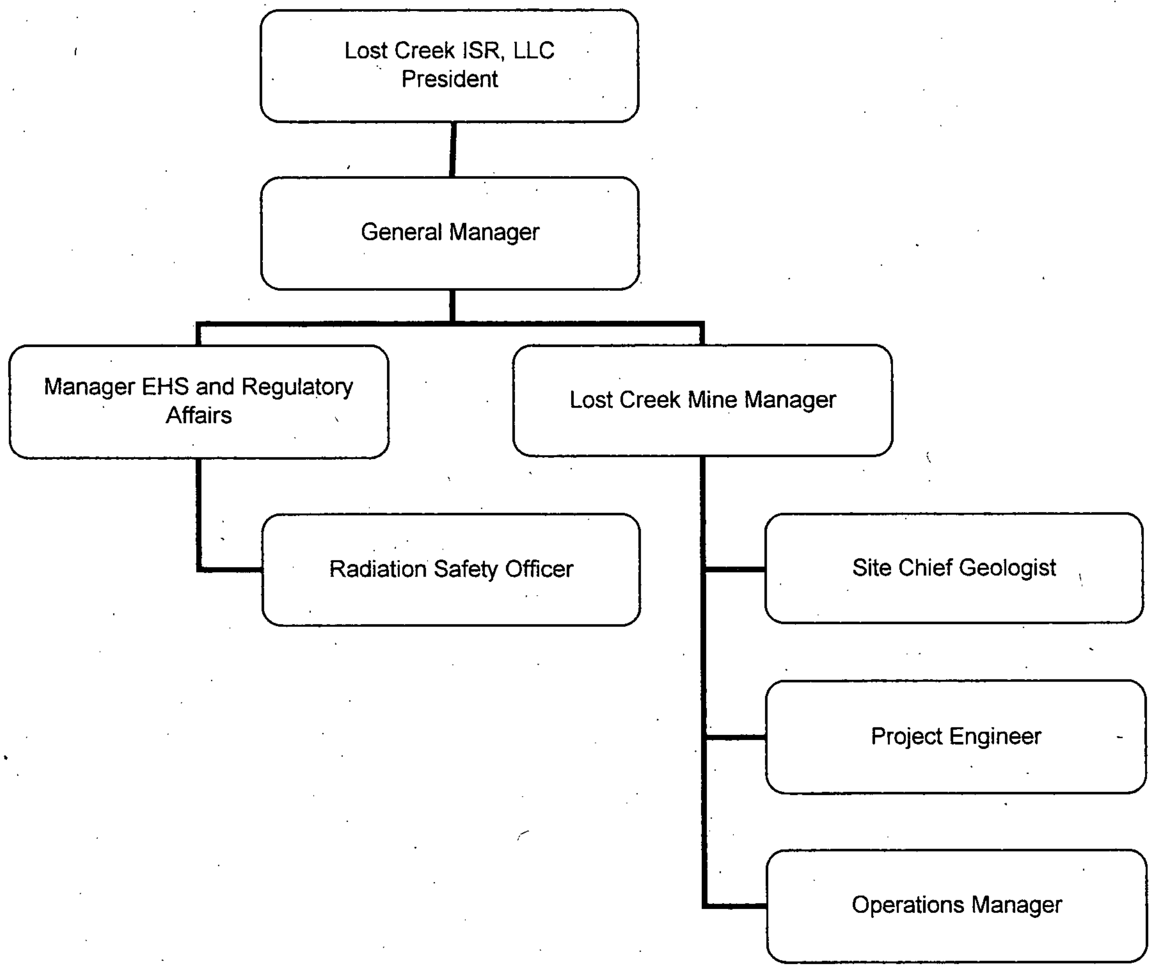

Table 5.7-1 Baseline Water Quality Monitoring Parameters

Major Ions	**Trace Constituents**
Calcium	Ammonia
Magnesium	Arsenic
Potassium	Barium
Sodium	Boron
Bicarbonate	Cadmium
Chloride	Chromium
Carbonate	Copper
Sulfate	Fluoride
Nitrate (Total)	Iron
	Lead
General Water Chemistry	Manganese
Alkalinity	Mercury
Total Dissolved Solids	Molybdenum
pH (field measured)	Nickel
pH (lab measured)	Selenium
Specific Conductance (field measured)	Vanadium
Temperature (field measured)	Zinc
Radionuclides	
Gross Alpha	
Gross Beta	
Radium-226	
Radium-228	
Uranium	

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6.0 GROUNDWATER QUALITY RESTORATION, SURFACE RECLAMATION, AND FACILITY DECOMMISSIONING

A variety of restoration and reclamation activities will be phased in throughout the project life as mine units are depleted of uranium. Final facility decommissioning and reclamation will occur once the Plant is no longer in use. **Figure 1.7-2** includes a schedule of activities for the Project, including the restoration and reclamation activities.

Reclamation of each mine unit and associated header houses involves:

1) groundwater restoration,
2) radiological decontamination,
3) equipment removal/decommissioning (e.g. well abandonment), and
4) surface reclamation (e.g., well site reseeding).

Groundwater restoration may start once uranium recovery is complete at that header house, and restoration of a header house may occur contemporaneously with operation of another header house in the same mine unit. To ensure maximum ore recovery and avoid interference between header houses, contemporaneous production and restoration of adjacent or overlying header houses and/or mine units will be carefully evaluated. Once groundwater restoration is complete, decontamination and other reclamation activities will start. Because some ore-bearing sands may overlie others in a mine unit, decontamination of equipment and other surface reclamation activities will start when all of the 'stacked' sands are restored.

Reclamation of the Plant and support facilities involves similar activities, including:

1) radiological decontamination,
2) equipment removal/decommissioning (e.g., building demolition), and
3) surface reclamation (e.g., road removal, topsoil replacement, and reseeding).

The following sections describe the criteria used to determine when production is complete, the status of the mine unit at the end of operations, the subsequent restoration and reclamation activities, and the criteria used to determine when restoration and reclamation have been successful.

6.1 Completion of Production Operations

Technical, economic, and operational criteria can be reviewed to determine if uranium recovery is complete in a given header house and/or mine unit. The technical criteria comprise the percentage recovery of the estimated ore reserves, the uranium concentration in the production fluid, and the header house flow rates. Typically, the technical criteria for considering production operations complete are:

- a uranium recovery of at least 80 percent;
- a production fluid uranium concentration reduced to a level not significantly greater than the injection fluid; and,
- in some instances, a reduced groundwater flow rate.

The economic criteria comprise the corporate financial objectives, the price of uranium, and the annual production targets. When production targets are no longer being met, and operational changes will not improve the possibility of meeting those targets, then ISR operations may be considered complete.

The Plant ion exchange and processing capacity may also factor into determining if ISR operations have been completed in a given header house or mine unit. If there is unused ion-exchange-recovery and waste-management capacity that can be filled by continued operation of an area, which is essentially depleted but will continue to supply a low-concentration production fluid, it may be economic to continue operation of that header house. Such an extension allows for the recovery of uranium for a period of a few months after the header house operations might normally be considered complete. In addition, such an extension allows for higher percent recovery of uranium, which may facilitate subsequent groundwater restoration. This extension will end when there is no longer sufficient capacity for low-concentration production fluid or the quantity of uranium recovered is insufficient to cover operating costs.

6.2 Plans and Schedules for Groundwater Quality Restoration

The objective of restoration and reclamation is to return the affected groundwater and land surface to the uses for which they were suitable before commencement of the Project operations. The methods to achieve this objective for groundwater are described in this section. Before discussing restoration methodologies, the chemistry of the system is briefly reviewed.

6.2.1 Conditions in the Mineralized Zone Before and After Operations

The uranium deposits underlying the Permit Area are similar to those found at other ISR operations in the US. They are primarily roll front deposits in fluvial sandstones, and the uranium was deposited when oxidized groundwater containing the uranium entered reducing conditions in the subsurface aquifers. The reducing agents were probably organic matter and pyrite and, to a lesser degree, hydrogen sulfide.

ISR operations essentially reverse the natural processes that deposited the uranium. Injection wells introduce lixiviant into the mineralized zone to oxidize the reduced uranium and to complex it with bicarbonates. Pumping from production wells draws the solution through the mineralized zone, oxidizing additional ore between the injection and production wells.

In turn, groundwater restoration essentially reverses the effects of the oxidation during ISR operations and re-establishes the reducing conditions that were present prior to production, to the extent possible. Groundwater sweep removes much of the groundwater oxidized during operations. During the RO phase, residual uranium and other metals mobilized under the oxidized conditions are removed, and the treated water reinjected. As necessary to accomplish restoration, specific reductants such as hydrogen sulfide may be added. Bioremediation may also be applied, if site conditions are suitable for this restoration technology.

6.2.2 Restoration Requirements

LC ISR, LLC commits to return the groundwater to the pre-operational class-of-use in accordance with WDEQ statutes and regulations. Restoration must demonstrate that Best Practicable Technology (BPT) has been applied. If possible, restoration will be conducted to achieve restoration levels that approximate the baseline water quality.

Prior to operation of each mine unit, groundwater class-of-use will be determined by the WDEQ-WQD on the basis of baseline water quality data collected in accordance with WDEQ requirements and submitted to WDEQ by LC ISR, LLC. The WDEQ Class-of-Use Standards are listed in **Table 6.2-1**. For the wells in the perimeter monitor ring and for wells in overlying and underlying aquifers, the class-of-use will be determined on a well-by-well basis. For the pattern area, baseline water quality data from monitor wells in the pattern area will be averaged to determine the class-of-use for that mine unit (WDEQ, 1977).

Baseline water quality data will be collected from the monitor wells in the perimeter ring, in the pattern area, and in the overlying and underlying aquifers before ISR operations in each mine unit, in accordance with the Testing Proposal which will be submitted to WDEQ-LQD for review and approval. A minimum of four samples will be collected from each well, at least 14 days apart. At least one of the four samples will be analyzed for the parameters required per WDEQ-LQD Guidelines 4 and 8, as listed in **Table 6.2-1**. The other samples may be analyzed for a reduced parameter list with agency approval.

6.2.3 Groundwater Restoration Methods

The following sections discuss the active phases that will be used under the groundwater restoration program. Following completion of groundwater restoration, stability monitoring will commence to demonstrate that the chemical constituents of the groundwater in the mine unit are in equilibrium with their immediate surroundings.

Restoration activities are designed to: optimize restoration equipment used in treating groundwater; minimize the number of pore volumes circulated during the restoration stage; and minimize net consumptive use of groundwater resources. LC ISR, LLC will monitor the quality of selected wells during restoration to determine the efficiency of the operations and to determine if additional or alternate techniques are necessary.

Restoration consists of three phases:

- groundwater sweep,
- groundwater treatment, and
- recirculation.

A reductant may be added at anytime during the restoration process to lower the oxidation potential of the production zone. Reductants have been used successfully in some mine units in Wyoming, but have been relatively ineffective in others, in part because the minerals present in one mine unit may respond differently than other minerals present in another mine unit. (For example, the solubility of manganese increases with decreasing oxidation conditions.) Therefore, the use of reductants will be evaluated on a case by case basis. A sulfide or sulfite compound may be added to the injection stream in concentrations sufficient to reduce the mobilized species. Biological reductants may be evaluated as experimental technology if warranted, depending on-site conditions. Additional descriptions of the active phases of groundwater restoration are presented below.

The progress of groundwater restoration is often measured on the basis of the number of 'pore volumes' treated in each phase. One pore volume is equivalent to:

- the volume of water within the pattern area (thickness of the ore sand times the pattern area times the effective porosity of the sand); plus
- the volume of water at the edge the pattern area affected by the horizontal 'flare' from the injection wells along the edge of the pattern area; plus
- the volume of water above and below the injection interval affected by the vertical 'flare' from the injection wells throughout the pattern.

The thickness of the ore sand and pattern area are readily measurable, and the effective porosity is determined from hydrogeologic information for each mine unit. The extent of the horizontal and vertical flare can be estimated from hydrogeologic data for each mine unit. For preliminary purposes, LC ISR, LLC has estimated the horizontal flare and vertical flare are both 20 percent of the volume in the pattern area, based on information from other Wyoming operations.

6.2.3.1 Groundwater Sweep

During groundwater sweep, water is pumped from the mine unit, without re-injection, causing an influx of baseline quality water from the perimeter of the mine unit, which 'sweeps' the affected portion of the aquifer. The perimeter baseline quality water has lower ion concentrations, which helps strip cations (e.g., sodium cations) that were mobilized by the lixiviant but subsequently attached to the clays in the pattern area during ISR operations. These remaining cations can be readily removed from the clays and affect groundwater quality; hence the need to remove them. The affected water near the edge patterns of the mine unit is also drawn back into the pattern area, making the later restoration phases more efficient.

The sweep water is treated or passed through the ion exchange circuit to capture uranium and then pumped to the UIC Class I wells. The number of pore volumes of groundwater sweep is dependent on the capacity of the wastewater disposal system and the effectiveness of the groundwater sweep in lowering the TDS. Past experience at other ISR operations in Wyoming and elsewhere indicates that this phase is more effective in capturing affected water near the edge of the mine unit than it is in lowering TDS levels and that the majority of benefits from groundwater sweep are realized in one pore volume. Typically, one pore volume or less is recovered before moving to the groundwater treatment phase.

6.2.3.2 Groundwater Treatment

Following the groundwater sweep phase, water will be pumped from the mine unit to treatment equipment and then re-injected into the mine unit. Ion exchange and RO circuits are used during this phase as shown on the generalized restoration flow diagram on **Figure 6.2-1**.

All water recovered from restoration will be passed through the ion exchange circuit to capture any remaining uranium. The ion exchange columns exchange the majority of the soluble uranium for chloride or sulfate. Once the solubilized uranium is removed, a small amount of reductant may be metered into the water being re-injected to reduce any pre-oxidized minerals. The concentration of reductant injected (if used) into the formation is determined by the concentration and type of trace elements encountered. The goal of reductant addition is to reduce those minerals that are solubilized by carbonate complexes in order to prevent the buildup of dissolved solids, which would increase the time for restoration to be completed.

A portion of the restoration recovery water can be sent to the RO unit. The use of an RO unit: 1) reduces TDS in the impacted groundwater; 2) reduces the quantity of water that must be removed from the aquifer to meet restoration limits; 3) concentrates the dissolved constituents in a smaller volume of brine to facilitate waste management and disposal; and 4) enhances the exchange of ions from the formation due to the large difference in ion concentration.

As previously mentioned, the water is pumped through the ion exchange circuit prior to RO. The RO unit contains membranes that pass about 60 to 75 percent of the water through, leaving the dissolved salts in the water that will not pass the membranes. **Table 6.2-2** shows typical RO manufacturers' specification data for removal of ion constituents. The clean water, called "permeate," will be re-injected, sent to storage for use in the ISR process, or to the wastewater disposal system. The 25 to 40 percent of water that is rejected, called "brine," contains the majority of dissolved salts in the groundwater recovered from the mine unit and is sent for disposal in the waste system. Make-up water may be added to the mine unit injection stream to control the amount of "bleed" in the restoration areas.

If reductant is added to the injection stream during the groundwater treatment stage, it will scavenge oxygen and reduce the oxidation-reduction potential (Eh) of the aquifer. During ISR operations, certain trace elements are oxidized. By adding a reductant, the Eh of the aquifer is lowered, thereby decreasing the solubility of these elements. As warranted, hydrogen sulfide, sodium sulfide (Na_2S), or a similar compound may be added as a reductant. LC ISR, LLC is more likely to use sodium sulfide as a reductant due to the chemical safety issues associated with proper handling of hydrogen sulfide. A comprehensive safety plan regarding reductant use will be implemented.

The number of pore volumes treated and re-injected during the groundwater treatment phase will depend on the efficiency of the RO in removing TDS and the effectiveness of the reductant, if used, in lowering the uranium and trace element concentrations. LC ISR, LLC will monitor the quality of selected wells throughout restoration to determine the effectiveness of the treatment/re-injection phase of groundwater restoration and to determine if additional or alternate techniques are necessary. Restoration at other ISR facilities within Wyoming has shown that the rate of TDS reduction drops off rapidly after five to seven pore volumes of RO treatment and re-injection.

6.2.3.3 Recirculation

At the completion of the groundwater treatment phase in a mine unit, recirculation will be initiated. Recirculation consists of pumping from the mine unit and re-injecting the recovered solution to recirculate solutions and homogenize the groundwater conditions. It is anticipated that one pore volume of groundwater will be recirculated.

The sequence of the activities will be determined by LC ISR, LLC based on operating experience and the wastewater system capacity. Not all phases of the restoration phases will be used if deemed unnecessary.

Once the active restoration activities are completed, LC ISR, LLC will collect groundwater samples to determine if the restoration requirements have been met. If so, LC ISR, LLC will start the stabilization monitoring phase and will submit supporting documentation that the restoration parameters are at or below the restoration standards. If at the end of restoration activities the parameters are not at or below the standards, LC ISR, LLC will either re-initiate certain of the restoration phases or submit documentation to the agencies that BPT has been used in restoration. The documentation will include an evaluation of the water quality data and a narrative of the restoration techniques used.

6.2.4 Stabilization Phase

Upon completion of restoration, a groundwater stabilization monitoring program will begin in which some or all of the wells used to evaluate restoration success will be sampled once per month for a period of six months. The wells and sampling parameters used to evaluate stability will be based on the overall conditions at the end of restoration with agency approval.

If the analytical results continue to meet the appropriate standards for the mine unit and do not exhibit significant increasing trends, LC ISR, LLC will submit supporting documentation to the regulatory agencies that the restoration parameters have remained at or below the restoration standards and request that the mine unit be declared restored.

6.2.5 Reporting

During the restoration process LC ISR, LLC will perform daily, weekly, and monthly analyses as needed to track restoration progress. These analyses will be summarized, along with the restoration methods, and discussed in the Semiannual Radiological Effluent and Environmental Monitoring Report submitted to NRC. This information will also be included in the final report on restoration.

Upon completion of restoration activities and before stabilization, the wells in the monitor ring, the overlying and underlying monitor wells, and the monitor wells in the pattern area will be sampled for the parameters required per WDEQ-LQD Guidelines 4 and 8, as listed in **Table 6.2-1**. The water quality data from each well in the monitor ring and from each overlying and underlying well will be compared with the baseline water quality data for that well. The average of the water quality data from the monitor wells in the pattern area will be compared with the baseline average from the pattern area. These comparisons will help ensure that the class-of-use criteria have been met and that the oxidation/reduction conditions in the pattern area are such that any residual uranium or other metals are not readily mobile. In addition, the water quality data will be compared with the EPA MCLs, if greater than baseline concentrations, to help ensure the groundwater outside the area exempted for ISR operations will be protective of human health. If the concentrations are at or below those approved by WDEQ and NRC, LC ISR, LLC will submit supporting documentation that the restoration parameters are at or below the restoration standards.

During stabilization, monthly samples will be collected to ensure the oxidation/reduction conditions do not fluctuate significantly. The wells and sampling parameters used to evaluate stability will be based on the overall conditions at the end of restoration with agency approval, except that the six-month sample will be for the parameters required per WDEQ-LQD Guidelines 4 and 8, as listed in **Table 6.2-1**. At the end of a six-month stabilization period, LC ISR, LLC will compile all water quality data obtained during restoration and stabilization and submit a final report to the regulatory agencies with the data and description of the restoration methods. If the analytical results continue to meet the appropriate standards for the mine unit and do not exhibit significant increasing trends, LC ISR, LLC will request the mine unit be declared restored. Following agency approval, mine unit reclamation and plugging and abandonment of wells will be performed as described in **Section 6.3**.

6.3 Mine Unit Reclamation

6.3.1 Preliminary Radiological Surveys and Contamination Control

Throughout the Project, radiation levels of the affected areas and facilities will be monitored for the safety of employees and the environment; and elevated radiation levels will be addressed during the course of the Project. In addition, requirements for spill remediation and for groundwater restoration reduce the likelihood of elevated radiation levels in the mine units and their associated facilities. Therefore, the need for field contamination control prior to reclamation is considered minimal. However, radiological surveys will be conducted prior to dismantling or disposing of any of the mine unit facilities at which radiological materials could be concentrated, such as header houses, pumps, and piping, in accordance with the Contamination Control Program (Program) developed for the Project (**Section 5.7**). Records of the surveys will be maintained in accordance with the Program specifications; and any necessary remediation activities will be conducted in accordance with the SOPs for the Project.

6.3.2 Well Abandonment

Once the NRC and WDEQ review and approve LC ISR, LLC's assessment that the groundwater restoration is complete in a given mine unit, all of the wells will be abandoned in accordance with applicable regulations, unless a well is needed for continued monitoring of another mine unit or retention of the well for future use has been requested and approved. Currently, the applicable well abandonment statutes and rules include:

- Wyoming Statute 35-11-404;
- WDEQ-LQD Rules and Regulations Chapter VIII;
- WDEQ-WQD Rules and Regulations Chapter XI, Section G; and
- WSEO Rules and Regulations Part III, Chapter VI, Section 5.

The regulations will be reviewed prior to well abandonment to ensure that the following procedures are still appropriate.

1) A drill rig, tremie pipe, or similar equipment will be used to ensure proper grouting through the entire length of the well.
2) The grout properties will be: a ten-minute gel strength of at least 20 pounds per 100 square feet and a filtrate volume not to exceed 0.824 cubic inches (13.5 cubic centimeters).

3) The volume of fluid necessary to grout the entire length of the well will be calculated and recorded.
4) A mud and/or water retention pit will be constructed by removing topsoil and subsoil from the pit area near the well. The depth of topsoil removed will be based on the soil characteristics of the area; and the removed material will be stockpiled and protected from wind and water erosion.
5) The grout will be mixed in a manner to ensure the appropriate fluid properties are obtained and will be introduced into the well through the drill pipe to the bottom of the well. The grout will be pumped until the grout rises to the well collar. The water displaced from the well will be directed to the water retention pit. The amount of grout pumped into the well will be compared with the calculated volume to ensure there are no major discrepancies, which could indicate bridging or another problem with the abandonment procedure.
6) The well will be left open for at least 24 hours to allow the grout to set.
7) If the grout has settled no more than 40 ft bgs the top of the well will be sealed with bentonite chips, pellets, or additional grouting material will be used. If the grout has settled more than 40 ft bgs, then additional grout will be introduced on top of settled grout through a tremie pipe.
8) Once the grout is set, the soil around the well collar will be excavated so the final plug depth is at least three ft bgs. The well casing above that depth will be removed.
9) A concrete plug will be set in place above the top of the casing, along with a steel plate with the permit number, well identification number, and date of plugging.
10) The excavated soil will be replaced into the hole around the abandoned well and into the mud/water retention pit and leveled with the surrounding surface or mounded slightly above it to ensure depressions are not created.
11) The disturbed area will be reseeded with the seed mixture listed in **Table 6.3-1**.
12) A written well abandonment report will be completed and sent to WSEO.

6.3.3 Facility and Road Reclamation

With the exception of any facilities, access roads, or utility corridors required for the operation of others, all of the facilities associated with a specific header house or mine unit will be removed once groundwater restoration in that header house or mine unit has been deemed complete.

The header houses and pump stations will be moved to new locations in others in the Permit Area or dismantled and disposed of in accordance with applicable regulations. Soil will be replaced at each header house or pump station in accordance with the depths and acreages salvaged during construction, as described in more detail in the Hydrologic Testing Proposal and subsequent Test Report submitted to WDEQ-LQD for review and approval prior to development of each mine unit. Soil replacement and reseeding will be done in accordance with the methods described below in **Section 6.6.**

Topsoil will be windrowed along pipeline routes; and buried piping will be excavated. Any contaminated piping will be disposed of at an NRC-licensed facility, and non-contaminated piping will be removed for salvage or for disposal in accordance with applicable regulations. Topsoil along the pipeline route will be re-spread and the disturbed area reseeded with the seed mixture listed in **Table 6.3-1.**

Unless approval for leaving a specific road is obtained for post-mine use, all roads will be reclaimed. Improved or constructed roads will be reclaimed by removal of culverts, removal of road surfacing materials, recontouring, as necessary, preparation of the seed bed, and reseeding in accordance with the procedures outlined below in **Section 6.6.**

Post-reclamation radiological surveys will be conducted in accordance with the methods described below in **Section 6.5.**

6.4 Reclamation and Decommissioning of Processing and Support Facilities

The facilities that require reclamation and decommissioning include:

1) processing and water treatment equipment, which includes tanks, filters, ion-exchange columns, pipes, pumps, and related equipment;
2) buildings and structures, processing facilities, shipping areas, and offices;
3) waste storage, treatment, and disposal facilities, including the UIC Class I wells;
4) buried pipes;
5) engineering control structures, such as dams and culverts; and
6) roads.

With the exception of any facilities, including roads, approved for post-operational use, all of the facilities associated with the Project will be removed once uranium processing operations have been completed. Approval for post-operational use must be supported by the landowners and/or lessees request, and approval from the BLM, which is the surface management agency of the Permit Area, and WDEQ. If any facility, including a road, is left post-operations, the responsibility for long-term maintenance and ultimate reclamation of the facility or road will be transferred to the accepting party.

6.4.1 Preliminary Radiological Surveys and Contamination Control

Throughout the Project, radiation levels of the affected areas and facilities will be monitored for the safety of employees and the environment; and elevated radiation levels will be addressed during the course of the Project. In addition, requirements for spill remediation and similar 'quick response' actions reduce the extent of contamination. Therefore, the need for contamination control prior to reclamation is expected to be confined to the equipment related to uranium concentration and shipping. However, radiological surveys will be conducted prior to dismantling or disposing all of the facilities in accordance with the Program developed for the Project (**Section 5.7**). Records of the surveys will be maintained in accordance with the Program specifications; and any remediation activities necessary prior to further decommissioning will be conducted in accordance with the SOPs for the Project.

6.4.2 Removal and Disposal of Equipment and Structures

Prior to demolition of the buildings and structures, all equipment will be decontaminated, if necessary, based on preliminary radiological surveys. Particular attention will be given to equipment and structures in which radiological materials could accumulate, including piping, traps, junctions, and access points. Radiological materials will either be decontaminated to NRC unrestricted release standards or removed for disposal at an NRC-licensed facility. Processing and water treatment equipment, including tanks, filters, ion exchange columns, pipes, and pumps, will be prepared, including decontamination if necessary, for use at another location or dismantled and disposed of in accordance with applicable regulations. Radiologically contaminated materials will be disposed of at an NRC-licensed facility; and materials contaminated with other industrial constituents will be disposed of at an appropriately licensed facility. Decontaminated and non-contaminated materials will be removed for salvage, disposed of on-site at a designated location and depth, or disposed of at an appropriately licensed solid waste facility. Any materials disposed of on-site will be covered with a minimum of four feet of overburden and topsoil, over any other required cover. The contours of the disposal area shall blend with those of the surrounding area.

Structures will be decontaminated, if necessary, and moved to a new location, salvaged, or dismantled and disposed of on-site at a designated location and depth, or disposed at an appropriately licensed solid waste facility. Concrete flooring, foundations, and foundation materials will be decontaminated, if necessary, broken up, and either buried in place, disposed of at a designated location and depth on-site, or disposed of at an appropriately licensed facility. Any materials disposed of on-site will be covered with a minimum of four feet of overburden and topsoil, over any other required cover. The contours of the disposal area shall blend with those of the surrounding area.

Records of equipment decontamination, distribution, disposal, and related decommissioning activities will be maintained in accordance with the specifications of the Program (**Section** 5.7); and any necessary decontamination activities will be conducted in accordance with the SOPs for the Project.

Soil will be replaced at sites from which structures are removed in accordance with the depths and acreages salvaged prior to installation of the structures as described in **Section 3.0** (Proposed Operations). Soil replacement and reseeding will be done in accordance with the methods described below in **Section 6.6**.

6.4.3 Waste Storage, Treatment, and Disposal Facilities

Those facilities for which a separate license has been obtained, e.g., a UIC Class I Well for process water injection, will be transferred to another owner or operator in accordance with applicable requirements or reclaimed in accordance with the separate license requirements.

Any sludge accumulation in the Storage Ponds, the pond liner, and, if necessary, the leak detection equipment will be removed, in accordance with the SOP for handling of contaminated materials, and disposed of at an NRC-licensed facility. The soil underneath the pond will be surveyed for radiological contamination, and any areas in which concentrations exceed limits for unrestricted use will be excavated and the contaminated material disposed of at an NRC-licensed facility. Confirmation surveying and sampling will be conducted in accordance with applicable requirements to ensure all contaminated material has been removed. The area will then be reclaimed in accordance with the procedures outlined above in **Section 6.4.2**.

All other waste facilities will be reclaimed in accordance with the procedures outlined above in **Section 6.4.2**.

6.4.4 Buried Piping and Engineering Control Structures

Buried piping and engineering control structures will be decontaminated and removed. All the reclamation will be done in accordance with the procedures outlined above in **Section 6.4.2**.

6.4.5 Roads

Improved or constructed roads will be reclaimed by removal of culverts, removal of road surfacing and road bed materials, and recontouring, as necessary. Unimproved roads will be recontoured, if necessary, and scarified, ripped, or disced to reduce compaction. The roads will then be reclaimed through preparation of the seed bed and reseeding, in accordance with the procedures outlined below in **Section 6.6**.

6.5 Post-Reclamation and Decommissioning Radiological Surveys

Gamma surveys will be conducted in the Permit Area, at all locations affected by the Project activities, once all of the equipment and facility removal is complete in a given area. As header houses and mine units are reclaimed, the radiological surveys will be conducted prior to reseeding; so if elevated concentrations are found, remedial actions can be taken without jeopardizing revegetation success.

6.5.1 Determination of Site Soil Cleanup Criteria

The pre-existing baseline conditions are presented in **Section 2.9** of this report. Elevated radiation levels resulting from the prior exploration activities and from naturally-occurring conditions will be used in the calculation of appropriate cleanup levels.

6.5.2 Soil Verification Survey Methodology

The post-reclamation surveys will be conducted using the same methodology as used for the baseline monitoring, although the coverage will only extend over the areas impacted by the Project activities.

6.6 Soil Replacement and Revegetation

Areas in which reclamation will be required within the Permit Area include the mine units, in particular where the header houses and roads have been removed, and the Plant area. Disturbed areas will be reclaimed to the approved post-operations land use by regrading the surface to the approximate pre-operations contour, re-establishing drainages, replacing salvaged soil, and revegetating the areas, in accordance with the procedures outlined below.

6.6.1 Post-Operational Land Use

The post-operations land use will be livestock grazing and wildlife habitat, which is the same as the pre-operations land use. Buildings, roads, wells, or other facilities constructed as part of the Project will be removed and the disturbance reclaimed, unless prior approval in obtained from the NRC and WDEQ to leave the facilities in place to improve post-operational access or land use.

6.6.2 Surface Preparation

Disturbed surfaces will be graded to approximate pre-operational contours and drainage patterns. Seed bed preparation will be performed under appropriate soil and climatic conditions. In areas where soil was not removed but was compacted due to site operations, e.g., two-track roads used to access monitor wells, soils will be scarified, ripped, or disced as necessary to aid in revegetation. In areas where soil was removed, the disturbed areas will be scarified, ripped, or disced as necessary to ensure soil stability after replacement.

6.6.3 Soil Replacement

Soils will be replaced where excavated, whenever possible. Due to the relatively uniform soil characteristics across the site, the similarity of the topsoil and subsoil, and the relative thinness of the topsoil and subsoil, separate handling of the topsoil and subsoil is not required, as described in **Section 3.1.1** of the Operations Plan. The soil thickness will generally be uniform and approximate the disturbance thickness. The replacement will be along the contour, where necessary to prevent soil erosion. To avoid clods, soils will not be replaced when the ground is wet or frozen. The replaced topsoil will be disced to create a proper seed bed.

6.6.4 Seed Mix, Reseeding Methods, and Fencing

The permanent seed mix and seeding rates for revegetation of the Permit Area are provided in **Table 6.3-1**. This seed mix will adequately support the post-operational land uses, livestock grazing and wildlife habitat, and was approved by Mark Newman of the BLM Rawlins Office on November 17, 2006 and by Melissa Bautz of the WDEQ-LQD Lander Field Office on November 3, 2006 (e-mail communications). If any of the approved seed is unavailable or prohibitive in cost at the time of seeding, other locally adapted and certified seed may be substituted with prior approval of BLM and WDEQ-LQD.

Two methods of seeding, pit and broadcast, will be used. Seeding will be performed as a continuous operation when conditions allow. In general, seeding will be completed during the spring or fall, whichever is the first normal period for favorable planting after the seed bed preparation.

Pit seeding will be the primary method. Areas with little gradient will be pit seeded with the rows of pits perpendicular to the direction of the prevailing wind. Where necessary to prevent erosion, pit seeding will be done along the contour. Pit seeding increases the likelihood of successful vegetation in the Permit Area by sheltering seeds from aeolian erosion and capturing moisture in the area of the seed.

Broadcast seeding will be performed on any steep slopes and drainage areas that may be disturbed in the Permit Area. The seed will be distributed uniformly over the area using a mechanical seed spreader.

Immediately after seeding, the areas will be raked or dragged along the contour. This will cover the seeds with approximately one-quarter inch of soil.

Temporary fencing may be installed to restrict access to reseeded areas until vegetation is successfully re-established. The fence specifications follow those of the BLM. Upon demonstration of successful revegetation, the fencing will be removed.

6.6.5 Revegetation Success Criteria

Revegetation shall be deemed complete no earlier than the fifth full growing season after seeding and when:

- the revegetation is self-renewing under the site conditions;
- the total vegetation cover of perennial species (excluding noxious weed species) and any species in the approved seed mix is at least equal to the total vegetation cover of perennial species (excluding noxious weed species) before operations;
- the species diversity and composition are suitable for the post-operational land use; and
- the total vegetation cover and species diversity and composition are quantitatively assessed in accordance with procedures approved by WDEQ-LQD.

Because many of the reclaimed areas are relatively small in comparison with the Permit Area and because of the similarity of the vegetation communities at the site, LC ISR, LLC will delineate a comparison area in an undisturbed portion of the site at least six months prior to evaluation of revegetation success. In addition, LC ISR, LLC will describe the quantitative methods to be used for comparing the total vegetation cover in the reclaimed and undisturbed areas and for evaluating species diversity and composition. These methods, as well as the size and location of the comparison area, will be submitted to WDEQ-LQD for review and approval at least six months prior to the fifth full growing season.

6.7 Decommissioning Health Physics and Radiation Safety

All decommissioning activities will be conducted in accordance with the same procedures used during ISR operations, as described in the Contaminant Control Program in **Section 5.7.2**.

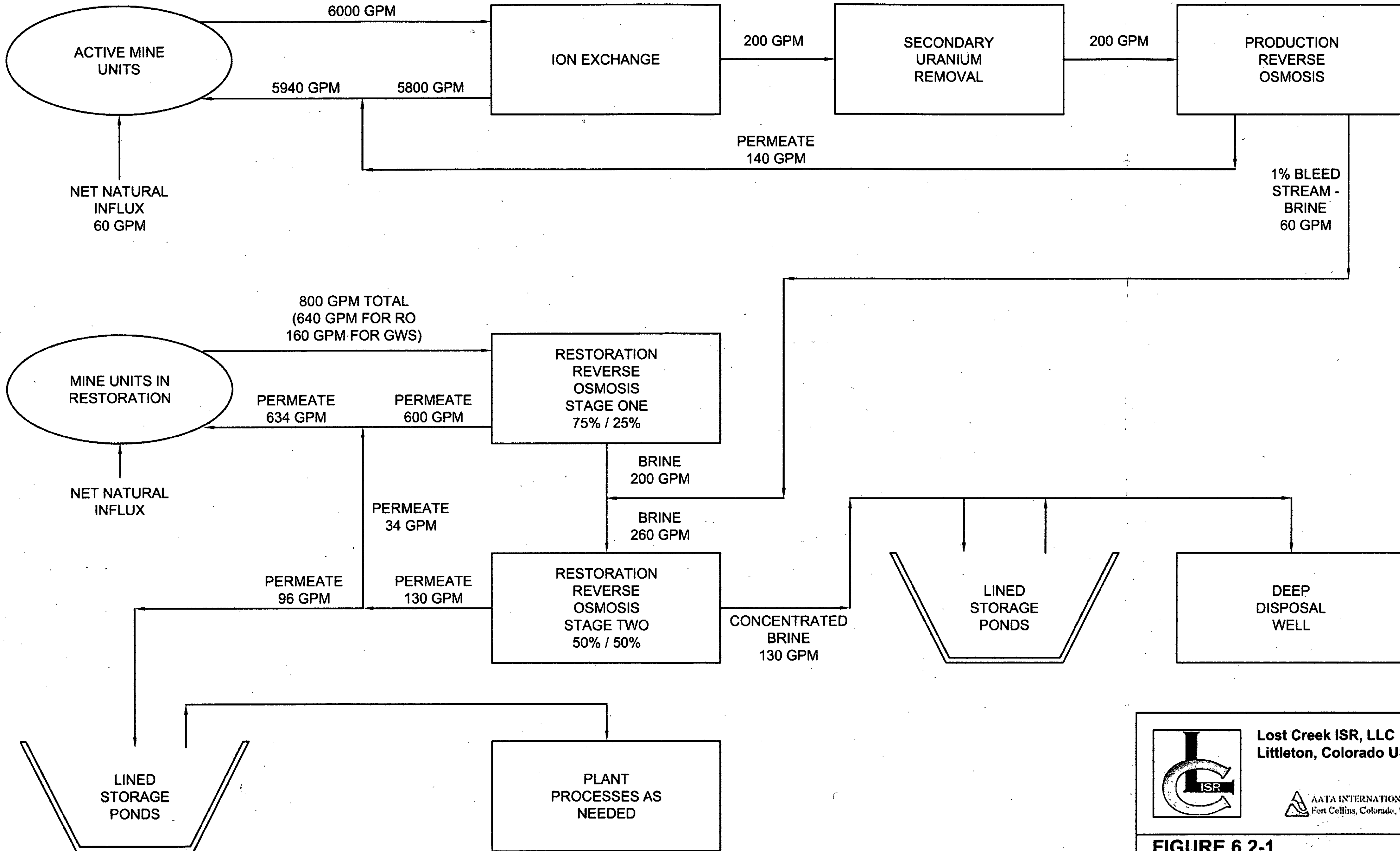
6.8 Financial Assurance

LC ISR, LLC will establish and maintain appropriate surety arrangements with NRC and WDEQ to cover the costs of groundwater restoration, radiological decontamination, facility decommissioning, and surface reclamation. The surety will be reviewed annually and adjusted to reflect changes in cost and in the Project.

The surety estimate for the Project, including surface reclamation of all the facilities and groundwater restoration of the first mine unit, is $4,630,000. Restoration costs for additional mine units will be added to the surety as the mine units are brought online. A detailed description of this surety estimate is provided in **Table 6.8-1**. The table includes a summary page and a series of worksheets with itemized costs for the reclamation and restoration activities. Each worksheet covers a particular task or associated tasks, such as Building Demolition. Worksheets are provided for:

- Groundwater Restoration,
- Building Demolition (including disposal),
- Pond Reclamation (including disposal of pond materials),
- Well Abandonment,
- Mine Unit Equipment, and
- Topsoil and Revegetation;

along with two worksheets, which provide information on quantities and weights of equipment for the demolition calculations.



MINE UNIT OPERATIONS AT 6,000 GPM
WITH A 1% BLEED (60 GPM)

Lost Creek ISR, LLC
Littleton, Colorado USA

AATA INTERNATIONAL, INC.
Fort Collins, Colorado, USA

FIGURE 6.2-1
Restoration Flow Diagram
Lost Creek Permit Area

Issued For: NRC TR 1.0 Drawn By: SMH
Issued / Revised: 10.15.2007
Drawing No. NRCTR 1.0 FIG 6.2-1 10.15.2007 SMH

Table 6.2-1 **Restoration Groundwater Quality Parameters** (Page 1 of 2)

Parameter	WDEQ/LQD Guidelines 4 & 8 [1]	WDEQ/WQD Groundwater Classification Standards [2]			EPA MCLs [3]
		Class I Domestic	Class II Agriculture	Class III Livestock	
GENERAL CHEMISTRY					
Total Dissolved Solids (mg/L)	3	500	2,000	5,000	-
Conductivity - field measured (μmhos)	3	-	-	-	
pH-field measured (su)	3	6.5 to 8.5	4.5 to 9.0	6.5 to 8.5	-
Temperature – field measured	3	-	-	-	-
Alkalinity	3	-	-	-	-
MAJOR IONS (mg/L)					
Calcium-dissolved	3	-	-	-	-
Potassium-dissolved	3	-	-	-	-
Magnesium-dissolved	3	-	-	-	-
Sodium-dissolved	3	-	-	-	-
Bicarbonate	3	-	-	-	-
Carbonate	3	-	-	-	-
Chloride-dissolved	3	250	100	2,000	-
Silica - dissolved	3	-	-	-	-
Sulfate	3	250	200	3,000	-
Ammonia Nitrogen as Nitrogen (as NH_3)	3	0.50	-	-	-
Nitrate + Nitrite as Nitrogen	3	-	-	100.0	10.0
Fluoride	3	4.0	-	-	4.0
TRACE METALS (mg/L)					
Aluminum-dissolved	3	-	5.0	5.0	-
Arsenic-dissolved	3	0.05	0.1	0.2	0.01
Barium-dissolved	3	2.0	-	-	2.0
Boron	3	0.75	0.75	5.0	-
Cadmium-dissolved	3	0.005	0.01	0.05	0.005

Table 6.2-1 **Restoration Groundwater Quality Parameters** (Page 2 of 2)

Parameter	**WDEQ/LQD Guidelines 4 & 8** [1]	**WDEQ/WQD Groundwater Classification Standards** [2]			**EPA MCLs** [3]
		Class I Domestic	**Class II Agriculture**	**Class III Livestock**	
Chromium-dissolved	3	0.10	0.1	0.05	0.1
Copper-dissolved	3	1.0	0.2	0.5	1.3
Iron-total and dissolved	3	0.3	5.0	-	-
Lead-dissolved	3	0.015	5.0	0.1	0.015
Manganese-total	3	0.05	0.2	-	-
Mercury-dissolved	3	0.002	-	0.00005	0.002
Molybdenum-dissolved	3	-	-	-	-
Nickel-dissolved	3	-	0.2	-	-
Selenium-dissolved	3	0.05	0.02	0.05	0.05
Vanadium	3	-	0.1	0.1	-
Zinc-dissolved	3	5.0	2.0	25.0	-
RADIONUCLIDES (pCi/L)					
Gross Alpha [4]	3	15.0	15.0	15.0	15.0
Gross Beta	3	-	-	-	- [5]
Radium-226 + 228	3	5.0	5.0	5.0	5.0
Uranium - dissolved	3	-	-	-	0.03

1 http://deq.state.wy.us/lqd/guidelines.asp.

2 http://deq.state.wy.us/wqd/WQDrules/Chapter_08.pdf. The above list is from Table I in Chapter 8 of the WDEQ/WQD Rules. There are broad narrative standards as well in Chapter 8, Section 4(d)), and the Table I in Chapter 8 also lists other parameters such as Sodium Adsorption Ratio (SAR). However, the parameters listed above are the ones of most concern for ISR operations.

3 Maximum Contaminant Levels, http://www.epa.gov/safewater/contaminants/index.html.

4 The gross alpha standard for WDEQ/WQD includes Ra-226 but excludes radon and uranium.

5 The MCL for gross beta is given as an exposure rate (4 mrem/year), which is addressed through the radiological monitoring for the site decommissioning.

Table 6.2-2 Typical Specification Data for Removal of Ion Constituents *

Parameter	Symbol and Ionic Charge	Percent Rejected
CATIONS		
Aluminum	Al^{+3}	≥ 99
Ammonium	NH_4^{+1}	88 to 95
Cadmium	Cd^{+2}	96 to 98
Calcium	Ca^{+2}	96 to 98
Copper	Cu^{+2}	98 to 99
Hardness	Ca^{+2} and Mg^{+2}	96 to 98
Iron	Fe^{+2}	98 to 99
Magnesium	Mg^{+2}	96 to 98
Manganese	Mn^{+2}	98 to 99
Mercury	Hg^{+2}	96 to 98
Nickel	Ni^{+2}	98 to 99
Potassium	K^{+1}	94 to 96
Silver	Ag^{+1}	94 to 96
Sodium	Na^{+1}	94 to 96
Strontium	Sr^{+2}	96 to 99
Zinc	Zn^{+2}	98 to 99
ANIONS		
Bicarbonate	HCO_3^{-1}	95 to 96
Borate	$B_4O_7^{-2}$	35 to 70
Bromide	Br^{-1}	94 to 96
Chloride	Cl^{-1}	94 to 95
Chromate	CrO_4^{-2}	90 to 98
Cyanide	CN^{-1}	90 to 95
Ferrocyanide	$Fe(CN)_6^{-3}$	≥ 99
Fluoride	F^{-1}	94 to 96
Nitrate	NO_3^{-1}	95
Phosphate	PO_4^{-3}	≥ 99
Silicate	SiO_2^{-1}	80 to 95
Sulfate	SO_4^{-2}	≥ 99
Sulfite	SO_3^{-2}	98 to 99
Thiosulfate	$S_7O_3^{-2}$	≥ 99

* (Osmonics, Inc.)

Table 6.3-1 Permanent Seed Mixture

Common Name	Scientific Name	Application (pounds per acre)
Thickspike wheatgrass	*Agropyron dasystacum*	4.0
Slender wheatgrass	*Agropyron trachycaulum*	2.5
Western wheatgrass	*Agropyron smithii*	2.0
Indian ricegrass	*Achnatherum hymenoides*	2.0
Prairie sandreed	*Calamovilfa longifolia*	2.0
Great Basin wildrye	*Leymus cinereus*	2.0
Winterfat	*Ceratoides lanata*	1.5
Sandberg bluegrass	*Poa secunda*	1.5
Big Sagebrush	*Artemesia tridentata*	1.0
Rubber Rabbitbrush	*Ericameria nauseosa*	1.0
TOTAL		19.5

TABLE 6.8-1 Surety Estimate (Page 1 of 35)

Lost Creek ISR, LLC
SUMMARY OF RECLAMATION/RESTORATION BOND ESTIMATE

I GROUNDWATER RESTORATION - Worksheet 1:	$1,662,495
II DECOMMISSIONING AND SURFACE RECLAMATION:	
A. Plant Equipment Removal and Disposal Worksheet 2	$73,968
B. Plant Building Demolition and Disposal Worksheet 3	$357,441
C. Storage Pond Sludge and Liner Handling Worksheet 4	$417,612
D. Well Abandonment Worksheet 5	$426,069
E. Wellfield Equipment Removal and Disposal Worksheet 6	$271,982
F. Topsoil Replacement and Revegation Worksheet 7	$72,944
G. Miscellaneous Reclamation Activities Worksheet 8	$73,347
Sub Total - Decommissioning and Surface Reclamation	$1,693,364

TABLE 6.8-1 Surety Estimate (Page 2 of 35)

Lost Creek ISR, LLC
SUMMARY OF RECLAMATION/RESTORATION BOND ESTIMATE

SUBTOTAL RESTORATION AND RECLAMATION		$3,355,859
Miscellaneous Costs Associated with Third Party Contractors		
Project Design	2%	
Contractor Profit & Mobilization	8%	
Pre-construction Investigation	1%	
Project Management	5%	
On-site monitoring	0.5%	
Site Security & Liability Assurance	1%	
Longterm Administration	2%	
Contingency	15%	
TOTAL CONTINGENCY	34.5%	$1,157,771
TOTAL RESTORATION AND RECLAMATION		$4,513,630

Table 6.8-1 Surety Estimate (Page 3 of 35)
Lost Creek ISR, LLC
Restoration and Reclamation Costs

WORKSHEET 1
GROUNDWATER RESTORATION

	Mine Unit #1	Explanation	Source
Technical Assumptions:			
Wellfield Area (Ft²)	1,784,484	Proposed area	Data
Wellfield Area (Acres)	40.97		Calculated
Affected Ore Zone Area (Ft²)	1,784,484	Proposed area affected	Data
Avg Completed Thickness (Ft)	12.0	Proposed thickness	Data
Affected Volume:			
Factor For Vertical Flare	10%	Vertical flare estimate	Estimated
Factor For Horizontal Flare	10%	Horizontal flare estimate	Estimated
Total Volume (Ft³)	25,910,708	=A * T * Vert Flare * Hor Flare	Calculated
Porosity	26.0%	Typical value for host sand	Data
Gallons Per Cubic Foot	7.48		Conversion Factor
Gallons Per Pore Volume	50,391,144	=Volume * Porosity * Gal/ft^3	Calculated
Number of Wells in Unit(s)			
Production Wells	180	Proposed well count	Data
Injection Wells	360	Proposed well count	Data
Monitor Wells	64	Proposed well count	Data
Average Well Spacing (Ft)	95	Proposed well spacing	Data
Average Well Depth (Ft)	500	Proposed well depth	Data

Table 6.8-1 **Surety Estimate** (Page 4 of 35)
Lost Creek ISR, LLC
Restoration and Reclamation Costs

WORKSHEET 1
GROUNDWATER RESTORATION

	Mine Unit #1	Explanation	Source
I GROUNDWATER SWEEP			
A. PLANT & OFFICE			
Operating Assumptions:			
Flowrate (gpm)	160	Planned flow	Data
PV's Required	1.0	Required value	Data
Total Gallons For Treatment	50,391,144	=Gal/Pore Volume * # Pore Volumes	Calculated
Total KGals for Treatment	50,391		Calculated
Cost Assumptions:			
Power			
Avg Connected Hp	40.00	Proposed pump horsepower	Data
Kwh's/Hp	0.746		Conversion Factor
$/Kwh	$0.060	Estimate based on tarriff	Unit Rate
Gallons Per Minute	160	Planned rate	Data
Gallons Per Hour	9600		Calculated
Cost Per Hour	$1.79		Calculated
Cost Per Gallon	$0.00019		Calculated
Cost Per KGal ($)	$0.187		Calculated
Chemicals			
Antiscalent ($/Kgals)	$0.120	Based on req'd dosage/estimated cost	Unit Rate
Repair & Maintenance ($/KGals)	$0.070	Estimate	Unit Rate
Analysis ($/KGals)	$0.060	On site laboratory analysis	Unit Rate
Total Cost Per KGal	$0.437		Calculated
Total Treatment Cost	$21,996		Calculated

Table 6.8-1 **Surety Estimate** (Page 5 of 35)
Lost Creek ISR, LLC
Restoration and Reclamation Costs

WORKSHEET 1
GROUNDWATER RESTORATION

	Mine Unit #1	Explanation	Source
I GROUNDWATER SWEEP (cont.)			
Utilities			
Power ($/Month)	$225	Estimate	Unit Rate
Propane ($/Month	$225	Estimate	Unit Rate
Time For Treatment			
Minutes For Treatment	314,945	=Total Gal for treatment / Flowrate (gpm)	Calculated
Hours For Treatment	5,249		Calculated
Days For Treatment	219		Calculated
Average Days Per Month	30.4		Calculated
Months For Treatment	7.2		Calculated
Utilities Cost ($)	$3,236		Calculated
TOTAL PLANT & OFFICE COST	$25,231		
B. WELLFIELD			
Cost Assumptions:			
Power			
Avg Flow/Pump (gpm)	32	Estimate from pumping	Data
Avg Hp/Pump	5.00	Estimate from pumping	Data
Avg # of Pumps Required	5.0	Estimate from pumping	Data
Avg Connected Hp	30.0	Pumps plus 5 hp for HH	Data
Kwh's/Hp	0.746		Conversion Factor
$/Kwh	$0.060	Estimate based on tarriff	Unit Rate
Gallons Per Minute	160	Planned flow	Data
Gallons Per Hour	9600		Calculated
Cost Per Hour ($)	$1.34		Calculated
Cost Per Gallon ($)	$0.0001		Calculated
Cost Per KGal ($)	0.140		Calculated
Repair & Maintenance ($/KGals)	$0.230	Estimate	Unit Rate
Total Cost Per KGal	$0.370		Calculated
TOTAL WELLFIELD COST	$18,638		Calculated
TOTAL GROUND WATER SWEEP COST	$43,870		Calculated

Table 6.8-1 Surety Estimate (Page 6 of 35)
Lost Creek ISR, LLC
Restoration and Reclamation Costs

WORKSHEET 1
GROUNDWATER RESTORATION

	Mine Unit #1	Explanation	Source
II REVERSE OSMOSIS			
A. PLANT & OFFICE			
Operating Assumptions:			
Flowrate (gpm)	640	Estimate from pumping	Data
PV's Required	5.0	Required value	Data
Total Gallons For Treatment	251,955,721	=Gal/Pore Volume * # of Pore Volume	Calculated
Total KGals for Treatment	251,956		Calculated
Feed to RO (gpm)	640	Planned flow	Data
Permeate Flow (gpm)	480	=Planned flow * Avg RO Recovery	Calculated
Brine Flow (gpm)	160	= Planned flow - Permeate flow	Calculated
Average RO Recovery	75.0%	RO design	Data
Cost Assumptions:			
Power			
Avg Connected Hp	300.00	Average value for each area	Data
Kwh's/Hp	0.746		Conversion Factor
$/Kwh	$0.060	Estimate based on tarriff	Unit Rate
Gallons Per Minute	640	Planned flow	Data
Gallons Per Hour	38400		Calculated
Cost Per Hour ($)	$13.43		Calculated
Cost Per Gallon ($)	$0.00035		Calculated
Cost Per KGal ($)	$0.350		Calculated

Table 6.8-1 Surety Estimate (Page 7 of 35)
Lost Creek ISR, LLC
Restoration and Reclamation Costs

WORKSHEET 1
GROUNDWATER RESTORATION

	Mine Unit #1	Explanation	Source
II REVERSE OSMOSIS (cont.)			
Chemicals			
Sulfuric Acid ($/KGals)	$0.090	Estimate	Unit Rate
Caustic Soda ($/KGals)	$0.023	Estimate	Unit Rate
Reductant ($/KGals)	$0.113	Estimate	Unit Rate
Antiscalent ($/Kgals)	$0.124	Based on required dosage/estimated cost	Unit Rate
Repair & Maintenance ($/KGals)	$0.135	Estimate	Unit Rate
Sampling & Analysis ($/KGals)	$0.060	Estimate	Unit Rate
Total Cost Per KGal ($)	$0.895		Calculated
Total Pumping Cost ($)	$225,422		Calculated
Utilities			
Power ($/Month)	$560	Estimate	Unit Rate
Propane ($/Month	$225	Estimate	Unit Rate
Time For Treatment			
Minutes For Treatment	393,681		Calculated
Hours For Treatment	6,561		Calculated
Days For Treatment	273		Calculated
Average Days Per Month	30.4		Calculated
Months For Treatment	9.0		Calculated
Utilities Cost ($)	$7,065		Calculated
TOTAL PLANT & OFFICE COST	$232,487		Calculated

Table 6.8-1 Surety Estimate (Page 8 of 35)
Lost Creek ISR, LLC
Restoration and Reclamation Costs

WORKSHEET 1
GROUNDWATER RESTORATION

	Mine Unit #1	Explanation	Source
B. WELLFIELD			
Cost Assumptions:			
Power			
Avg Flow/Pump (gpm)	32.00	Average value for each area	Data
Avg Hp/Pump	5.00	Average value for each area	Data
Avg # of Pumps Required	20.0	Average value for each area	Data
Avg Connected Hp	110.0		Calculated
Kwh's/Hp	0.746		Conversion Factor
$/Kwh	$0.060	Estimate based on tarriff	Unit Rate
Gallons Per Minute	640	Planned flow	Data
Gallons Per Hour	38,400		Calculated
Cost Per Hour ($)	$4.92		Calculated
Cost Per Gallon ($)	$0.0001		Calculated
Cost Per KGal ($)	$0.128		Calculated
Repair & Maintenance ($/KGals)	$0.230	Estimate	Unit Rate
Total Cost Per KGal	$0.358		Calculated
TOTAL WELLFIELD COST	$90,255		Calculated
TOTAL REVERSE OSMOSIS COST	$322,742		Calculated

Lost Creek ISR, LLC
Restoration and Reclamation Costs

WORKSHEET 1
GROUNDWATER RESTORATION

	Mine Unit #1	Explanation	Source
III WASTE DISPOSAL WELL			
Operating Assumptions:			
Annual Evaporation Capacity (Gals)	0		Data
Avg. Monthly Evap. Capacity (Gals)	0		Calculated
Total Disposal Requirement			
RO Brine Total Gallons	62,988,930	=Treatment Gal * (1- RO Recvry)	Calculated
RO Brine Total KGallons	62,989		Calculated
Brine Concentration Factor	50%	RO design	Data
Total Concentrated Brine (Gals)	31,494,465	=RO Brine Gallons * Brine Conc. Factor	Calculated
Months of RO Operation	9.0		Calculated
Average Monthly Reqm't (Gallons)	3,499,385	=Total Conc Brine / Months RO Ops	Calculated
Monthly Balance for DDW (Gals)	3,499,385	=Avg Monthly Reqm't - Avg Monthly Evap	Calculated
Total WDW Disposal (Gallons)	31,494,465		Calculated
Total WDW Disposal (KGals)	31,494		Calculated
Cost Assumptions:			
Power			
Avg Connected Hp	100.0	Estimate	Data
WDW Avg Connected Hp	200.0	Estimate	Data
Kwh's/Hp	0.746		Conversion Factor
$/Kwh	$0.060	Estimate based on tarriff	Unit Rate
Gallons Per Minute	150.0	Planned flow	Data
Gallons Per Hour	9000		Calculated
Cost Per Hour ($)	$13.43		Calculated
Cost Per Gallon ($)	$0.0015		Calculated
Cost Per KGal ($)	$1.492		Calculated

Table 6.8-1 Surety Estimate (Page 10 of 35)
Lost Creek ISR, LLC
Restoration and Reclamation Costs

WORKSHEET 1
GROUNDWATER RESTORATION

	Mine Unit #1	Explanation	Source
III WASTEDISPOSAL WELL (cont.)			
Chemicals ($/Kgals)			
RO Antiscalent ($/Kgals)	$0.225	Based on required dosage and cost	Unit Rate
WDW Antiscalent ($/Kgals)	$0.254	Based on required dosage and cost	Unit Rate
Sulfuric Acid ($/Kgals)	$0.315	Estimate	Unit Rate
Corrosion Inhibitor	$0.244	Estimate	Unit Rate
Repair & Maint ($/Kgals)	$0.259	Estimate	Unit Rate
Total Cost Per KGal	$2.789		Calculated
TOTAL WASTE DISPOSAL WELL COST	$87,838		Calculated

	Mine Unit #1	Explanation	Source
IV STABILIZATION MONITORING			
Operating Assumptions:			
Time of Stabilization (mos)	9	Time frame required	Data
Frequency of Analysis (mos)	3	Required sampling	Data
Total Sets of Analysis	3	Required sampling	Data
Cost Assumptions:			
Power ($/Month)	$1,125	Estimate	Unit Rate
Total Power Cost	$10,125		Calculated
Sampling & Analysis (each set)	$4,050	Estimate	Unit Rate
Total Sampling & Analysis Cost ($)	$12,150		Calculated
Utilities ($/Month)	$2,250	Estimate	Unit Rate
Total Utilities Cost ($)	$20,250		Calculated
TOTAL STABILIZATION COST	$42,525		Calculated

Table 6.8-1 Surety Estimate (Page 11 of 35)
Lost Creek ISR, LLC
Restoration and Reclamation Costs

WORKSHEET 1
GROUNDWATER RESTORATION

	Mine Unit #1			Explanation	Source
V LABOR					
Cost Assumptions	Cost/Hour	Hours/Year	Cost		
Crew:					
1 Supervisor	$25.00	2080	$52,000	Anticipated operations crew	Data
4 Operators	$20.00	2080	$166,400	Anticipated operations crew	Data
2 Maintenance	$20.00	2080	$83,200	Anticipated operations crew	Data
2 Vehicles	$13.50	2080	$56,160	Anticipated operations crew	Data
Cost per Year			$357,760		
Time Required - Years (After Prod + Stability)	2.0				
TOTAL RESTORATION LABOR COST	$715,520				

VI RESTORATION CAPITAL REQUIREMENTS	
1 Plug and Abandon DDW (2)	$450,000
Total	$450,000

	Mine Unit # 1	TOTAL
SUMMARY:		
I GROUNDWATER SWEEP	$43,870	
II REVERSE OSMOSIS	$322,742	
III WASTE DISPOSAL WELL	$87,838	
IV STABILIZATION	$42,525	
SUB TOTAL	$496,975	$496,975
V LABOR		$715,520
VI CAPITAL		$450,000
TOTAL GROUNDWATER RESTORATION COST		$1,662,495
GRAND TOTAL		**$1,662,495**

Table 6.8-1 Surety Estimate (Page 12 of 35)

WORKSHEET 2
PLANT EQUIPMENT REMOVAL AND DISPOSAL

	Shop / Lab Office	Precipitation Section	Chemical Section	Ion Exchange Section	Restoration Section	Total	Explanation	Source
Volume (Yds³)	68	46	17	111	96		Estimate of equipment to be removed	Data
Quantity Per Truck Load (Yds³)	20	20	20	20	20		Typical load for shipping	Data
Number of Truck Loads	3.4	2.3	0.9	5.6	4.8			Calculated
I Decontamination Cost								
Decontamination Cost ($/Load)	$620	$620	$620	$620	$620		Estimated average decontaminate	Unit Rate
Percent Requiring Decontamination	50.0%	100.0%	0.0%	100.0%	100.0%		% Expected	Data
Total Cost	$1,054	$1,426	$0	$3,441	$2,976	$8,897		Calculated
II Dismantle and Loading Cost								
Cost Per Truck Load ($)	$805	$805	$805	$805	$805		Estimated average dismantle cost	Unit Rate
Total Cost	$2,737	$1,852	$684	$4,468	$3,864	$13,605		Calculated
III Oversize Charges								
Percent Requiring Permits	10.0%	10.0%	10.0%	10.0%	10.0%			Data
Cost Per Truck Load ($)	$367	$367	$367	$367	$367			Unit Rate
Total Cost	$125	$84	$31	$204	$176	$620		Calculated
IV Transportation & Disposal								
A. Landfill								
Percent To Be Shipped	90.0%	50.0%	100.0%	50.0%	50.0%		% acceptable at landfill	Data
Distance (Miles)	48	48	48	48	48		Distance to landfill	Data
Cost Per Mile ($)	$2.90	$2.90	$2.90	$2.90	$2.90		Current Transport rate	Unit Rate
Transportation Cost	$426	$160	$118	$386	$334			Calculated
Disposal Fee Per Cubic Yard	$13.50	$13.50	$13.50	$13.50	$13.50		Landfill fee	Unit Rate
Disposal Cost ($)	$826	$311	$230	$749	$648			Calculated
Total Cost	$1,252	$471	$348	$1,136	$982			Calculated
B. Licensed Site								
Percent To Be Shipped	10.0%	50.0%	0.0%	50.0%	50.0%		% requiring disposal at licensed site	Calculated
Distance (Miles)	105	105	105	105	105		Distance to Shirley Basin	Data
Cost Per Mile ($)	$2.90	$2.90	$2.90	$2.90	$2.90		Current Transport rate	Unit Rate
Transportation Cost	$104	$350	$0	$845	$731			Calculated
Disposal Cost Per Cubic Foot ($)	$12.40	$12.40	$12.40	$12.40	$12.40		Licensed site fee	Unit Rate
Quantity Per Truck Load (Yds³)	20.0	20.0	20.0	20.0	20.0		Typical load for shipping	Data
Quantity Per Truck Load (Ft³)	540	540	540	540	540			Calculated
Disposal Cost	$2,277	$7,700	$0	$18,581	$16,070			Calculated
Total Cost Licensed Site	$2,380	$8,051	$0	$19,426	$16,801			Calculated
Total Cost Transportation & Disposal	$3,632	$8,521	$348	$20,562	$17,783	$50,846		Calculated
TOTAL COST	$7,548	$11,883	$1,063	$28,674	$24,799	$73,968		Calculated

WORKSHEET 3
PLANT BUILDING DEMOLITION AND DISPOSAL

	Plant	Header Houses	Booster Pump Bldgs.	Total	Explanation	
BUILDING DEMOLITION AND DISPOSAL						
Structural Character	2 Story Steel Frame	1 Story Pre Fab (9)	1 Story Pre Fab (2)			
Demolition Volume (ft³)	1,248,000	29,430	6,540		Estimated Volume of Structures	Data
Cost of Demolition Per ft³	$0.1474	$0.1474	$0.1474			Unit Rate
Demolition Cost ($)	$183,955	$4,338	$964	$189,257		Calculation
Factor For Gutting	20.0%	10.0%	10.0%			Data
Cost For Gutting ($)	$36,791	$434	$96	$37,321		Calculation
Weight (pounds)	196,750	99,000	22,000		Estimated weight of building components [1]	Data
Weight per Truckload	40,000	40,000	40,000		Typical load for shipping	Data
Number of Truckloads	4.9	2.5	0.6			Calculation
Distance to Landfill	48	48	48		Distance to landfill	Data
Cost per Mile	$2.90	$2.90	$2.90		Current Transport rate	Unit Rate
Transportation Cost	$685	$345	$77	$1,106		
Disposal Cost per Ton	$40.20	$40.20	$40.20		Landfill fee	Unit Rate
Disposal Cost	$3,955	$1,990	$442	$6,387		Calculation
TOTAL COST	$225,386	$7,106	$1,579	$234,071		Calculation

Table 6.8-1 **Surety Estimate** (Page 14 of 35)

WORKSHEET 3
PLANT BUILDING DEMOLITION AND DISPOSAL

	Plant	Header Houses	Booster Pump Bldgs.	Total	Explanation	
CONCRETE DECONTAMINATION, DEMOLITION & DISPOSAL						
Area (ft²)	30,050	424	94		Building concrete area	Data
Average Thickness (ft)	1	1.0	1.0			Data
Volume (ft³)	30,050	424	94			Calculation
Percent Requiring Decontamination	75.0%	50.0%	50.0%			Data
Percent Decontaminated	75.0%	75.0%	75.0%			Data
Decontamination ($/ft²)	$0.191	$0.191	$0.191			Unit Rate
Decontamination Cost	$4,305	$61	$13	$4,379		Calculation
Demolition ($/ft²)	$2.124	$2.124	$2.124			Unit Rate
Demolition Cost	$63,826	$901	$200	$64,926		Calculation
Transportation & Disposal						
A. Onsite Disposal						
Percent to be Disposed Onsite	90%	90%	90%			Data
Transportation Cost	$0	$0	$0			Data
Disposal Cost per Cubic Foot	$0.055	$0.055	$0.055			Unit Rate
Disposal Cost ($)	$1,487	$21	$5	$1,513		Calculation
B. Licensed Site						
Percent to be Shipped	10%	10%	10%			Calculation
Distance (Miles)	105	105	105			Data
Cost per Mile ($)	$2.90	$2.90	$2.90		Current Transport rate	Unit Rate
Transportation Cost	$1,694	$24	$5	$1,724		Calculation
Disposal Cost per Cubic Foot	$4.16	$4.16	$4.16			Unit Rate
Quantity Per Truck Load (Yds³)	20	20	20			Data
Quantity Per Truck Load (ft³)	540	540	540			Calculation
Disposal Cost ($)	$12,501	$176	$39	$12,716		Calculation
TOTAL COST	$83,814	$1,183	$262	$85,258		Calculation

WORKSHEET 3
PLANT BUILDING DEMOLITION AND DISPOSAL

	Plant	Header Houses	Booster Pump Bldgs.	Total	Explanation	
SOIL REMOVAL & DISPOSAL	Assume removal of 3" of Contaminated Soil Under Primary Areas, Disposal at a Licensed Facility					
Removal, Front End Loader ($50/hr)	$800	$800	$200	$1,800		Data
Quantity to be Shipped (ft³)	6600	810	180			Data
Distance (Miles)	105	105	105			Data
Cost Per Mile ($)	$2.90	$2.90	$2.90			Unit Rate
Transportation Cost ($)	$3,722	$457	$102	$4,280		Calculation
Disposal fee Per Cubic Foot($)	$4.16	$4.16	$4.16			Unit Rate
Quantity per Truckload (ft³)	540	540	540			Data
Disposal Cost ($)	$27,456	$3,370	$749	$31,574		Calculation
TOTAL COST	$31,978	$4,626	$1,050	$37,654		Calculation
RADIATION SURVEY						
Area required (acres)	0.69	0.01	0.00			Data
Survey Cost ($/acre)	$653.00	$653.00	$653.00			Unit Rate
TOTAL SURVEY COST ($)	$450	$6	$1	$457		Calculation
TOTAL COST	$341,627	$12,921	$2,893	$357,441		Calculation

[1] Building Weight Calculation

Ends	2	1	4800	9600
Roof	2	82.5	260	42900
Sidewall	2	20	260	10400
Internal Wall	1	20	460	9200
Internal Wall	1	30	220	6600
				78700
Density	2.5	#/sq. ft.		196750

WORKSHEET 4
POND RECLAMATION COST

	Storage Pond 1	Storage Pond 2	Total	
POND SLUDGE:				
Average Sludge Depth (ft)	0.250	0.250		Data
Average Area of Sludge (ft²)	40,300	40,300		Data
Volume of Sludge (ft³)	10,075	10,075		Calculated
Volume of Sludge (Yds³)	373	373		Calculated
Volume of Sludge Per Truck Load (Yds³)	20.0	20.0		Data
# of Truck Loads of Sludge	18.7	18.7		Calculated
Sludge Handling Cost Per Load ($)	$268.00	$268.00		Unit Rate
Total Sludge Handling Cost ($)	$5,012	$5,012	$10,023	Calculated
Transportation & Disposal				
Percent To Be Shipped	100.0%	100.0%		Data
Distance (Miles)	105	105		Data
Cost Per Mile ($)	$2.90	$2.90		Unit Rate
Transportation Cost ($)	$5,694	$5,694		Calculated
Disposal Cost Per Cubic Foot ($)	$12.38	$12.38		Unit Rate
Quantity Per Truck Load (Yds³)	20.0	20.0		Data
Quantity Per Truck Load (ft³)	540	540		Calculated
Disposal Cost ($)	$125,013	$125,013		Calculated
Total Transportation & Disposal ($)	$130,707	$130,707	$261,414	Calculated
TOTAL SLUDGE COST ($)	$135,719	$135,719	$271,438	Calculated

POND LINER:				
Total Pond Area (Acres)	0.93	0.93		Data
Total Pond Area (ft²)	40,300	40,300		Calculated
Factor For Sloping Sides	20.0%	20.0%		Data
Total Liner Area (ft²)	48360	48360		Calculated
Liner Thickness (Millimeters)	30	30		Data
Liner Thickness (Inches)	0.1181	0.1181		Calculated
Liner Thickness (ft)	0.0098	0.0098		Calculated
"Swell" Factor	25.0%	25.0%		Data
Liner Volume (ft³)	592	592		Calculated
Truck Loads of Liner	1.1	1.1		Calculated
Liner Handling Cost ($)				
Labor Crew Cost per Hour ($)	$135	$135		Unit Rate
Hours per Load	2.0	2.0		Unit Rate
Liner Handling Cost Per Load ($)	$270.00	$270.00		Calculated
Total Liner Handling Cost ($)	$297	$297	$594	Calculated
Transportation & Disposal				
Percent To Be Shipped	100.0%	100.0%		Data
Distance (Miles)	105	105		Data
Cost Per Mile ($)	$2.90	$2.90		Unit Rate
Transportation Cost ($)	$335	$335		Calculated
Disposal Cost Per Cubic Foot ($)	$12.38	$12.38		Unit Rate
Quantity Per Truck Load (ft³)	540	540		Data
Disposal Cost ($)	$7,354	$7,354		Calculated
Total Transportation & Disposal ($)	$7,689	$7,689	$15,377	Calculated
TOTAL LINER COST ($)	$7,986	$7,986	$15,971	Calculated

WORKSHEET 4
POND RECLAMATION COST

	Storage Pond 1	Storage Pond 2	Total	
POND BACKFILL:				
Backfill required (Yds^3)	10,448	10,448		Data
Backfill Cost ($\$/Yd^3$)	$1.13	$1.13		Unit Rate
TOTAL BACKFILL COST ($)	$11,806	$11,806	$23,612	Calculated
RADIATION SURVEY				
Areal required (acres)	1.02	1.02		Data
Survey Cost ($/acre)	$653.00	$653.00		Unit Rate
TOTAL SURVEY COST ($)	$665	$665	$1,330	Calculated
LEAK DETECTION SYSTEM REMOVAL				
Volume of Gravel and Piping (ft^3) (Assume 3")	10075	10075		Data
Quantity per Truckload (ft^3)	540	540		Data
Quantity to be Shipped (Loads)	18.7	18.7		Calculated
Distance (Miles)	105	105		Data
Cost per Mile ($)	$2.90	$2.90		Unit Rate
Transportation Cost ($)	$5,681	$5,681		Calculated
Handling Cost	$5,038	$5,038		Unit Rate (Imbedded)
Disposal Fee per Cubic Foot ($)	$4.16	$4.16		Unit Rate
Disposal Cost ($)	$41,912	$41,912		Calculated
TOTAL LEAK DETECTION SYSTEM REMOVAL	$52,631	$52,631	$105,261	Calculated
TOTAL POND RECLAMATION COST	$208,806	$208,806	$417,612	Calculated

Table 6.8-1 Surety Estimate (Page 18 of 35)

WORKSHEET 5
WELL ABANDONMENT

	Mine Unit # 1	Source
Number of Wells	605	Data
Average Depth (feet)	500	Data
Average Diameter (inches)	4.5	Data
Materials		
Class G Neat Cement Required (ft³/Well)	55.2	Data
Sacks of Cement Required/Well [1]	43.1	Data
Cost Per Sack Cement ($)	$12.00	Unit Rate
Cost/Well Cement ($)	$517.72	Calculated
Sacks of Betonies Required/Well	1.2	Data
Cost Per Bag Betonite ($)	$2.90	Calculated
Cost/Well Betonies ($)	$3.53	Unit Rate
Total Materials Cost per Well	$521.25	Calculated
Labor		
Hours Required per Well	3.0	Data
Labor Cost per Hour	$45.00	Unit Rate
Total Labor Cost per Well ($)	$135.00	Calculated
Equipment Rental		
Hours Required per Well	1.0	Data
Backhoe w/Operator Cost/Hr ($)	$48.00	Unit Rate
Total Equipment Cost per Well ($)	$48.00	Calculated
Total Cost per Well ($)	$704.25	Calculated
TOTAL WELL ABANDONMENT COST ($)	$426,069	Calculated

[1] 15 ppg Class G cement requires 6 gallons water per sack cement and 1-1/2% betonite by weight

WORKSHEET 6
WELLFIELD EQUIPMENT REMOVAL & DISPOSAL

	Mine Unit # 1	Source
I Wellfield Piping		
A. Removal		
Surface Length/Well (Ft)	250	
Downhole Length/Well (Ft)	350	
Total Number of Wells	540	
Total Quantity (Ft)	324,000	Calculated
Cost of Removal ($/Ft)	$0.217	Unit Rate
Cost of Removal ($)	$70,308	Calculated
Average OD (Inches)	1.6	
Chipped Volume Reduction (Ft^3/Ft)	0.008	Unit Rate
Chipped Volume (Ft^3)	2,592	Calculated
Quantity Per Truck Load (Ft^3)	540	
Total Number of Truck Loads	4.8	Calculated
B. Survey & Decontamination		
Percent Requiring Decontamination	0%	
Loads for Decontamination	0.0	Calculated
Cost for Decontamination ($/Load)	$620.00	Unit Rate
Cost for Decontamination ($)	$0	Calculated
C. Transport & Disposal		
1.) Landfill		
a. Transportation		
Percent To Be Shipped	0.0%	
Loads To Be Shipped	0.0	Calculated
Distance (Miles)	48	
Transportation Cost ($/mile)	$2.90	Unit Rate
Transportation Cost ($)	$0	Calculated
b. Disposal		
Disposal Fee Per Yd^3	$13.50	Unit Rate
Yds^3 Per Load	20	
Disposal Cost ($)	$0	Calculated
Total Cost - Landfill	$0	Calculated
2.) Licensed Site		
a. Transportation		
Percent To Be Shipped	100.0%	Calculated
Loads To Be Shipped	4.8	Calculated
Distance (Miles)	105	
Cost Per Mile ($/mile)	$2.90	Unit Rate
Transportation Cost ($)	$1,462	Calculated
b. Disposal		
Disposal Cost Per Ft^3	$12.38	Unit Rate
Disposal Fee Per Yd^3	$334.26	Calculated
Quantity Per Truck Load (Yds^3)	20	
Disposal Cost ($)	$32,089	Calculated
Total Cost - Licensed Site	$33,551	Calculated
Total Cost - Transport & Disposal	$33,551	Calculated
Total Cost - WF Piping Removal & Disposal	$103,859	Calculated

Table 6.8-1 Surety Estimate (Page 20 of 35)

WORKSHEET 6
WELLFIELD EQUIPMENT REMOVAL & DISPOSAL

						Mine Unit # 1	Source
II	Production Well Pumps						
	A.	Pump and Tubing Removal					
		Number of Production Wells				180	
		Cost of Removal ($/well)				$24.13	Unit Rate
		Cost of Removal ($)				$4,343	Calculated
		Number of Pumps Per Truck Load				180	
		Number of Truck Loads (Pumps)				1.0	Calculated
	B.	Survey & Decontamination (Pumps)					
		Percent Requiring Decontamination				100.0%	
		Loads for Decontamination				1.0	Calculated
		Cost for Decontamination ($/Load)				$620.00	Unit Rate
		Cost for Decontamination ($)				$620	Calculated
	C.	Tubing Volume Reduction & Loading					
		Length per Well (Ft)				400	
		Total Quantity (Ft)				72,000	Calculated
		Cost of Removal ($/Ft)				$0.027	Unit Rate
		Cost of Removal ($)				$1,944	Calculated
		Average OD (Inches)				2.0	
		Chipped Volume Reduction (Ft³/Ft)				0.012	
		Chipped Volume (Ft³)				864	Calculated
		Quantity per Truckload (Ft³)				540	
		Number of Truck Loads				1.6	Calculated
	D.	Transport & Disposal					
		1.)	Landfill				
				a.	Transportation		
					Percent To Be Shipped (Pumps)	0.0%	
					Loads To Be Shipped	0.0	Calculated
					Distance (Miles)	48	
					Cost Per Mile ($/mile)	$2.90	Unit Rate
					Transportation Cost ($)	$0	Calculated
				b.	Disposal		
					Disposal Fee Per Yd³	$13.50	Unit Rate
					Yds³ Per Load	20	
					Disposal Cost ($)	$0	Calculated
			Total Cost - Landfill			$0	Calculated
		2.)	Licensed Site				
				a.	Transportation		
					Percent To Be Shipped (Pumps)	100.0%	
					Percent To Be Shipped (Tubing)	100.0%	
					Loads To Be Shipped	2.6	Calculated
					Distance (Miles)	105	
					Cost Per Mile ($/mile)	$2.90	Unit Rate
					Transportation Cost ($)	$792	Calculated
				b.	Disposal		
					Disposal Cost Per Ft³	$12.38	Unit Rate
					Disposal Fee Per Yd³	$334.26	Calculated
					Quantity Per Truck Load (Yds³)	20	
					Disposal Cost ($)	$17,382	Calculated
			Total Cost - Licensed Site			$18,173	Calculated
		Total Cost - Transport & Disposal				$18,173	Calculated
	Total Cost - Pump Removal & Disposal					$25,081	Calculated

Table 6.8-1 Surety Estimate (Page 21 of 35)

WORKSHEET 6
WELLFIELD EQUIPMENT REMOVAL & DISPOSAL

					Mine Unit # 1	Source
III	Surface Trunkline Piping					
	A.	Removal				
		Total Quantity (Ft)			0	
		Cost of Removal ($/Ft)			$0.161	Unit Rate
		Cost of Removal ($)			$0	Calculated
		Average OD (Inches)			8.750	
		Chipped Volume Reduction (Ft^3/Ft)			0.088	Unit Rate
		Chipped Volume (Ft^3)			0	Calculated
		Quantity Per Truck Load (Ft^3)			540	
		Total Number of Truck Loads			0.0	Calculated
	B.	Survey & Decontamination				
		Percent Requiring Decontamination			0.0%	
		Loads for Decontamination			0.0	Calculated
		Cost for Decontamination ($/Load)			$620.00	Unit Rate
		Cost for Decontamination ($)			$0	Calculated
	C.	Transport & Disposal				
		1.)	Landfill			
			a.	Transportation		
				Percent To Be Shipped	0.0%	
				Loads To Be Shipped	0.0	Calculated
				Distance (Miles)	48	
				Cost Per Mile ($/mile)	$2.90	Unit Rate
				Transportation Cost ($)	$0	Calculated
			b.	Disposal		
				Disposal Fee Per Yd^3	$13.50	Unit Rate
				Yds^3 Per Load	20	
				Disposal Cost ($)	$0	Calculated
			Total Cost - Landfill		$0	Calculated
		2.)	Licensed Site			
			a.	Transportation		
				Percent To Be Shipped	100.0%	Calculated
				Loads To Be Shipped	0.0	Calculated
				Distance (Miles)	105	
				Cost Per Mile ($/mile)	$2.90	Unit Rate
				Transportation Cost ($)	$0	Calculated
			b.	Disposal		
				Disposal Cost Per Ft^3	$12.38	Unit Rate
				Disposal Fee Per Yd^3	$334.26	Calculated
				Quantity Per Truck Load (Yds^3)	20	
				Disposal Cost ($)	$0	Calculated
			Total Cost - Licensed Site		$0	Calculated
		Total Cost - Transport & Disposal			$0	Calculated
	Total Cost - Surface Trunkline Removal & Disposal				$0	Calculated

Table 6.8-1 Surety Estimate (Page 22 of 35)

WORKSHEET 6
WELLFIELD EQUIPMENT REMOVAL & DISPOSAL

					Mine Unit # 1	Source
IV	Buried Trunkline					
	A.	Removal				
		Total Quantity (Ft)			24,304	
		Cost of Removal ($/Buried Ft)			$3.15	Unit Rate
		Cost of Removal ($)			$38,279	Calculated
		Average OD (Inches)			9.635	
		Chipped Volume Reduction (Ft^3/Ft)			0.309	Unit Rate
		Chipped Volume (Ft^3)			7,510	Calculated
		Quantity Per Truck Load (Ft^3)			540	
		Number of Truck Loads			13.9	Calculated
	B.	Survey & Decontamination				
		Percent Requiring Decontamination			0.0%	
		Loads for Decontamination			0.0	Calculated
		Cost for Decontamination. ($/Load)			$620.00	Unit Rate
		Cost for Decontamination. ($)			$0	Calculated
	C.	Transport & Disposal				
		1.)	Landfill			
			a.	Transportation		
				Percent To Be Shipped	0.0%	
				Loads To Be Shipped	0.0	Calculated
				Distance (Miles)	48	
				Cost Per Mile ($/mile)	$2.90	Unit Rate
				Transportation Cost ($)	$0	Calculated
			b.	Disposal		
				Disposal Fee Per Yd^3	$13.50	Unit Rate
				Yds^3 Per Load	20	
				Disposal Cost ($)	$0	Calculated
			Total Cost - Landfill		$0	Calculated
		2.)	Licensed Site			
			a.	Transportation		
				Percent To Be Shipped	100.0%	Calculated
				Loads To Be Shipped	13.9	Calculated
				Distance (Miles)	105	
				Cost Per Mile ($/mile)	$2.90	Unit Rate
				Transportation Cost ($)	$4,233	Calculated
			b.	Disposal		
				Disposal Cost Per Ft^3	$12.38	Unit Rate
				Disposal Fee Per Yd^3	$334.26	Calculated
				Quantity Per Truck Load (Yds^3)	20	
				Disposal Cost ($)	$92,924	Calculated
			Total Cost - Licensed Site		$97,157	Calculated
		Total Cost - Transport & Disposal			$97,157	Calculated
	Total Cost - Buried Trunkline Removal & Disposal				$135,436	Calculated

WORKSHEET 6
WELLFIELD EQUIPMENT REMOVAL & DISPOSAL

					Mine Unit # 1	Source
V	Manholes					
	A.	Removal				
		Total Quantity			9	
		Cost of Removal ($ Each)			$146.32	Unit Rate
		Cost of Removal ($)			$1,317	Calculated
		Quantity Per Truck Load			10	
		Number of Truck Loads			0.9	Calculated
	B.	Survey & Decontamination				
		Percent Requiring Decontamination			0.0%	
		Loads for Decontamination			0.0	Calculated
		Cost for Decontamination ($/Load)			$620.00	Unit Rate
		Cost for Decontamination ($)			$0	Calculated
	C.	Transport & Disposal				
		1.)	Landfill			
			a.	Transportation		
				Percent To Be Shipped	0.0%	
				Loads To Be Shipped	0.0	Calculated
				Distance (Miles)	48	Unit Rate
				Cost Per Mile ($/mile)	$2.90	Calculated
				Transportation Cost ($)	$0	
			b.	Disposal		
				Disposal Fee Per Yd³ ($)	$13.50	Unit Rate
				Yds³ Per Load	20	
				Disposal Cost ($)	$0	Calculated
			Total Cost - Landfill		$0	Calculated
		2.)	Licensed Site			
			a.	Transportation		
				Percent To Be Shipped	100.0%	Calculated
				Loads To Be Shipped	0.9	Calculated
				Distance (Miles)	105	
				Cost Per Mile ($/mile)	$2.90	Unit Rate
				Transportation Cost ($)	$274	Calculated
			b.	Disposal		
				Disposal Cost Per Ft³	$12.38	Unit Rate
				Disposal Fee Per Yd³	$334.26	Calculated
				Quantity Per Truck Load (Yds³)	20	
				Disposal Cost ($)	$6,017	Calculated
			Total Cost - Licensed Site		$6,291	Calculated
		Total Cost - Transport & Disposal			$6,291	Calculated
	Total Cost Manhole Removal & Disposal				$7,608	Calculated
TOTAL COST - WELLFIELD EQUIP REMOVAL & DISP					$271,982	Calculated

WORKSHEET 7
TOPSOIL REPLACEMENT & REVEGETATION

	Mine Unit # 1	
I Plant		
A. Topsoil Handling & Grading		
Affected Area (Acres)	5.0	
Average Affected Thickness (Ins)	12.0	
Topsoil Volume (Yds³)	8,067	Calculated
Unit Cost - Haul/Place ($/Yd³)	$1.13	Unit Cost
Topsoil Handling Cost ($)	$9,115	Calculated
Unit Cost - Grading ($/Ac)	$56.28	Unit Cost
Grading Cost ($)	$281	Calculated
Sub Total - Topsoil	$9,397	Calculated
B. Radiation Survey & Soil Analysis		
Unit Cost ($/Ac)	$653.00	Unit Cost
Sub Total - Survey & Analysis	$3,265	Calculated
C. Revegetation		
Fertilizer ($/Ac)	$52.33	Unit Cost
Seeding Prep & Seeding ($/Ac)	$189.85	Unit Cost
Mulching & Crimping ($/Ac)	$311.25	Unit Cost
Sub Total Cost/Acre	$553.43	Calculated
Sub Total - Revegation	$2,767	Calculated
Sub Total - Plant	$15,429	Calculated

II Ponds		
A. Topsoil Handling & Grading		
Affected Area (Acres)	5.0	
Average Affected Thickness (Ins)	12	
Topsoil Volume (Yds³)	8,067	Calculated
Unit Cost - Haul/Place ($/Yd³)	$1.13	Unit Cost
Topsoil Handling Cost ($)	$9,115	Calculated
Unit Cost - Grading ($/Ac)	$56.28	Unit Cost
Grading Cost ($)	$281	Calculated
Sub Total - Topsoil	$9,397	Calculated
B. Radiation Survey & Soil Analysis		
Unit Cost ($/Ac)	$653.00	Unit Cost
Sub Total - Survey & Analysis	$3,265	Calculated
C. Revegation		
Fertilizer ($/Ac)	$52.33	Unit Cost
Seeding Prep & Seeding ($/Ac)	$189.85	Unit Cost
Mulching & Crimping ($/Ac)	$311.25	Unit Cost
Sub Total Cost/Acre	$553.43	Calculated
Sub Total - Revegation	$2,767	Calculated
Sub Total - Ponds	$15,429	Calculated

WORKSHEET 7
TOPSOIL REPLACEMENT & REVEGETATION

	Mine Unit # 1	
III Wellfields		
A. Topsoil Handling & Grading		
Affected Area (Acres)	0.0	
Average Affected Thickness (Ins)	3.5	
Topsoil Volume (Yds³)	0	Calculated
Unit Cost - Haul/Place ($/Yd³)	$1.13	Unit Cost
Topsoil Handling Cost ($)	$0	Calculated
Unit Cost - Grading ($/Ac)	$56.28	Unit Cost
Grading Cost ($)	$0	Calculated
Sub Total - Topsoil	$0	Calculated
B. Radiation Survey & Soil Analysis		
Unit Cost ($/Ac)	$653.00	Unit Cost
Sub Total - Survey & Analysis	$0	Calculated
C: Spill Cleanup		
Affected Area (Acres)	-	Calculated
Affected Area (ft²)	-	
Average Affected Thickness (ft)	0.25	
Affected Volume (ft³)	-	Calculated
Quantity per Truckload (ft³)	540	
Quantity to be Shipped (Loads)	0.0	Calculated
Distance (Miles)	105	
Cost per Mile ($)	$2.90	Unit Cost
Transportation Cost ($)	$0	Calculated
Handling Cost ($200/Load)	$0	Calculated
Disposal Fee per Cubic Foot ($)	$4.16	Unit Cost
Disposal Cost ($)	$0	Calculated
Sub Total - Spill Cleanup	$0	Calculated
D. Revegation		
Fertilizer ($/Ac)	$52.33	Unit Cost
Seeding Prep & Seeding ($/Ac)	$189.85	Unit Cost
Mulching & Crimping ($/Ac)	$311.25	Unit Cost
Sub Total Cost/Acre	$553.43	Calculated
Sub Total - Revegation	$0	Calculated
Sub Total - Wellfields ($)	$0	Calculated

WORKSHEET 7
TOPSOIL REPLACEMENT & REVEGETATION

	Mine Unit # 1		
IV Roads			
A. Topsoil Handling & Grading			
Affected Area (Acres)	11.1		
Average Affected Thickness (Ins)	12		
Topsoil Volume (Yds³)	17,908	Calculated	width (feet)
Unit Cost - Haul/Place ($/Yd³)	$1.13	Unit Cost	borrow (feet)
Topsoil Handling Cost ($)	$20,236	Calculated	total
Unit Cost - Grading ($/Ac)	$56.28	Unit Cost	acres
Grading Cost ($)	$625	Calculated	
Sub Total - Topsoil	$20,861	Calculated	
B. Radiation Survey & Soil Analysis			
Unit Cost ($/Ac)	$653.00	Unit Cost	
Sub Total - Survey & Analysis	$7,248	Calculated	
C. Revegation			
Fertilizer ($/Ac)	$52.33	Unit Cost	
Seeding Prep & Seeding ($/Ac)	$189.85	Unit Cost	
Mulching & Crimping ($/Ac)	$311.25	Unit Cost	
Sub Total Cost/Acre	$553.43	Calculated	
Sub Total - Revegation	$6,143	Calculated	
Sub Total - Roads ($)	$34,252	Calculated	

Main Road Lengths (ft)	Secondary Road Lengths (ft)	
1556		
594		
228		
356	966	
362	391	
211	276	
2309	291	
1260	311	
244	257	
1029	330	
5049	323	
13198	3145	
20	12	
12	8	Total Road
32	20	Area
9.695500459	1.443985308	11.13948577

WORKSHEET 7
TOPSOIL REPLACEMENT & REVEGETATION

	Mine Unit # 1	
V Other		
A. Topsoil Handling & Grading		
Affected Area (Acres)	1.0	
Average Affected Thickness (Ins)	3.0	
Topsoil Volume (Yds³)	403.33	Calculated
Unit Cost - Haul/Place ($/Yd³)	$1.13	Unit Cost
Topsoil Handling Cost ($)	$456	Calculated
Unit Cost - Grading ($/Ac)	$56.28	Unit Cost
Grading Cost ($)	$56	Calculated
Sub Total - Topsoil	$512	Calculated
B. Radiation Survey & Soil Analysis		
Unit Cost ($/Ac)	$653.00	Unit Cost
Sub Total - Survey & Analysis	$653	Calculated
C. Revegation		
Fertilizer ($/Ac)	$52.33	Unit Cost
Seeding Prep & Seeding ($/Ac)	$189.85	Unit Cost
Mulching & Crimping ($/Ac)	$311.25	Unit Cost
Sub Total Cost/Acre	$553.43	Calculated
Sub Total - Revegation	$553	Calculated
Sub Total - Other	$1,718	Calculated
VI Remedial Action		
A. Topsoil Handling & Grading		
Affected Area (Acres)	11.1	
Average Affected Thickness (Ins)	0.0	
Topsoil Volume (Yds³)	0	Calculated
Unit Cost - Haul/Place ($/Yd³)	$1.13	Unit Cost
Topsoil Handling Cost ($)	$0	Calculated
Unit Cost - Grading ($/Ac)	$0.00	Unit Cost
Grading Cost ($)	$0	Calculated
Sub Total - Topsoil	$0	Calculated
B. Radiation Survey & Soil Analysis		
Unit Cost ($/Ac)	$0.00	Unit Cost
Sub Total - Survey & Analysis	$0	Calculated
C. Revegation		
Fertilizer ($/Ac)	$52.33	Unit Cost
Seeding Prep & Seeding ($/Ac)	$189.85	Unit Cost
Mulching & Crimping ($/Ac)	$311.25	Unit Cost
Sub Total Cost/Acre	$553.43	Calculated
Sub Total - Revegation	$6,115	Calculated
Sub Total - Remedial Action	$6,115	Calculated

TOTAL COST - TOPSOIL & REVEGETATION	$72,944

Table 6.8-1 Surety Estimate (Page 28 of 35)

WORKSHEET 8
MISCELLANEOUS RECLAMATION

I	Fence Removal & Disposal		
	Quantity (Feet)	9,500	
	Cost of Removal/Disposal ($/Ft)	$0.68	Unit Cost
	Cost of Removal/Disposal ($)	$6,460	Calculated

II	Powerline Removal & Disposal		
	Quantity (Feet)	15,300	
	Cost of Removal/Disposal ($/Ft)	$1.00	Unit Cost
	Cost of Removal/Disposal ($)	$15,300	Calculated

III	Powerpole Removal & Disposal		
	Quantity	51	
	Cost of Removal/Disposal ($/Each)	$100.00	Unit Cost
	Cost of Removal/Disposal ($)	$5,100	Calculated

IV	Transformer Removal & Disposal		
	Quantity	12	
	Cost of Removal/Disposal ($/Each)	$2,428	Unit Cost
	Cost of Removal/Disposal ($)	$29,131	Calculated

V	Booster Pump Assembly Removal & Disposal		
	Quantity	8	
	Cost of Removal/Disposal ($/Each)	$298	Unit Cost
	Cost of Removal/Disposal ($)	$2,380	Calculated

VI	Culvert Removal & Disposal		
	Quantity (Feet)	200	
	Cost of Removal/Disposal ($/Ft)	$3.48	Unit Cost
	Cost of Removal/Disposal ($)	$696	Calculated

IX	Utilities Cost		
	Quantity (Mos)	6	
	Cost Per Month ($/Month)	$2,380	Unit Cost
	Total Cost ($)	$14,280	Calculated

TOTAL MISCELLANEOUS COST	$73,347	Calculated

Table 6.8-1 Surety Estimate (Page 29 of 35)

Lost Creek ISR, LLC

Equipment and Tank List

Plant Section: 1 **Shop / Lab / Office** **% contamination:** 10%

Concrete:	Quantity (each)	Length (feet)	Width or Area (feet)/(sq ft)	Thickness (feet)	Volume (cu. Feet)	Volume (cu. Yds.)	Contam.	Contam. Volume	
Shop Floor	1	180	40	0.5	3600	133.3	N	0.0	
Lab Floor	1	40	40.5	0.5	810	30.0	Y	30.0	
Office Floor	1	40	80	0.5	1600	59.3	N	0.0	
Perimeter Beam	1	340	1	4	1360	50.4	N	0.0	
Internal Perimeter	1	300	1	2	600	22.2	N	0.0	
					7970	295.2		30.0	10%

Equipment:	Quantity (each)	Length (feet)	Width or Area (feet)/(sq ft)	Thickness (feet)	Volume (cu. Feet)	Volume (cu. Yds.)	Contam.	Contam. Volume	
Lab Tables	1	1	435	3	1305	48.3	Y	48.3	
Air Compressor	1	3	3	2	18	0.7	N	0.0	
Water Heater	2	3	3	6	108	4.0	N	0.0	
Generator	1	6	4	4	96	3.6	N	0.0	
MCC	1	20	2	8	320	11.9	N	0.0	
					1847	68.4		48.3	71%

Table 6.8-1 Surety Estimate (Page 30 of 35)

Lost Creek ISR, LLC

Equipment and Tank List

Plant Section: 2 Precipitation % contamination: 100%

Concrete:		Quantity (each)	Length (feet)	Width or Area (feet)/(sq ft)	Thickness (feet)	Volume (cu. Feet)	Volume (cu. Yds.)	Contam.	Contam. Volume	
	Precip Floor	1	180	40	0.5	3600	133.3	Y	133.3	
	Perimeter Beam	1	40	1	4	160	5.9	Y	5.9	
	Internal Perimeter	1	400	1	2	800	29.6	Y	29.6	
	Tank Base	6	1	140	1	840	31.1	Y	31.1	
	Pump Base	4	5	5	1	100	3.7	Y	3.7	
						5500	203.7		203.7	100%

Equipment:		Quantity (each)	Length (feet)	Width or Area (feet)/(sq ft)	Thickness (feet)	Volume (cu. Feet)	Volume (cu. Yds.)	Contam.	Contam. Volume	
	Filter Press	2	12	3	4	288	10.7	Y	10.7	
	YC Slurry Tank	2	1	89.1	1	178.2	6.6	Y	6.6	
	YC Slurry Trailer	2	1	189	1	378	14.0	Y	14.0	
	Precip. Tank	4	1	91.8	1	367.2	13.6	Y	13.6	
	Pumps	8	2	2	1	32	1.2	Y	1.2	
						1243.4	46.1		46.1	100%

Table 6.8-1 Surety Estimate (Page 31 of 35)

Lost Creek ISR, LLC

Equipment and Tank List

Plant Section: 3 Chemical Storage % contamination: 0%

Concrete:		Quantity (each)	Length (feet)	Width or Area (feet)/(sq ft)	Thickness (feet)	Volume (cu. Feet)	Volume (cu. Yds.)	Contam.	Contam. Volume	
	Chem. Floor	1	80	40	0.5	1600	59.3	N	0.0	
	Perimeter Beam	1	120	1	4	480	17.8	N	0.0	
	Internal Perimeter	1	120	1	2	240	8.9	N	0.0	
	Acid Floor	2	16	16	1	512	19.0	N	0.0	
	Acid Perimeter	2	64	1	2	256	9.5	N	0.0	
	Tank Base	4	1	140	1	560	20.7	N	0.0	
	Pump Base	4	5	5	1	100	3.7	N	0.0	
						3748	138.8		0.0	0%

Equipment:		Quantity (each)	Length (feet)	Width or Area (feet)/(sq ft)	Thickness (feet)	Volume (cu. Feet)	Volume (cu. Yds.)	Contam.	Contam. Volume	
	Soda Ash Tank	1	1	81	1	81	3.0	N	0.0	
	Bicarb Tank	1	1	56.7	1	56.7	2.1	N	0.0	
	NaOH Tank	1	1	81	1	81	3.0	N	0.0	
	NaCl Saturator	1	1	75.6	1	75.6	2.8	N	0.0	
	Peroxide Tank	1	1	18.9	1	18.9	0.7	N	0.0	
	HCl Tank	1	1	2.7	1	2.7	0.1	N	0.0	
	Acid Tank	2	1	56.7	1	113.4	4.2	N	0.0	
	Pumps	6	2	2	1	24	0.9	N	0.0	
						453.3	16.8		0.0	0%

Lost Creek ISR, LLC

Equipment and Tank List

Plant Section:	4	Ion Exchange				% contamination:		100%	
Concrete:		Quantity (each)	Length (feet)	Width or Area (feet)/(sq ft)	Thickness (feet)	Volume (cu. Feet)	Volume (cu. Yds.)	Contam.	Contam. Volume
	IX Floor A	1	180	80	0.5	7200	266.7	Y	266.7
	IX Floor B	1	40	40	0.5	800	29.6	Y	29.6
	Perimeter Beam	1	300	1	4	1200	44.4	Y	44.4
	Tank Base	12	1	140	1	1680	62.2	Y	62.2
	IX Base	56	1	1	2	112	4.1	Y	4.1
	Pump Base	8	5	5	1	200	7.4	Y	7.4
						11192	414.5		414.5	100%

Equipment:		Quantity (each)	Length (feet)	Width or Area (feet)/(sq ft)	Thickness (feet)	Volume (cu. Feet)	Volume (cu. Yds.)	Contam.	Contam. Volume	
	IX Column	10	1	86.4	1	864	32.0	Y	32.0	
	Guard Column	2	1	64.8	1	129.6	4.8	Y	4.8	
	Elution Vessel	2	1	86.4	1	172.8	6.4	Y	6.4	
	Fresh Eluate Tank	2	1	91.8	1	183.6	6.8	Y	6.8	
	Eluate Tank	2	1	91.8	1	183.6	6.8	Y	6.8	
	Rich Eluate Tank	2	1	99.9	1	199.8	7.4	Y	7.4	
	Fresh Water Tank	2	1	91.8	1	183.6	6.8	Y	6.8	
	Resin Water Decant	1	1	35.1	1	35.1	1.3	Y	1.3	
	Resin Water Tank	1	1	91.8	1	91.8	3.4	Y	3.4	
	Waste Water Tank	2	1	91.8	1	183.6	6.8	Y	6.8	
	RW Sand Filter	1	1	13.5	1	13.5	0.5	Y	0.5	
	RW Bag Filter	4	1	0.8	1	3.2	0.1	Y	0.1	
	RW Element Filter	4	1	0.8	1	3.2	0.1	Y	0.1	
	Eluate Sump Filter	4	1	0.8	1	3.2	0.1	Y	0.1	
	Eluate Bag Filter	6	1	0.8	1	4.8	0.2	Y	0.2	
	Eluate Element Filter	4	1	0.8	1	3.2	0.1	Y	0.1	
	Resin Screen	4	8	4	1	128	4.7	Y	4.7	
	RO Unit	1	20	4	6	480	17.8	Y	17.8	
	RO Pump	1	1	3.7	1	3.7	0.1	Y	0.1	
	IC/PC Pump	12	1	3.7	1	44.4	1.6	Y	1.6	
	WDW Pump	1	4	6	2	48	1.8	Y	1.8	
	Sump Pump	4	1	1	3	12	0.4	Y	0.4	
	Pumps	6	2	2	1	24	0.9	Y	0.9	
						2998.7	111.1		111.1	100%

Table 6.8-1 Surety Estimate (Page 33 of 35)

Lost Creek ISR, LLC

Equipment and Tank List

Plant Section: 5 **Restoration** **% contamination:** **100%**

Concrete:		Quantity (each)	Length (feet)	Width or Area (feet)/(sq ft)	Thickness (feet)	Volume (cu. Feet)	Volume (cu. Yds.)	Contam.	Contam. Volume	
	Rest. Floor	1	40	80	0.5	1600	59.3	Y	59.3	
	IX Base	8	1	1	2	16	0.6	Y	0.6	
	Pump Base	1	5	5	1	25	0.9	Y	0.9	
						1641	60.8		60.8	100%

Equipment:		Quantity (each)	Length (feet)	Width or Area (feet)/(sq ft)	Thickness (feet)	Volume (cu. Feet)	Volume (cu. Yds.)	Contam.	Contam. Volume	
	Rest. Column	2	1	75.6	1	151.2	5.6	Y	5.6	
	RO Unit	5	20	4	6	2400	88.9	Y	88.9	
	RO Pump	5	1	3.7	1	18.5	0.7	Y	0.7	
	Sump Pump	1	1	1	3	3	0.1	Y	0.1	
	Pumps	2	2	2	1	8	0.3	Y	0.3	
						2580.7	95.6		95.6	100%

Lost Creek ISR, LLC
Equipment and Tank List

Plant

Item	CS = Qty (each)	Type	Material	ID (feet)	Height (feet)	Unit Volume (cu. Ft)	Total Volume (cu. Ft)	Thickness (inches)	Unit Dry Wt. (pounds)	Total Dry Wt. (pounds)	Unit Crushed Volume (cu. yd.)	Total Crushed Volume (cu. yd.)	Vessel Numbers
Pressure Vessels													
Ion Exchange Columns	10	Ellip Hd	CS	11.5	9	3739	37393	0.750	25000	250000	3.2	32.3	IX-1 to 10
Guard Columns	2	Ellip Hd	CS	6.5	9	1195	2389	0.500	9200	18400	2.4	4.8	IX-11, 12
Restoration Columns	2	Ellip Hd	CS	10	8	2513	5027	0.625	13700	27400	2.8	5.6	IX-13, 14
Elution Vessels	2	Ellip Hd	CS	11.5	9	3739	7479	0.750	25000	50000	3.2	6.5	E-1, 2
Tanks													
Fresh Eluate Tanks	2	Flat Btm	FRP	14	18	11084	22167	1.000	10,450	20,900	3.4	6.8	T-210A, B
Eluate Tanks	2	Flat Btm	FRP	14	18	11084	22167	1.000	10,450	20,900	3.4	6.8	T-211A, B
Rich Eluate Tanks	2	Flat Btm	FRP	14	20	12315	24630	1.000	11,286	22,572	3.7	7.3	T-212A, B
Fresh Water Tanks	2	Flat Btm	FRP	14	18	11084	22167	1.000	10,450	20,900	3.4	6.8	T-200A, B
Resin Water Decant	1	Cone Btm	FRP	12	8.5	3845	3845	0.750	3,896	3,896	1.3	1.3	T-201
Resin Water Tank	1	Flat Btm	FRP	14	18	11084	11084	1.000	10,450	10,450	3.4	3.4	T-202
Waste Water Tanks	2	Flat Btm	FRP	14	18	11084	22167	1.000	10,450	20,900	3.4	6.8	T-203A, B
Precipitation Tanks	4	Flat Btm	FRP	14	18	11084	44334	1.000	10,450	41,801	3.4	13.6	T-213A - D
Y/C Slurry Storage	2	Cone Btm	CS - RL	12.5	15	7363	14726	0.500	8,242	16,484	3.3	6.6	T-220A, B
Soda Ash Tank	1	Flat Btm	FRP	12	20	9048	9048	1.000	9,316	9,316	3.0	3.0	T-214
Bicarb Mix Tank	1	Flat Btm	FRP	12	12	5429	5429	1.000	6,449	6,449	2.1	2.1	T-215
NaCl Saturator	1	Flat Btm	FRP	12	18	8143	8143	1.000	8,599	8,599	2.8	2.8	T-216
NaOH Tank	1	Flat Btm	FRP	12	20	9048	9048	1.000	9,316	9,316	3.0	3.0	T-219
H2O2 Tank	1	Hor Tank	Alum	9	16.5	4199	4199	0.375	2,396	2,396	0.7	0.7	T-220
Acid Day Tank	1	Flat Btm	CS	5.5	6	570	570	0.250	773	773	0.1	0.1	T-217
Acid Tanks	2	Flat Btm	FRP	12	12	5429	10857	1.000	6,449	12,899	2.1	4.2	T-218A, B
Filtration													
RW Sand Filter	1	Ellip Hd	CS	6	12.5	1414	1414	0.500	7,450	7,450	0.5	0.5	
RW Bag Filter	2		316ss	2	3	38	75	0.375	175	351	0.03	0.1	
RW Element Filter	2		304ss	2	3	38	75	0.375	175	351	0.03	0.1	
Eluate Sump Filter	2		316ss	2	3	38	75	0.375	175	351	0.03	0.1	
Eluate Bag Filter	6		316ss	2	3	38	226	0.375	175	1,052	0.03	0.2	
Eluate Element Filter	2		304ss	2	3	38	75	0.375	175	351	0.03	0.1	
Slurry Filter Press	2						0			0	0.00	0.0	

Table 6.8-1 Surety Estimate (Page 35 of 35)

Lost Creek ISR, LLC
Equipment and Tank List

Plant	CS = Qty (each)	Type	Material	ID (feet)	Height (feet)	Unit Volume (cu. Ft)	Total Volume (cu. Ft)	Thickness (inches)	Unit Dry Wt. (pounds)	Total Dry Wt. (pounds)	Unit Crushed Volume (cu. yd.)	Total Crushed Volume (cu. yd.)	Vessel Numbers
Pumps													
IC Pumps (75 hp submersible)	6		SS			3.7	22		560	3,360			P-206A - F
PC Pumps (75 hp submersible)	6		SS			3.7	22		560	3,360			P-207A - F
RO Pumps (75 hp horizontal)	6		CS/SS			3.7	22		560	3,360			
Waste Water Pumps (25 hp centrifugal)	2		SS				0		100	200			P-203A/B
Resin Water Pumps (20 hp centrifugal)	4		SS				0		265	1,060			P-201A/B, 202A/B
Waste Disposal Pump (Plunger)	2		CS/SS			23	46		2,400	4,800			
Sump Pumps (5 hp)	4		SS				0		295	1,180			
Reverse Osmosis													
200 GPM Unit	6						0			0			
Other													
Resin Screens	4		CS/SS				0			0			S-1A, B, S-2A, B
Water Heater							0			0			
Air Compressor							0			0			
Slurry Trailer	2		CS				0	0.375	15,000	30,000	7	14.0	TR-1, 2
Generator	2						0			0			
MCC							0			0			

FRP =	0.06
CS =	0.28
SS =	0.29
Al =	0.097
Accy Fact	1.1

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ATTACHMENT

Attachment 7.2-1 MILDOS-AREA Modeling Results

7.0 ENVIRONMENTAL EFFECTS

This section describes the potential environmental effects from the construction and operation activities of the Project. An ER, which addresses the environmental effects of the Project in greater detail, has been submitted concurrently with this report.

Compared with conventional mining, ISR operations have the following advantages in terms of environmental effects.

(1) ISR results in significantly less permanent surface disturbance since pits, shafts, overburden and waste piles, haul roads, and tailings disposal facilities are not needed.

(2) No mill tailings are produced. Therefore, the volume of solid wastes is reduced significantly. The gross quantity of solid wastes produced by ISR is generally less than one percent of that produced by conventional milling methods.

(3) Because no ore and overburden stockpiles, or tailings pile(s), are created and the crushing and grinding ore-processing operations are not needed, the air pollution problems caused by windblown dust from these sources are eliminated.

(4) The tailings produced by conventional mills contain essentially all of the Ra-226 originally present in the ore. By comparison, less than five percent of the radium in an orebody is brought to the surface when ISR methods are used. Consequently, operating personnel are not exposed to the radionuclides present in and emanating from the ore and tailings, and the potential for radiation exposure is significantly less than that associated with conventional mining and milling.

(5) By removing the solid wastes from the site to a licensed waste disposal site, the entire Permit Area can be returned to unrestricted use within a relatively short time.

(6) ISR production results in significantly less water consumption than conventional mining and milling.

The socioeconomic advantages of ISR include:

- ability to produce from a lower grade ore,
- a smaller capital investment compared to conventional mining/milling,
- less risk to the worker (in terms of exposure to radioactive materials and safety),
- shorter lead time before production begins, and
- reduced strain on regional infrastructure, due to lower manpower requirements.

Site preparation, construction, and operations of the Project will be conducted such that potential environmental effects will be minimized to the greatest extent possible.

7.1 Site Preparation, Construction, and Operations

The Project requires the preparation, construction, and operation of the following:

- the access roads/utility corridors, including pipelines connecting the mine units to the Plant;
- the Plant, which includes the ion exchange facility and other processing circuits, the shop, the laboratory, storage areas, fuel tanks, the offices, possible living quarters, and parking;
- the Storage Ponds, which will be used in conjunction with the UIC Class I wells, located adjacent to the Plant;
- UIC Class I wells; and
- the mine units, which include header houses and injection/production/monitor wells.

Since mine unit construction will be ongoing throughout the Project, the environmental effects of mine unit preparation and construction will primarily occur during operations.

7.1.1 Land Use

During the life of the Project, a total of approximately 260 acres of the land surface will be disturbed; approximately seven percent of the total Permit Area. **Table 7.1-1** shows the itemized calculations on the areas of the expected disturbance. While some of the disturbances, such as the Plant and main access roads, are long-term (through the life of the Project), most are temporary, and will be reclaimed within months or years of disturbance. Ultimately, all disturbed areas will be reclaimed to support the post-operational land uses of the Permit Area.

The existing land uses of the Permit Area are livestock grazing and wildlife habitat. To control access and to prevent livestock damage to the wells and facilities, all mine units, Storage Ponds and other processing facilities at the Plant will be fenced for the duration of the Project according to BLM fencing specifications. Since the region, in general, has similar attributes supportive of livestock grazing and wildlife habitat, and the area of long-term disturbance accounts only a small portion of the Permit Area, the Project should not have a significant impact to the existing land use.

Cumulative adverse impacts to the land uses are not foreseen. The majority of the Permit Area will not be disturbed; and an abundance of similar land is available surrounding the Permit Area. In addition, the Project will conform to the land use regulations of Sweetwater County as well as the Regional Management Plan of the BLM (BLM, 2004c and 1987). Mitigation and monitoring measures on topsoil protection, erosion control, revegetation, and wildlife are presented in **Section 4.0** of the ER.

7.1.2 Transportation

During the Project, the materials transported to and from the Permit Area will be classified as: 1) shipments of construction materials, process chemicals, office supplies, and related materials from suppliers to the Plant; 2) shipments of waste material to be disposed of off-site; and 3) shipment of yellowcake slurry to an off-site drying facility.

The planned network of on-site roads is portrayed in **Figure 2.1-1**. These roads will be maintained and improved as appropriate. On-site access will be restricted through appropriate signage, fences, gates, and security.

The off-site transportation routes will be comprised of pre-existing BLM, county, state, and federal roads. These routes will not be substantially impacted with transport vehicles to and from the Permit Area. If improvements to off-site roads are needed, permits will be obtained from the BLM, and all relevant guidelines will be followed.

Detailed discussion on transportation impacts and risk analysis are presented in **Section 4.2** of the ER. Transportation accident prevention and response are discussed in **Section 7.4.7** of this report.

Records of shipping, driver training, truck safety certifications, and on-site road maintenance will be kept at the LC ISR, LLC office.

7.1.3 Soils

Soils will be impacted during the Project due to the removal of vegetation and topsoil for the construction of primary and secondary access roads, the Plant, the Storage Ponds, header houses, field lay-down areas (for construction equipment and materials), mud pits and pipelines. As shown in **Table 7.1-1**, the total area of soil removal during the project is approximately 58 acres (less than 1.5 percent of the Permit Area). Vegetation and soil removal from the construction of mud pits and pipelines will be temporary (short-term) with reclamation being completed within weeks. Equipment lay-down areas will be reclaimed after mine unit construction, and header houses in each mine unit will be reclaimed after restoration is complete. The impacts from road and plant construction will coincide with the life of the Project).

There will be two-track (tertiary) access roads throughout the mine units during field construction and operation. Although topsoil and vegetation will not be removed, traveling on these roads will result in soil compaction. Soil compaction will change the soil structure and reduce soil productivity. These impacts, however, will all be short-term (e.g., during the construction of a mine unit or through the life of the mine unit).

Access to the Permit Area will be restricted and vehicular traffic will be minimized during operations. This will reduce the occurrence of compacted soils. Compacted soils will be broken up by the discing/ripping procedures in preparation for seeding during surface reclamation.

Soil erosion and sedimentation will be reduced by: minimizing vegetation removal; surfacing common-use roads with gravel; establishing speed limits; reclaiming areas in a timely manner; installing engineering controls; and implementing other best management practices, such as dust suppression, when necessary.

Mitigation and monitoring of impacts on soils are discussed in **Section 4.3** of the ER.

7.1.4 Geology

There will be no impact on geology during site preparation and construction.

The removal of uranium from the target sandstones will result in permanent change in the geochemical composition of these rocks.

No significant matrix compression or ground subsidence is expected, as the net withdrawal of fluid (bleed) will be less than one percent. Following completion of groundwater restoration, groundwater levels will re-equilibrate to approximate pre-operational levels.

Changes to the aquifer pressure may impact the transmissivity of the Lost Creek Fault. Overall, the pressure of the produced aquifer will be decreased during operation and restoration activities. Locally, increases in pressure due to injection wells will be balanced by the production wells. It is highly unlikely that the planned ISR operations will reactivate the Fault, and less likely still the fault would generate a destructive earthquake. In this regard, the Fault, while laterally extensive in the Permit Area, is not considered a major structural feature in the Great Divide Basin.

7.1.5 Hydrology

Unlike conventional mining where large and permanent alterations to the hydrologic regime are common, impacts on surface and groundwater by ISR activities will be relatively small in scale and temporary in duration. Detailed discussions on impacts of hydrology are presented in **Section 4.5** of the ER.

7.1.5.1 Surface Water

As presented in **Section 2.7** of this report, surface water is very limited, and there are no perennial streams in the Permit Area. Surface water flow is infrequent due to the high infiltration capacity, low annual precipitation, and high evaporation rate. Some intermittent and localized flow could occur near springs, but none have been located within the Permit Area. Potential impacts on surface water from the Project will be minimal. There is no aquatic life or wetlands within the Permit Area.

To minimize impacts to surface water, the location of facilities and roads in ephemeral drainages will be avoided. Pipelines and roads will cross ephemeral drainage channels. Pipelines will be buried under the channels. Once the pipelines are buried, the channel configuration will be reestablished and the disturbed area will be seeded as soon as possible. Culverts and ditches as well as other engineering controls will be installed when necessary to allow continued drainage.

Native groundwater will be discharged to the surface during pump testing, well installation, and monitor well sampling. This discharge will be controlled to assure that no water will get into nearby surface water drainage.

In Wyoming, the EPA has delegated the implementation of the WYPDES permit program to the WDEQ. LC ISR, LLC will obtain a WYPDES permit for storm water discharge. Under this permit, LC ISR, LLC will implement measures to control the erosion and deposition of sediment.

Adverse impacts to surface water are not anticipated due to the absence of nearby surface water bodies and due to the control measures that will be implemented according to the WYPDES permit that will be obtained from WDEQ.

Water-use permits with legal descriptions inside and within two miles of the Permit Area were queried using the WSEO Water Rights Database (WSEO, 2006). According to the query, surface-water-use permits do not exist inside and within two miles of the Permit Area. Since the closed system of ISR operations does not involve the use of or discharge to surface water, the Project has no foreseeable impact to surface-water uses.

7.1.5.2 Groundwater

Potential impacts to groundwater from the Project include changes to groundwater levels and quality, due to either consumption of groundwater or the ISR process.

Within the Permit Area

Groundwater levels will be affected during the life of each mine unit. Cones of depression will be created to control the movement of fluids during operation; and the produced aquifer will be swept during reclamation. Since the operation of mine units will be sequential, a limited amount of groundwater will be affected at one time.

An evaluation of groundwater impacts due to drawdown of the production zone during ISR and restoration operations has been presented in **Section 3.2.7.3**. Based on the operational design and available hydrology, groundwater impacts, and consumption related to the operations are anticipated to be small. Data from the pump tests conducted at the Project indicate that the ore-bearing aquifer has permeability (hydraulic conductivity), porosity, and storativity that are consistent with other successful ISR projects in Wyoming. Groundwater consumption of the Project is expected to be 0.5 percent to 1.5 percent of the total production flow. An additional consumptive volume will be used during aquifer restoration, particularly during the groundwater sweep phase. It is expected that the net consumption for the entire operation will be on the order of 175 gpm for the project life. Much of this consumptive use is during the restoration phase, especially during groundwater sweep. As discussed in **Section 3.2.7.3**, because of the limited thickness of the HJ Sand, consumptive use of groundwater could potentially lower water levels in the Permit Area by more than 100 feet.

Water levels will be routinely measured in the production zone and overlying and underlying aquifers. Sudden changes in water levels within the production zone may indicate that the mine unit flow system is out of balance. Flow rates would be adjusted to correct this situation. Increases in water levels in the overlying aquifer or underlying aquifers may be an indication of fluid migration from the production zone. Adjustments to well flow rates or complete shut down of individual wells may be required to correct this situation. Increases in water levels in the overlying aquifer may also be an indication of casing failure in a production, injection or monitor well. Isolation and shut down of individual wells can be used to determine the well causing the water level increases.

Groundwater quality within the pattern areas of each mine unit will be altered during operation activities. The groundwater of the ore-bearing aquifer will be used, treated, and recycled to recover uranium in solution. In order to dissolve the uranium, the chemistry of the target aquifer will be altered within the pattern area. However, groundwater impacts to the production zone outside the monitor well ring are not expected. Further, no water quality impacts to the overlying or underlying aquifers are anticipated. A Class III UIC permit will be obtained from WDEQ-LQD and an aquifer exemption obtained from WDEQ/EPA.

To ensure the production fluids are contained within the designated area of the ore-bearing aquifer, the production zone and overlying and underlying aquifer monitor wells will be sampled semi-monthly. An extensive water-sampling program will be conducted prior to, during and following ISR operations to identify any potential impacts to hydrology of the area. Groundwater restoration requirements will also help ensure the protection of the affected groundwater resources.

Outside the Permit Area

Currently, groundwater is not used for domestic or irrigation purposes inside the Permit Area and within two miles of the Permit Area boundary. The majority of the groundwater-use permits filed in the vicinity of the Permit Area are for monitoring or miscellaneous purposes related to operations and do not represent consumptive use of groundwater.

BLM has four active wells (and four associated stock ponds), located outside of the Permit Area, but within one mile of the permit boundary, for livestock use (**Figure 2.2-4**). As discussed previously, little (if any) impacts on these water uses are expected. Two of the wells (Boundary Well No. 4775 and Battle Spring Wells No. 4777) are less than 300 feet deep, shallower than the proposed ISR depths in the HJ Horizon. The East Eagle Nest Draw Well is also relatively shallow (370 feet deep) compared to the depth of the top of the primary ore zone of interest, the HJ Sand (400 feet). The Battle Spring Draw Well No. 4551, at 900 feet deep, is much deeper than the HJ Sand. Although the specific screened interval of this well is not known, the relative depth of this well reduces the potential for impacts from the Project.

The potential impacts to the wells will be minimized by altering ISR operations on different sides of the Fault, and potential production from different sands (e.g., the KM Sand as approved in future permit submittals). Any water level declines in the four BLM wells are not expected to impact the water quality in these wells because of the relative similarity in the water quality at these depths. Throughout the phases of the Project, LC ISR, LLC will monitor water levels in these wells and correspond with BLM to ensure that these wells are not impacted in a manner that restricts the intended use.

7.1.6 Ecology

The majority of impacts on ecology will occur during site preparation and facility construction, which require the removal of vegetation, decreasing wildlife habitat. There is no wetland or aquatic life in the Permit Area. Detailed discussion on ecological impacts, mitigation and monitoring are presented in **Section 4.6** of the ER.

7.1.6.1 Vegetation

During the lifetime of the project, the total area of vegetation removal will be about 58 acres (see **Table 7.1-1**), less than 1.5 percent of the Permit Area. The two vegetation types disturbed by construction activities include the Lowland Big Sagebrush Shrubland (30 percent) and the Upland Big Sagebrush Shrubland (70 percent).

Near half of the vegetation removal area (pipelines and mud pits) will be reclaimed within a few weeks to a few months. WDEQ and BLM approved seed mix will be used for revegetation.

Vegetation of the Permit Area will also be impacted by traveling on the two-track access roads within the mine units during field construction and operations. Although these roads do not require vegetation removal, extensive traveling will cause vegetation stress and may take months or even years to recover. Impacts of this kind occur mostly during field construction phase.

The Project is not likely to adversely affect sensitive plant species because federally- and state-listed or proposed endangered or threatened species or proposed or designated critical habitats do not occur within the Permit Area. LC ISR, LLC will take vegetation protection into account while planning for field development. Detailed mitigation and reclamation measures are presented in **Section 4.6** of the ER.

7.1.6.2 Wildlife

Potential impacts of the Project on wildlife include: direct and indirect loss and/or modification of habitat; increased mortality from collision with vehicles; increased poaching or hunting due to improved access; possible mortality (of small mammals, birds, reptiles, and amphibians) from construction activities; possible mortality from exposure to toxic compounds or chemicals; displacement of wildlife due to increased human activity; and increased disruption/stress to wildlife using the sagebrush habitats at or near the Permit Area.

Direct impacts to wildlife habitat will occur in areas that are physically altered by the construction of roads, the Plant, the Storage Pond(s), mud pits/wells, header houses, and pipelines. Indirect impacts will occur from an increased human presence, dust, and noise. Indirect impacts may displace or preclude wildlife use near areas of human use/disturbance.

Human activity (noise, traffic, human presence) in each mine unit will decline after initial drilling, construction, and start-up. Wildlife use of areas adjacent to ISR operations is anticipated to increase as animals become habituated to the activity. Contemporaneous revegetation of disturbed areas will help minimize habitat loss and provide quality forage. Previous ISR sites that have implemented active revegetation programs have become attractive to wildlife, principally deer and antelope.

LC ISR, LLC will follow BLM and WGFD guidelines on wildlife protection while planning and conducting ISR operations at the Project. Site-specific monitoring programs will be implemented per federal and state guidelines. Detailed mitigation and monitoring measures are presented in **Section 4.6** of the ER.

7.1.7 Air Quality

Air quality impacts which may result from construction and operation activities will be primarily fugitive dust and engine exhaust emissions. Based on experience at other ISR facilities, these types of emissions are not expected to be significant. Detailed discussion on air quality impacts, mitigation and monitoring are presented in **Section 4.7** of the ER.

Fugitive dust may be generated by vehicular traffic, earth-moving activities during construction and wind erosion of disturbed areas. These will be intermittent, quickly dispersed and should not represent significant air emission impacts. To reduce fugitive dust, on-site speed limits will be established and disturbed land will be revegetated during the first available seeding window after construction is complete. Should fugitive dust become an issue, other mitigation measures, such as applying water to the unpaved roads, will be implemented.

Gaseous emissions (e.g., carbon dioxide, carbon monoxide, nitrogen oxides, oxygen, radon, sulfur dioxide, and volatile organic compounds) may be released to the atmosphere from operating of diesel drilling rigs and gasoline powered service vehicles during construction, as well as from vents and exhausts at the Plant and mine units during operations. These emissions will be dispersed rapidly and will not cause any exceedance of any applicable air quality standards in the Permit Area. Engines will be regularly maintained and pollution prevention equipment will be used to ensure that emissions are minimized.

7.1.8 Noise

Noise impacts were assessed by comparing background noise levels with projected noise levels during construction and operation activities. The proximity of sensitive receptors was considered in the impacts analysis. The closest residence, church, or school is around 15 miles from the northeast Project boundary (e.g., Bairoil) and will be more than 16 miles from the nearest mine unit.

Most of the noise will be generated during site preparation and mine unit construction when heavy trucks and equipment will generate high levels of noise at the construction site. By the time these noises reach the nearest residential area (14 to 16 miles away), however, they will have attenuated below background noise level (e.g., not audible) and well below the 55-dBA (A-weighted decibel) guideline to protect against activity interference and annoyance (EPA, 1978).

Mine unit construction will occur only during daylight hours. The 70-dBA, 24-hour average sound energy guideline for hearing protection (EPA, 1978) will not be exceeded on-site.

Noises generated during ISR operation will be at significantly lower levels than those from the site preparation and construction phase. No exceedance of any applicable noise criteria for off-site receptors or for on-site personnel is expected.

7.1.9 Cultural Resources

Potential impacts on cultural resources occur mainly during site preparation and construction phase, especially when vegetation and top soil removal is involved. Detailed discussion on cultural resource impacts, mitigation, and monitoring is presented in **Section 4.8** of the ER.

Class III cultural resource surveys have been performed over the Permit Area and submitted to BLM for review. Three prehistoric archaeological sites were identified in the Permit Area as meeting the eligibility criteria of the NRHP.

LC ISR, LLC will make every effort to avoid disturbing any of the potential NRHP sites. Site boundaries will be clearly marked and a buffer around the sites will be maintained. Construction and operation activities that occur near significant properties will be monitored by an archaeologist. In the event that significant sites cannot be avoided, LC ISR, LLC will prepare site-specific treatment plans to guide data recovery excavations.

Prior to implementation, the treatment plan(s) will be subject to review and approval by BLM and the Wyoming SHPO, and will be subject to review and comment by concerned Native American groups.

Cultural resource monitoring is recommended in the immediate vicinity of significant sites that are to be avoided. Proposed mitigation actions for cultural resource impacts will be in accordance with BLM and SHPO requirements.

7.1.10 Visual/Scenic Resources

The Project will result in temporary, minor impacts to visual and scenic resources. The Project will maintain the visual resource classification of the area, Visual Resource Class III, as described in **Section 2.4.2**.

Most of the modifications to the landscape introduced by the Project will not be visible from the public road network, which is lightly traveled. The most proximate facilities are about 5 miles from the nearest county road; and the rolling topography will hide the facilities from travelers, except from a limited number of vantage points. The Project will not affect locally important or high-quality views. The facilities will be discernable, but will not be a dominant landscape feature from a distance.

To minimize impacts to visual and scenic resources, building materials and paint will be chosen to blend with the natural environment, according to BLM guidelines. All structures will have a low profile in order to minimize the number of vantage points from which they may be visible.

ISR operations will not cause modifications to scenery or topography that will persist after restoration and reclamation.

7.1.11 Socioeconomics

While the Project will generally have a positive effect to the socioeconomics of the area, although short-term, negative indirect effects on the local government infrastructure and housing may occur due to increases in population and demand for public facilities and services. A detailed discussion on socioeconomic effects is presented in **Section 4.10** of the ER.

The local population is expected to increase as a result of increased employment opportunities generated both directly and indirectly by the Project. The increased demand for housing will likely increase housing prices (rental costs and home sales prices).

Public facilities and services that may be impacted by an increase in population include: Rawlins water and sewer distribution system and streets; the Carbon and Sweetwater County road maintenance for Mineral Exploration Road; and the BLM Sooner Road. With the additional influx in population, improvements to these public systems may be required sooner than anticipated and would have budgetary effects on local governments for capital improvement funding.

Emergency services, including fire, police, ambulance, and hospital services, should not be impacted by the increased population or employment.

Wages and salaries paid to skilled and unskilled workers on the Project will have a positive impact on local businesses such as restaurants, service stations, and retail stores. In addition to local expenditures near the Project, workers will also be contributing to their local economy in the form of expenditures for goods, services, housing, insurance, entertainment, and food. This increased economic activity may enhance the availability of goods and services, as well as cultural, educational, and recreational opportunities.

Increases in taxes and revenues would provide counties and communities with more discretionary dollars to develop infrastructure and support the population. Taxes, including severance taxes, ad valorem production, and property taxes, will accrue to the federal, state, and local governments. Other tax revenues generated from the Project will include sales, use, and lodging taxes.

7.1.12 Environmental Justice

The economic base of the region is predominately agriculture and natural resource development, except in Rawlins and Casper. Segments of the population are lower income, particularly in rural areas, due to the typical lower income of the agricultural sector. According to 2003 census data, families within the defined poverty status represented less than 12 percent of the population in Carbon County (Census Bureau, 2000a) and less than nine percent in Sweetwater County (Census Bureau, 2000a). Neither low-income (poverty status) nor minority populations will be disproportionately impacted by the Project.

7.1.13 Public and Occupational Health

In the vicinity of the Permit Area, minerals and chemicals occur naturally and from historic land uses. These minerals and chemicals may have properties that are harmful to the health of humans. During the life of the Project, human exposures to the parameters of concern will be minimized by following best management practices (BMPs) and monitoring human health and the conditions of different environments.

Considering that the Permit Area is remotely located, the potential impact to the health of the general public will be minimal. No known residence is within 14 miles of the Permit Area. However, nearby land may be accessed for recreational or livestock purposes, thereby potentially affecting the public with short-term exposure.

Public and occupational health impacts during construction and operation activities is discussed and evaluated in detail in **Section 5.0** of this report.

7.1.14 Waste Management

Airborne, liquid, and solid wastes will be produced by the Project. All of these wastes are typical of ISR projects currently operating in Wyoming. Existing BPT will be used in all aspects of waste management at the Permit Area. Detailed discussions on effluent control and waste management are presented in **Section 4.0** of this report.

Non-radioactive gaseous emissions will readily disperse in the atmosphere and will not create an adverse impact to air quality. Airborne particulates will be minimal. Fugitive dust emissions will be minimized due to the inherent nature of ISR operations and the restricted road access.

Impacts from radioactive airborne effluents are foreseen as negligible since ISR operations is conducted in a closed system consisting of wet materials and the yellowcake drying and packaging will occur off-site.

The liquid and solid wastes generated from the Project will include domestic sewage, non-radioactive wastes, and radioactive byproduct wastes. These wastes will be treated, removed, and disposed of according to the applicable local, state, and federal regulations. As such, cumulative adverse impacts to the environment are not anticipated.

7.2 Radiological Effects

ISR facility exposure pathways to radiological materials are considerably different from pathways associated with conventional uranium mining methods. First, the majority of the uranium radioactive daughter products is not removed from the orebody, but remains underground within the ore zone. Additionally, no drying of the uranium product will be performed at the Permit Area. This greatly reduces the potential radiological air particulate pathway typically associated with conventional uranium ore milling or those ISR facilities which produce dried product.

Radon will be released from the solutions at the mine units and vented from the Plant building to the atmosphere during operation or when vessels are opened for maintenance. Experience from other ISR projects show that these releases will only be a small fraction of the natural background dose contribution and will not result in a significant off-site impact.

Potential radiological impacts from the Project were modeled using the MILDOS-AREA model. The results of this modeling are presented in as **Attachment 7.2-1**. MILDOS (ANL, 1989) was originally developed to estimate doses from conventional uranium milling operations, including large area releases such as ore storage pads and tailings ponds. Inputs to the dose are limited to uranium decay chain radionuclides. MILDOS was subsequently updated in 1998 to address potential impacts of ISR operations. ISR-specific source terms, such as production wells and restoration wells, are included in the updated version (ANL, 1998).

7.2.1 Exposure Pathways

Since the Project is an ISR operation, the only source of planned radioactive emissions is radon gas, which is dissolved in the recovery solution. Radon gas may be released as the solution is brought to the surface and processed. Unplanned emissions from the site are possible as a result of accidents and engineered structure failure, which are not addressed in the MILDOS-AREA modeling.

MILDOS was used to estimate doses from radon released during the following operations.

- New wells: When drilling new wells into the orebody, drill cuttings, including ore, are transported to the surface in drilling mud. Cuttings are temporarily stored in mud pits, where Rn-222 may be released to the atmosphere.
- Producing mine units: Radon that is dissolved in the lixiviant may be released either from purge water or from gas venting at the wellhead.
- Ion Exchange facility: Radon gas may be released from the columns as a function of the volume of the columns, the porosity of the resin and the unloading rate of the column.

- Restoration activities: During the restoration of the mine units, water is circulated within and discharged from the wells in release rates similar to those from producing mine units.

Pathways for potential human exposures are diagrammed in **Figure 7.2-1**.

7.2.1.1 Exposures from Water Pathways

Solutions in the production zones will be controlled and adequately monitored to ensure that migration does not occur. For purposes of off-site exposures, no off-site releases of water are planned or expected. Therefore, there are no quantifiable water-related pathways.

7.2.1.2 Exposures from Air Pathways

As currently planned, the only source of potential radionuclide emissions is Rn-222 release from either venting or purge water releases, as described above. Atmospheric releases of Rn-222 can result in exposure from either inhalation of contaminated air, direct gamma exposure from deposited decay products or ingestion of foodstuffs contaminated with decay products. The MILDOS-AREA computer code was used to estimate potential exposures and doses to human receptors and populations surrounding the Permit Area. The results are summarized below. A more detailed analysis of modeling results is given in **Attachment 7.2-1** of this report.

Doses to Specific Receptor Locations

Since there are no permanent residents in the vicinity of the proposed facility, a series of 17 locations were modeled around the perimeter of the Permit Area boundary as shown in **Figure 7.2-2**. The map shows modeled receptor locations, as well as centroids of each mine unit, and locations of the Plant Site One (the preferred plant location) and Plant Site Two (an alternative).

The dose to the public limit is 100 millirem per year (mrem/yr), as noted in Title 10 of the CFR, Part 20. MILDOS modeling for Plant Site One indicates that potential dose from all but one of the 17 locations will be below the 100 mrem/yr limit (**Table 7.2-1** and **Figure 7.2-3a**). Location NB, which is about 980 feet (300 meters) from the Plant, showed a calculated TEDE value of about 140 mrem/yr, which decreased to about 40 mrem/yr within 1,000 feet of the northern boundary. The possibility of a permanent residence at this location during the Project is next to none as this is federal land. For Plant Two location, none of the boundary receptors exceed 40 mrem/yr (**Figure 7.2-3b**).

Doses to Potential Workers

Annual doses were calculated to a hypothetical worker located 460 feet (140 meters) to the northeast, southeast, southwest, and northwest of the Ion Exchange Facility. Calculated MILDOS TEDE values were multiplied by 0.22 (2000/8760) and averaged (**Figure 7.2-4** and **Table 7.2-2**). Calculated doses peak in 2014, with the period of 2012 through 2015 being the highest-dose years. All years are well below occupational limits. For the specific locations modeled, these doses likely overestimate worker doses, because MILDOS includes food intake pathways that would not be applicable to the ISR facility.

7.2.1.3 Exposures from External Radiation

External radiation exposures that may result from releases of radioactive material are calculated within MILDOS and are included in the dose estimates summarized above.

7.2.1.4 Total Human Exposures

There are no towns of any size within 15 miles (24 km) from the mine unit or the proposed plant sites. Towns within 50 miles (80 km) from the Permit Area include the Rawlins, Jeffrey City, Wamsutter, and Bairoil, as summarized in **Table 7.2-3**. Using populations as shown in **Table 7.2-3**, population doses in person-rem per year (person-rem/yr), from the Plant Site One releases, were calculated for both TEDE and the dose to the bronchial epithelium of receptors.

Estimated doses to populations surrounding the Permit Area are summarized in **Table 7.2-4**. The maximum estimated annual population dose, 0.13 person-rem/yr within 50 miles (80 km) and 4.56 person-rem to all populations, will occur in 2014 as expected, based on results for individual receptors. While there are no standards for population dose, it is interesting to compare these calculated doses to the natural background for the same region. The average US resident receives 360 mrem per year (National Council on Radiation Protection and Measurements, 1987). When applying this average US effective dose to the MILDOS population (8,985 residents), the natural background population dose (TEDE) would be approximately 3,200 person-rem per year, which is approximately 24,000 times higher than that of the calculated maximum 0.13-person-rem-per-year population dose of the Project. Population doses from releases of Plant Site Two are effectively the same, which is understandable given the minimal change in distance relative to the population distribution.

7.2.1.5 Exposures to Flora and Fauna

Because of their relative mobility, some native animals, including small mammals and birds, may have contact with Rn-222 releases. It is possible that individual animals might have contact with higher concentrations of Rn-222 than any member of the public because of potential proximity to releases. However, the mobility of biota makes it unlikely that any individual animal will receive a constant concentration for the entire year. There are no current dosimetric standards for protection of biota. However, it has been assumed by the International Commission on Radiological Protection that if humans were protected, then biota in the same exposure environment would also be protected.

US Department of Energy (DOE) Order 5400.5 proposed a limit of one rad per day (rad/d) for aquatic organisms. Title 10 CFR Part 834, Subpart F proposes limits of one rad/d for terrestrial plants and 0.1 rad/d for terrestrial animals. Those proposed values are far higher than the doses calculated to any receptor outlined above. Therefore, it is reasonable to expect no significant impact from the contacts of biota with releases from the Plant.

7.3 Non-Radiological Effects

7.3.1 Airborne Emissions

Potential air quality impacts will primarily occur during construction and operation activities. The parameters of concern are fugitive dust and engine exhaust emissions. The atmospheric stability of the Permit Area is low due to the winds; and any particulate and gaseous releases will be quickly dispersed. The closest off-site receptor, Bairoil, is located about 15 miles from the Permit Area and not directly downwind of the prevailing wind direction. Therefore, air emissions are not expected to cause adverse impacts to human health.

Mine unit construction and travel on unpaved roads will result in minor intermittent emissions of fugitive dust. Contemporaneous reclamation, driving under speed limits and restricting off-road traffic will minimize the presence of fugitive dust.

Gaseous emissions will result from the operation of internal combustion engines and venting from the mine units and the Plant. During construction phase, exhaust from diesel drilling rigs and gasoline-powered service vehicles will produce small amounts of carbon monoxide, sulfur dioxide and other internal combustion engine emissions. Small amounts of exhausts and gaseous oxygen and carbon dioxide may be emitted from the mine units and the Plant during production phase. These gaseous emissions will readily disperse in the atmosphere and are not expected to create an adverse impact to human health.

7.3.2 Sediment Loads

Potential sediment loading and sedimentation could occur if uncontrolled runoff carrying sediments from the disturbed areas reach the drainages within and downstream of the Permit Area. There are no perennial streams or wetlands within the Permit Area. The only time for any sediment to reach the surface water drainage and be carried downstream would be during spring snow melt when short-term sustained flow may occur. Erosion control measures will be implemented during the Project to minimize potential sediment loading to surface water drainages.

All disturbances will be revegetated as soon as possible following the disturbance. All long-term topsoil stockpiles will be fully contained and vegetated. A containment ditch and berm will be constructed around each stockpile to prevent any loss of topsoil from the stockpile until revegetation is established. Where necessary, fences, straw bales or other erosion control techniques will be used to prevent sediment from leaving the disturbed area. Purge water from monitor wells will be discharged towards diversion structures to prevent runoff onto disturbed areas.

Fuel storage and staging areas will be managed in such a manner that no off-site drainage will be allowed to enter the staging area; nor will any surface runoff initiated in the staging area be allowed to exit. This will be accomplished by berming and/or ditching the perimeter of the entire staging area. Fuel and lubricant storage areas will be bermed separately from the rest of the staging area.

Inspection, reporting, and maintenance of storm water control features will comply with WYPDES requirements.

7.3.3 Groundwater Quantity and Quality

As discussed in **Section 7.1.5** of this report, impacts to hydrology are expected to be minimal. The net consumptive use of groundwater is anticipated to be on the order of 175 gpm for the majority of the operational life of the Project. Potential impacts due to drawdown from consumptive use have been discussed previously. No impacts to groundwater quality outside the monitor well ring for each mine unit are expected.

The liquid effluent will be managed in the Storage Ponds and UIC Class I wells. There will be no discharge from the Storage Ponds. UIC Class I wells will permanently dispose of liquid wastes and will be permitted under a Class I UIC Permit issued by WDEQ. The Class I UIC permit will require quarterly reporting to ensure that the well(s) are operated consistent with the Class I permit requirements. Based on the operation of other UIC Class I wells at ISR facilities in Wyoming, little or no non-radiological impact is expected due to the liquid effluent from the Project.

7.4 Effects of Accidents

7.4.1 Tank Failure

The process fluids will be contained in the process tanks and vessels and piping circuits within the Plant. Alarms and automatic controls are used to monitor and keep levels within prescribed limits. In the unlikely event of a failure of a process vessel or tank in the building, the fluid would be contained within the building, collected in sumps, and pumped to other tanks or to a lined Storage Pond. The Plant will be designed with a retaining wall to contain any process and/or wash fluids. The area would then be washed down with water contained in a similar manner, eliminating any environmental impact from the failure.

No process tanks are planned outside of the Plant. If a tank or vessel were installed outside of the Plant building and were to fail, it could result in the spill of leach solution to a retention or containment system. The liquids would then be pumped to another tank or lined pond. The environmental impact of such an accident could result in some soils being contaminated, requiring controlled disposal. All areas affected by such a failure or leak would be surveyed; any contaminated soils or material requiring controlled disposal would be removed and disposed of in accordance with NRC and/or state requirements. The affected area would then be reclaimed as specified in **Section 6.0** of this report; therefore, there would be no long-term impact from such an accident.

7.4.2 Pipeline Failure

The rupture of a pipeline between the Plant and the mine units could result in a loss of either pregnant or barren solutions to the surface. To minimize the volume of fluid that could be lost, the pipeline systems will be equipped with high-pressure and low-pressure shutdown systems and flow meters. The systems will also be equipped with alarms; the operator will be alerted immediately if a major malfunction occurs. Additionally, the pipelines will have periodic valve stations that will allow the operator to minimize the volume spilled by isolating the area of concern. If the volume and/or concentration of the solutions released in such an accident did constitute an environmental concern, the area would be surveyed and the contaminated soils would be removed and disposed of according to NRC and/or state regulations. The pipelines will normally be buried approximately five to six ft bgs and will be of a corrosion-free HDPE material; therefore, the probability of such a failure, after the pipelines have been tested and placed in service, is considered small. Piping junctions will be made of either corrosion-free HDPE, stainless steel, epoxy-coated steel or a combination of the three to minimize the opportunity for a leak at a junction. The same is true for the pipelines transferring waste fluid to the UIC Class I disposal wells.

Industry experience has shown that most spills are the result of partial failures or ruptures of piping and/or fittings (NRC, 1997). Instrumentation and a physical presence in the operating area help to minimize the extent of a discharge from a pipeline failure. The Project will have Field Operators, who will be responsible for daily field review of operating systems as well as monitoring of instrumentation.

7.4.3 Pond Failure

The Storage Ponds will be constructed with leak detection systems; and these systems will be monitored daily. In the event of a leak, the fluid in the compromised unit would be transferred to the sister pond and the liner would be repaired as needed. The pond area will be surveyed and reclaimed as part of the final reclamation, eliminating any significant long-term impact.

A Storage Pond embankment failure would be the most severe type of pond failure. To minimize the risk of an embankment failure, the ponds will be inspected daily to ensure there is no significant deterioration of the embankments. Should a failure occur, all impacted areas would be surveyed, cleaned up as needed, and reclaimed.

7.4.4 Casing Failure

A casing failure in an injection well would have the potential for environmental impact because the leach fluid is injected under pressure. It is possible that this type of failure could continue for several days before being detected by the monitoring system. If such a failure did occur, the defective well would be either repaired or plugged and abandoned. If contamination of another aquifer were indicated, wells would be drilled and completed in the contaminated aquifer and then produced until concentrations of lixiviant constituents were reduced to acceptable levels, as per WDEQ approved baseline values. With proper casing, cementing, and testing procedures, the probability of such a failure is very low.

To minimize the risk of a casing failure significantly impacting the environment, should one occur, monitor wells will be completed in the aquifers above and below the ore zone. The fluid levels and quality of the water in the adjacent aquifers will be routinely monitored during operations to check for fluid movement into these aquifers. In addition, casing integrity tests will be performed on all injection wells prior to using the wells for injection and after any work that involves entering a well with a cutting tool, such as a drill bit or underreamer.

Failure of a production well casing would not normally cause an excursion; because the production wells do not operate under pressure.

7.4.5 Leaking Exploration Holes

Movement of leach solution between aquifers through old exploration holes in the Permit Area is considered unlikely. Recent drill holes were abandoned with either bentonite mud or grouted. Both the mud and the grout are an effective seal against fluid interchange between the various aquifer units penetrated by the drilling. Additional well bore sealing is provided by the rapid swelling and bridging of the isolating shales between the sandstone units.

However, to ensure there is no communication between aquifers, monitor wells completed in the aquifers above and below the ore zone will be checked routinely for changes in aquifer pressure and water composition. In addition, pump tests will be conducted prior to mine unit start-up to demonstrate that no significant communication between the aquifers exists. Should leakage between aquifers through old drill holes be indicated during the tests, the old holes would be re-entered and plugged. If contamination of another aquifer was indicated, wells would be drilled and completed in the contaminated aquifer, sampled, and if needed, produced to reduce the concentration of any leach solution fluids to acceptable levels.

7.4.6 Excursions

One of the primary concerns in ISR operations, both for efficient mining and protection of the environment, is preventing excursions and, should one occur, mitigating its impact. The systems employed to achieve this objective include: regular recording and evaluation of injection and production rates and pressures, so each mine unit remains 'balanced' and the appropriate bleed rate is maintained (**Section 3.2.7**); and measuring water levels and sampling for specific parameters on a regular basis in the monitor wells, which are installed at specific locations and depths for excursion detection (**Section 3.2.2**). The excursion paramters, or Upper Control Limits (UCLs), are specific to each mine unit to be indicative of migration of lixiviant, and it is anticipated that these parameters will be chloride, conductivity, and total alkalinity. The monitoring program is described in more detail in **Section 5.7.8**, along with the control measures that will be taken should an excurion occur. Preliminary assessment of the effectiveness of these control measures is provided in **Section 3.2.7.4**, and the excursion monitoring will be tailored for each mine unit in the Hydrologic Test Plan and Report prepared for each mine unit per WDEQ.

7.4.7 Transportation Accidents

Materials transportation to and from the Project will take place in three forms: 1) shipments of yellowcake slurry from the Plant to a toll drying facility; 2) shipments of process chemicals from suppliers to the Plant; and 3) shipments of waste material to be disposed of off-site. To minimize transportation accidents, LC ISR, LLC will implement necessary prevention and response measures, such as regular road maintenance, driver safety training, using proper containers and establishing the chain of command for emergency response.

7.4.7.1 Yellowcake Slurry Shipments

The Project will regularly truck yellowcake slurry shipments (approximately 70 per year at full capacity) to licensed facilities for drying and packaging. When yellowcake slurry is transported, it is carried in specifically designed tanker trucks that are top load/unload and have a supporting superstructure. Such tanker trucks will withstand the impact of most collisions.

In the most severe conditions, an accident would result in a rupture of the tank and the release of only a portion of the slurry. During this accident, the slurry would pour onto the ground and thicken as water in the slurry soaked into the ground. The viscosity of the yellowcake slurry will reduce the chance that a spill would travel sufficient distance during a spill to enter a waterway before being contained by emergency personnel. In the unlikely event of such an accident, all yellowcake and contaminated soils would be removed and processed through a mill or disposed of at an NRC-licensed facility. All disturbed areas would then be reclaimed in accordance with all applicable state and NRC regulations.

The risk of an accident involving a yellowcake spill will be kept to a minimum by use of US DOT approved containers and exclusive-use shipments. To further reduce the environmental impact should an accident occur, personnel from LC ISR, LLC will be trained in response and cleanup and will be the primary responders in charge of cleanup of contaminated materials at the accident site.

A recent analysis of the transportation risk for trucks carrying dried yellowcake estimated that the 50-year dose commitments to the general public would be 0.14 to 2.0 man-Sievert (man-Sv), depending on the fraction of the yellowcake that was released (NRC, 1997). Exposures would likely be much lower in the worst-case Lost Creek scenario since: 1) little or no airborne release would occur due to the slurry form of the yellowcake; 2) the analysis considered the population densities in the eastern United States, which are generally much higher than Wyoming and the western US; 3) the modeled release time was 24 hours and an actual slurry spill would be contained much more quickly; and 4) the mathematical model was conservative by nearly a factor of six (DOE, 1994).

7.4.7.2 Shipment of Chemicals

The Project will receive shipments of chemicals to the Plant for the ISR operations. Examples of these are: carbon dioxide, oxygen, diesel fuel, gasoline, salt, soda ash, sulfuric acid, hydrogen peroxide and drilling mud. Local environmental impacts could occur if a truck delivering process chemicals or analytical reagents were involved in an accident. The environmental impacts would depend on the severity of the accident, the magnitude of the release, and the unique properties of the chemical. The potential for a shipping accident depends on the frequency of deliveries and the accident rates described in **Section 3.2** of the ER.

Any spills would be removed and the area would be cleaned and reclaimed. Shipments of the chemicals used in solution recovery in truck load quantities are common to many industries and present no abnormal risk. Since most of the material would be recovered or could be removed, no significant long-term environmental impact would result from a shipping accident involving these materials.

7.4.7.3 Shipments of Material for Off-site Disposal

Disposal of all 11(e)(2) byproduct waste generated by the Project will occur at an off-site, NRC-licensed disposal facility. Most shipping will occur at the end of the Project, during facility decommissioning. LC ISR, LLC is in the process of seeking access to an NRC licensed disposal facility.

All of the 11(e)(2) byproduct wastes are solid/semisolid wastes and would be easily recollected and contained in a case of an overturning accident. Cleanup and reclamation (if needed) would be conducted according to all applicable regulations and no long-term impact would be generated.

7.4.8 Other Accidents

7.4.8.1 Fires and Explosions

The fire and explosion hazard in the Permit Area will be minimal, as the Plant will not use flammable liquids in the gathering and processing of uranium into yellowcake slurry. Natural gas used for building heat or accumulation of gaseous oxygen will be the primary source for a potential fire or explosion. The products from the processing circuits will not be in a dry form; thus, the likelihood of radioactive material dispersion will be minimized in an explosion or a fire. The majority of the process tanks are not under pressure. Pressure vessels, such as those used for ion exchange and elution, will contain no flammable component, but rather ion exchange resin and lixiviant. All of the pressure vessels will have pressure relief valves installed. All of the buildings will be adequately ventilated to minimize radon exposure, which also reduces the opportunity for buildup of explosive gases in the Plant.

7.4.8.2 Tornadoes

The Project is located in Sweetwater County, Wyoming. From 1950 through 2004, 19 tornadoes have been recorded to touch down within Sweetwater County. All of these were classified as either F0, with wind speeds of 40 to 72 mph and described as gale tornadoes, or F1, with wind speeds of 73 to 112 mph and described as moderate tornadoes (Wyoming Climate Atlas – University of Wyoming, 2007). The F scales for the tornadoes is based on the Fujita Scale that is commonly used to measure the relative strength of a tornado based on the destruction.

The probability of occurrence of a tornado in the Permit Area is about one in 100,000 years to one in 1,000,000 years (Curtis and Grimes, 2007). The Permit Area is categorized as region three in relative tornado intensity. For this category, the wind speed of the "design" tornado is 240 mph, of which 190 mph is rotational and 50 mph is translational. None of the plant structures are designed to withstand a tornado of this intensity.

The nature of the operation is such that little more could be done to secure the Permit Area with advance warning than without it. The yellowcake product has the highest specific activity of any material processed at the Permit Area; however, since the material would be wet slurry, the potential environmental effects would be relatively low.

7.5 Economic and Social Effects of Construction and Operation

A summary on the socioeconomic effects of the Project is presented in **Section 7.1.11** of this report. The costs and benefits for the construction and operation of the Project are discussed in **Section 9.0** of this report. Details on the economic and social effects of the Project are presented in **Section 4.10** of the ER.

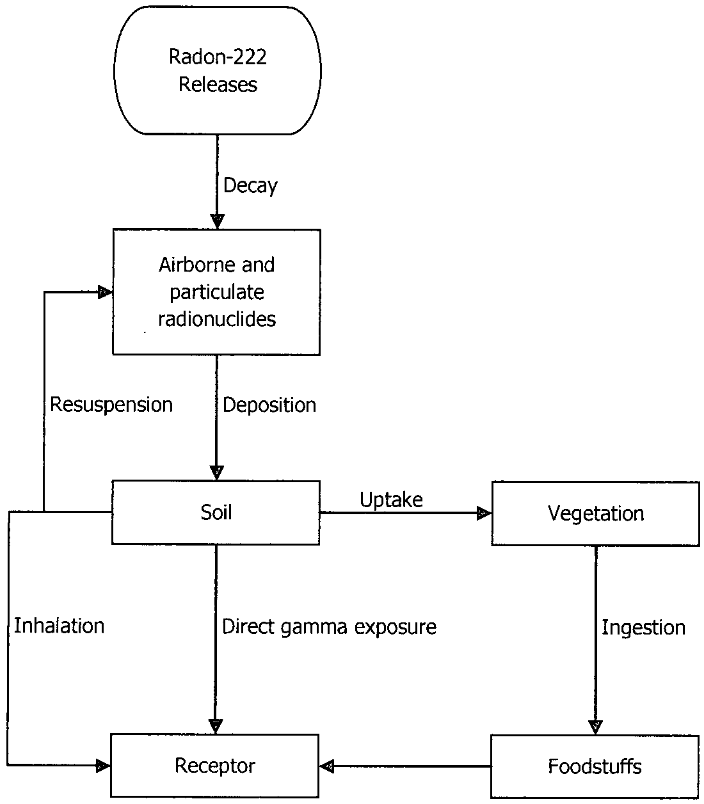

Figure 7.2-1 Pathways for Potential Human Exposures

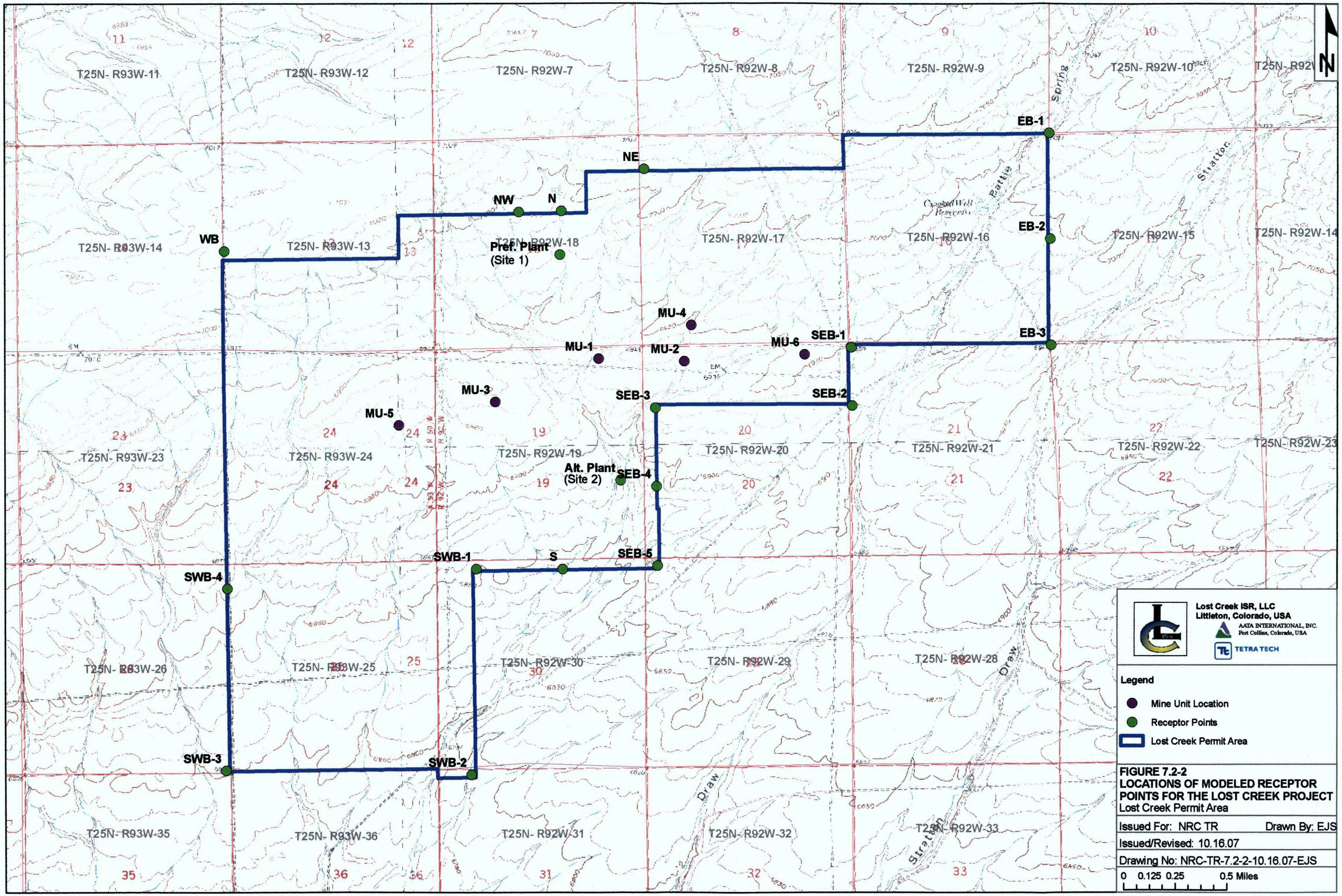

FIGURE 7.2-2
LOCATIONS OF MODELED RECEPTOR POINTS FOR THE LOST CREEK PROJECT
Lost Creek Permit Area

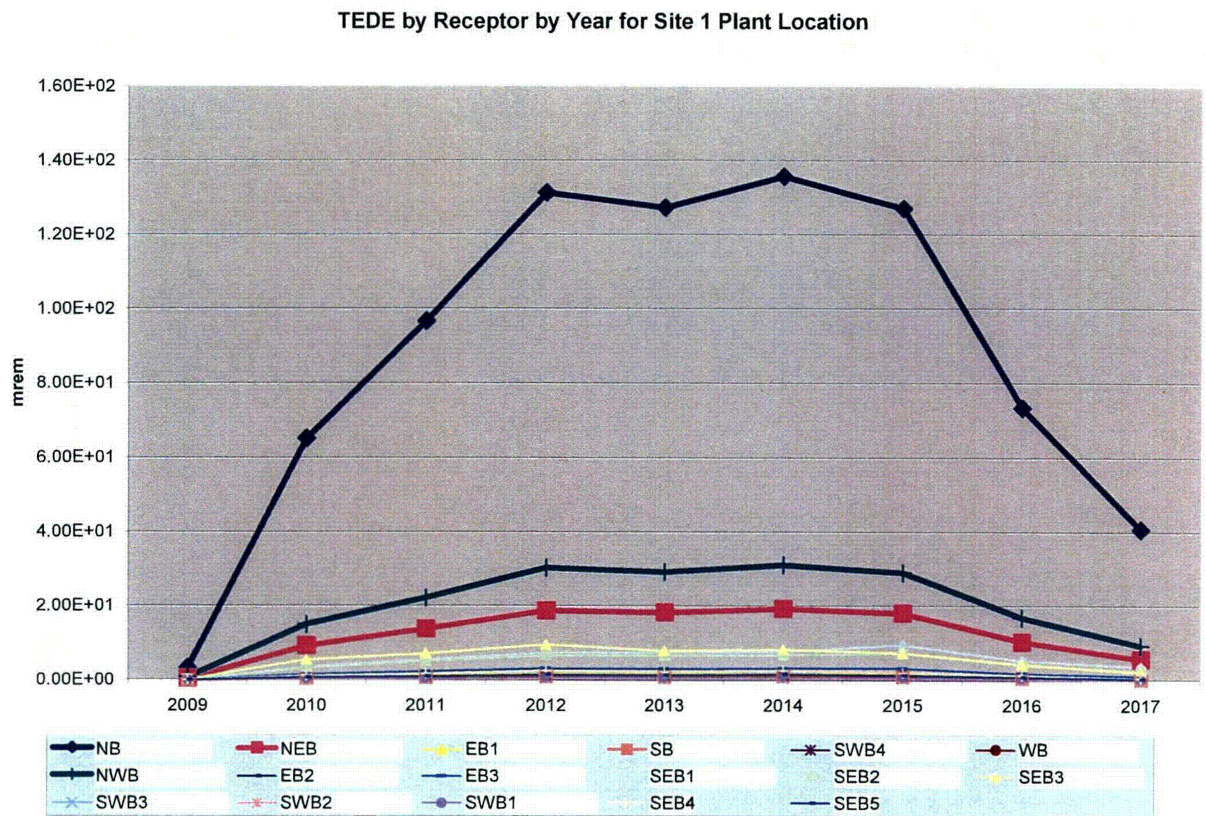

Figure 7.2-3a Total effective dose equivalent by receptor at the Site 1 Plant location

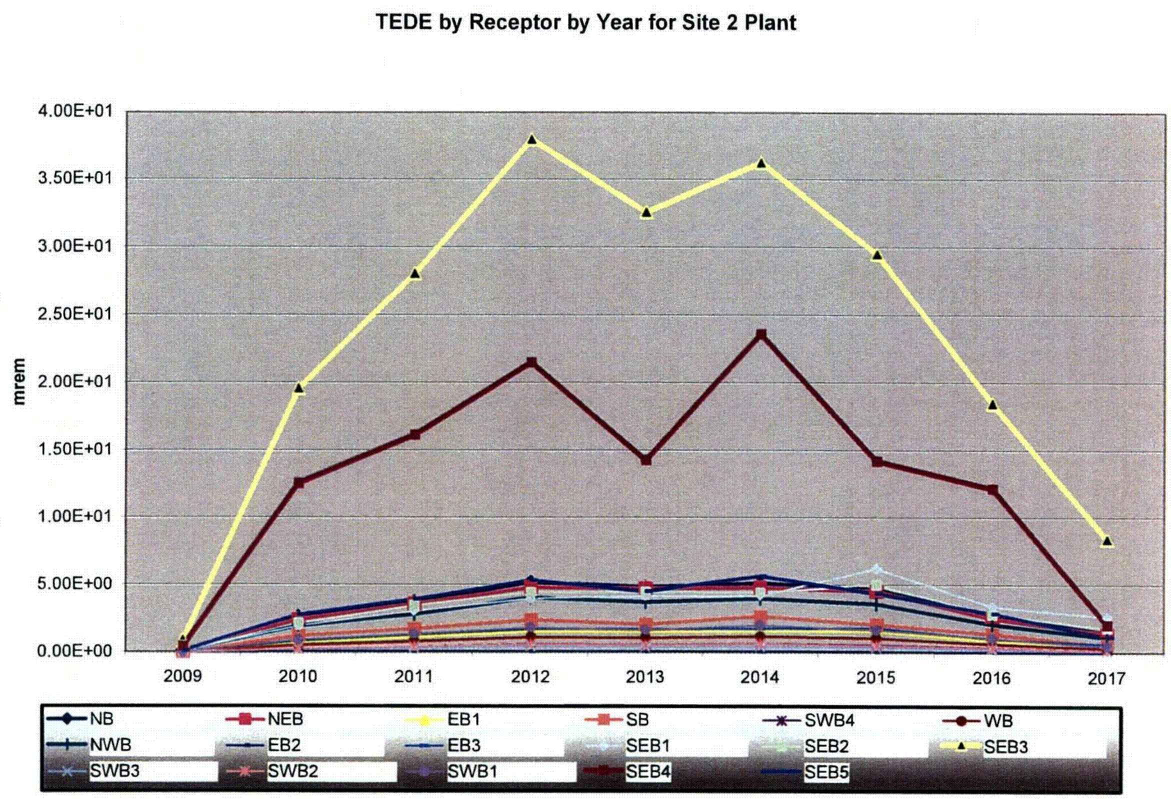

Figure 7.2-3b Total effective dose equivalent by receptor at the Site 2 Plant location

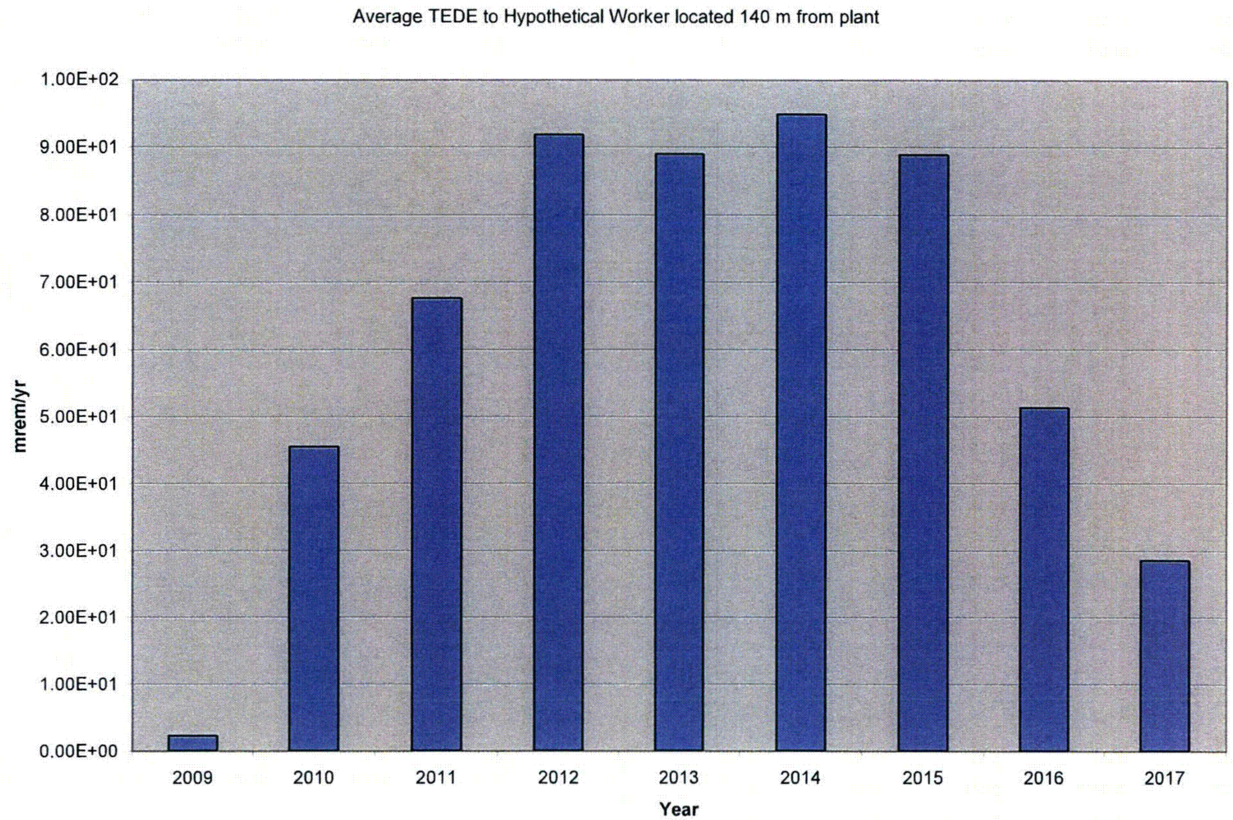

Figure 7.2-4 MILDOS-calculated doses to a hypothetical worker located 140 m from the Site 1 Plant

Table 7.1-1 **Itemized Calculations on the Areas of the Expected Disturbance**

Disturbance Type	Term of Disturbance	Acres
Roads		
Permanent main access road from the Sooner Road to the plant	Long term (≥ project life)	11.4
Permanent main roads - from plant into and through the mine unit	Long term (≥ project life)	3.4
Secondary roads- from main road to header houses	Long term (≥ project life)	4.5
Pipelines and Header Houses		
Header Houses	Long term (≥ project life)	0.4
Main Pipeline Ditch	Short term (2 weeks to 6 months)	1.0
Secondary lines (from main line to header house)	Short term (2 weeks to 6 months)	1.5
Tertiary lines (from HH to wellheads)	Short term (2 weeks to 6 months)	5.4
Mud Pits		
Mud Pits (I/P wells)	Short term (2 weeks to 6 months)	10.4
Mud Pits (Monitoring wells)	Short term (2 weeks to 6 months)	1.2
Mud Pits (Delineation Holes)	Short term (2 weeks to 6 months)	7.4
Field construction laydown areas	Short term (6 to 20 months)	1.4
Lost Creek plant compound	Long term (≥ project life)	10.0
	Total	58.0

Table 7.2-1 MILDOS Modeling Results for Plant 1 (Page 1 of 2)

Receptor	2009	2010	2011	2012	2013	2014	2015	2016	2017
	Site 1 Plant Location								
NB	3.24E+00	6.53E+01	9.67E+01	1.31E+02	1.27E+02	1.36E+02	1.27E+02	7.34E+01	4.07E+01
NEB	4.69E-01	9.39E+00	1.39E+01	1.88E+01	1.84E+01	1.93E+01	1.81E+01	1.04E+01	5.77E+00
EB1	4.10E-02	8.14E-01	1.23E+00	1.64E+00	1.62E+00	1.69E+00	1.67E+00	9.52E-01	5.58E-01
SB	2.18E-02	4.77E-01	6.97E-01	9.76E-01	8.92E-01	1.18E+00	9.30E-01	6.22E-01	2.45E-01
SWB4	1.13E-02	2.32E-01	3.39E-01	4.66E-01	4.33E-01	4.99E-01	4.29E-01	2.63E-01	1.27E-01
WB	3.04E-02	5.97E-01	8.79E-01	1.22E+00	1.17E+00	1.29E+00	1.17E+00	6.92E-01	3.63E-01
NWB	7.47E-01	1.50E+01	2.21E+01	3.03E+01	2.92E+01	3.11E+01	2.91E+01	1.68E+01	9.28E+00
EB2	2.07E-02	1.31E-01	1.32E-01	1.32E-01	1.32E-01	1.33E-01	1.32E-01	6.65E-02	1.16E-03
EB3	7.64E-02	1.52E+00	2.28E+00	3.06E+00	3.02E+00	3.14E+00	3.13E+00	1.77E+00	1.04E+00
SEB1	1.82E-01	3.65E+00	5.57E+00	7.40E+00	7.49E+00	7.75E+00	9.55E+00	5.35E+00	3.73E+00
SEB2	1.66E-01	3.33E+00	5.17E+00	6.75E+00	6.74E+00	6.83E+00	7.27E+00	4.09E+00	2.55E+00
SEB3	3.10E-01	5.55E+00	7.19E+00	9.58E+00	7.98E+00	8.32E+00	7.32E+00	4.30E+00	2.24E+00
SWB3	6.58E-03	1.46E-01	2.17E-01	2.98E-01	2.79E-01	3.13E-01	2.75E-01	1.66E-01	8.44E-02
SWB2	9.17E-03	2.08E-01	3.09E-01	4.26E-01	3.96E-01	4.57E-01	3.95E-01	2.43E-01	1.19E-01
SWB1	1.78E-02	3.81E-01	5.56E-01	7.67E-01	7.04E-01	9.23E-01	7.41E-01	4.93E-01	1.96E-01
SEB4	5.87E-02	1.20E+00	1.70E+00	2.44E+00	2.15E+00	2.59E+00	2.02E+00	1.28E+00	5.68E-01
SEB5	3.43E-02	7.13E-01	1.03E+00	1.45E+00	1.31E+00	1.61E+00	1.29E+00	8.27E-01	3.58E-01
Max	3.24E+00	6.53E+01	9.67E+01	1.31E+02	1.27E+02	**1.36E+02**	1.27E+02	7.34E+01	4.07E+01

Table 7.2-1 **MILDOS Modeling Results for Plant 1** (Page 2 of 2)

Receptor	2009	2010	2011	2012	2013	2014	2015	2016	2017
	Site 2 Plant Location								
NB	1.40E-01	2.65E+00	3.75E+00	5.21E+00	4.85E+00	5.13E+00	4.70E+00	2.71E+00	1.48E+00
NEB	1.28E-01	2.46E+00	3.62E+00	4.84E+00	4.77E+00	4.86E+00	4.57E+00	2.56E+00	1.42E+00
EB1	3.86E-02	7.68E-01	1.16E+00	1.55E+00	1.52E+00	1.59E+00	1.58E+00	8.99E-01	5.28E-01
SB	5.31E-02	1.25E+00	1.79E+00	2.44E+00	2.11E+00	2.71E+00	2.11E+00	1.41E+00	5.50E-01
SWB4	1.53E-02	3.15E-01	4.63E-01	6.32E-01	5.94E-01	6.70E-01	5.91E-01	3.56E-01	1.78E-01
WB	2.77E-02	5.42E-01	7.99E-01	1.11E+00	1.06E+00	1.18E+00	1.07E+00	6.31E-01	3.29E-01
NWB	1.03E-01	1.96E+00	2.81E+00	4.06E+00	3.73E+00	4.00E+00	3.59E+00	2.09E+00	1.12E+00
EB2	1.28E-02	8.09E-02	8.18E-02	8.28E-02	8.27E-02	8.29E-02	8.27E-02	4.17E-02	1.15E-03
EB3	4.40E-02	8.61E-01	1.30E+00	1.73E+00	1.74E+00	1.78E+00	1.84E+00	1.03E+00	6.27E-01
SEB1	9.90E-02	1.97E+00	3.06E+00	4.00E+00	4.19E+00	4.24E+00	6.26E+00	3.45E+00	2.67E+00
SEB2	1.10E-01	2.21E+00	3.50E+00	4.48E+00	4.53E+00	4.48E+00	5.06E+00	2.81E+00	1.84E+00
SEB3	8.94E-01	1.96E+01	2.81E+01	3.80E+01	3.26E+01	3.63E+01	2.95E+01	1.85E+01	8.43E+00
SWB3	9.02E-03	2.01E-01	3.00E-01	4.10E-01	3.83E-01	4.27E-01	3.77E-01	2.27E-01	1.17E-01
SWB2	1.28E-02	3.05E-01	4.51E-01	6.18E-01	5.64E-01	6.53E-01	5.56E-01	3.45E-01	1.66E-01
SWB1	4.22E-02	9.28E-01	1.35E+00	1.84E+00	1.67E+00	2.03E+00	1.69E+00	1.08E+00	4.74E-01
SEB4	4.68E-01	1.26E+01	1.62E+01	2.15E+01	1.43E+01	2.36E+01	1.43E+01	1.22E+01	2.05E+00
SEB5	1.19E-01	2.78E+00	3.95E+00	5.34E+00	4.54E+00	5.67E+00	4.39E+00	2.91E+00	1.16E+00
Max	8.94E-01	1.96E+01	2.81E+01	3.80E+01	3.26E+01	**3.63E+01**	2.95E+01	1.85E+01	8.43E+00

Table 7.2-2 MILDOS-Calculated Doses to a Hypothetical Worker Located 140 m from Plant 1

	TEDE (mrem/yr)								
Location	2009	2010	2011	2012	2013	2014	2015	2016	2017
NE (0.1, 0.1, 1)	2.93E+00	5.91E+01	8.77E+01	1.19E+02	1.15E+02	1.23E+02	1.15E+02	6.68E+01	3.70E+01
SE (0.1, -0.1, 1)	3.80E+00	7.65E+01	1.14E+02	1.54E+02	1.49E+02	1.59E+02	1.49E+02	8.63E+01	4.80E+01
SW (-0.1, -0.1, 1)	1.47E+00	2.96E+01	4.39E+01	5.98E+01	5.79E+01	6.18E+01	5.79E+01	3.33E+01	1.85E+01
NW (-0.1, -.1, 1)	8.40E-01	1.70E+01	2.51E+01	3.41E+01	3.30E+01	3.52E+01	3.29E+01	1.90E+01	1.06E+01
Average	2.26E+00	4.55E+01	6.76E+01	9.18E+01	8.90E+01	9.49E+01	8.89E+01	5.14E+01	2.85E+01

Table 7.2-3 Population of towns within 50 miles (80 km) from the Permit Area *

Town	Direction	Distance (km)	Population
Rawlins	SE	75	8500
Jeffrey City	NNE	40	110
Wamsutter	S	50	275
Bairoil	ENE	35	100

* (Census Bureau (US), 2000e)

Table 7.2-4 **Estimated Doses to Populations Surrounding the Permit Area**

	2009	2010	2011	2012	2013	2014	2015	2016	2017
	Total Effective Dose Equivalent (person-rem)								
Population within 80 km	3.25E-03	6.40E-02	9.48E-02	1.28E-01	1.25E-01	1.33E-01	1.26E-01	7.29E-02	4.01E-02
Population Outside 80 km	1.11E+00	2.18E+01	3.24E+01	4.39E+01	4.27E+01	4.54E+01	4.29E+01	2.47E+01	1.37E+01
All Populations	1.11E+00	2.19E+01	3.25E+01	4.40E+01	4.29E+01	4.56E+01	4.30E+01	2.48E+01	1.37E+01
	Bronchial Dose (person-rem)								
Population within 80 km	1.12E-01	2.20E+00	3.26E+00	4.41E+00	4.30E+00	4.56E+00	4.31E+00	2.47E+00	1.37E+00
Population Outside 80 km	4.62E+00	9.10E+01	1.35E+02	1.83E+02	1.79E+02	1.90E+02	1.79E+02	1.03E+02	5.73E+01
All Populations	4.73E+00	9.32E+01	1.39E+02	1.88E+02	1.83E+02	1.94E+02	1.83E+02	1.06E+02	5.86E+01

Attachment 7.2-1

Estimated Radiation Doses from the Lost Creek ISR, LLC Lost Creek In Situ Recovery Facility

September 2007

INTRODUCTION

Lost Creek ISR, LLC (LC ISR, LLC) is planning to construct and operate an in situ facility for recovery of uranium at a location in central Wyoming in the vicinity of Lost Creek (Lost Creek Project). The permit area is approximately 50 miles northwest of Rawlins, WY in the Great Divide Basin. In order to estimate the potential impact to members of the public residing near the facility, radiation doses were modeled using the MILDOS-AREA code. MILDOS-AREA has been approved for this use by the United States (US) Nuclear Regulatory Commission (NRC).

PROJECT DESCRIPTION

The Lost Creek Project (Project) will consist of six mine units that will be developed for injection and recovery of uranium leaching solutions over an eight year period. The leaching solution or lixiviant, which consists of groundwater augmented with oxygen and carbon dioxide, is pumped into the underground orebody to mobilize the uranium. Extraction wells remove the lixiviant containing uranium (pregnant solution) from the orebody. The uranium is then extracted from the pregnant solution by passing through ion exchange columns.

Mine units and processes are staged as shown in Figure 1. The plan calls for installation of new wells in Mine Unit 1 to begin in 2009 and be completed in 2010. The underground ore will be lixiviated (termed "Production" on the figure) beginning approximately eight months following the initiation of new well installation. Production in Mine Unit 1 will continue into the second quarter (Q2) of 2011. Restoration of MU-1 will begin in the third quarter (Q3) of 2011 and continue for approximately the first half of 2012 (Q1-2). Mine Units 2-6 will follow the same pattern with initiation of each subsequent unit in the year following the previous mine unit installation.

The Ion Exchange facility, located at the main plant, will be operational beginning in the fourth quarter (Q4) of 2009 and will continue more or less constantly through the first half of 2016. Lixiviant will be pumped from each active mine unit to the Ion Exchange facility for elution.

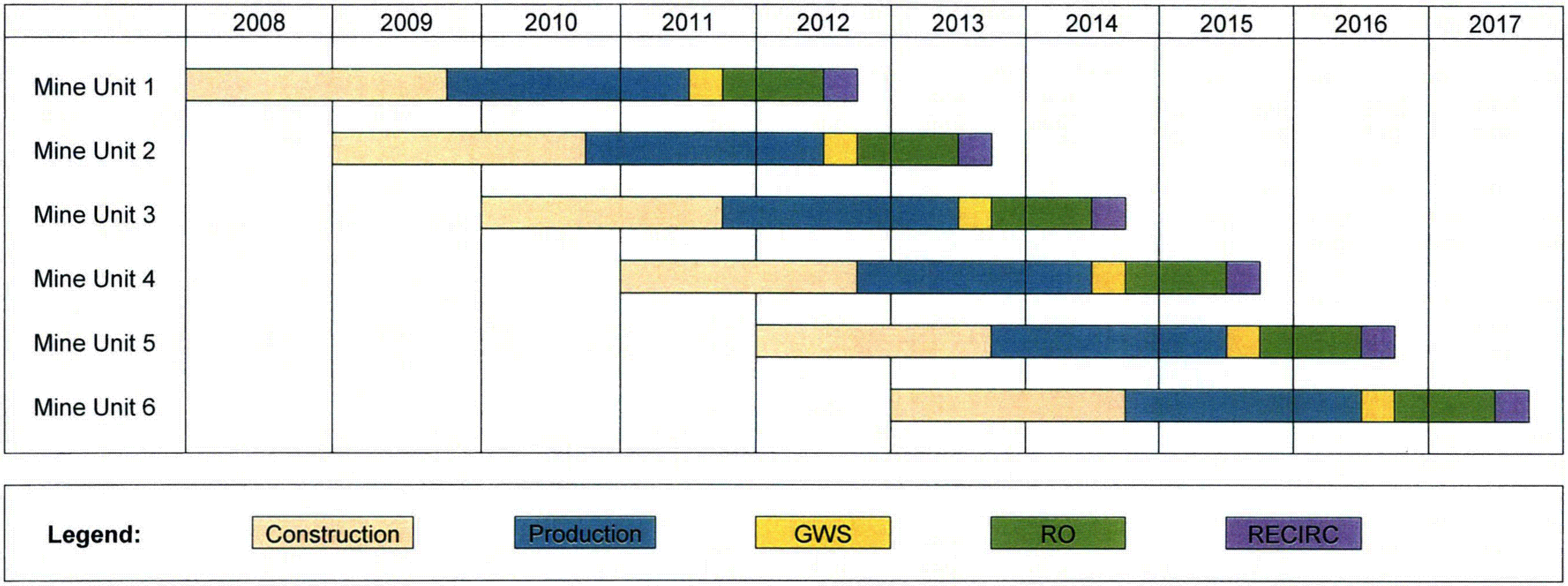

Figure 1 **Staging of various processes at the Lost Creek ISR facility.**

POTENTIAL RADIOACTIVE EFFLUENTS

Uranium-238 (U-238) in the orebody ultimately decays to Ra-226 and then Rn-222. Uranium (including U-238, U-234, and U-235) and radon are soluble in the leach solution and may be released during operations. Because the facility will not have a dryer, there is no potential for release of radionuclides in airborne particulates. Thus, radon gas is the only potential radioactive effluent. The MILDOS code was used to estimate potential doses to members of the public and workers from radon released during the following operations.

- New wells: When drilling new wells into the orebody, drill cuttings, including ore, are transported to the surface in drilling mud. Cuttings are temporarily storing in mud pits where Rn-222 may be released to the atmosphere.
- Producing mine units: Radon this is dissolved in the lixiviant may be released in two ways, either from purge water or from gas venting at the wellhead.
- Ion Exchange columns: Radon gas may be released from the columns as a function of the volume of the columns, the porosity of the resin and the unloading rate of the column.
- Restoration activities: During the restoration of the mine units, water is circulated within and discharged from the wells in release rates similar to those from producing mine units.

MILDOS MODELING

The computer code MILDOS-AREA was used to estimate potential radiation doses from planned Lost Creek ISR operations. MILDOS (ANL, 1989) was originally developed to estimate doses from conventional uranium milling operations, including large area releases such as ore storage pads and tailings beaches. Inputs to the dose are limited to uranium decay chain radionuclides. MILDOS was subsequently updated in 1998 to address potential impacts of uranium in situ leaching operations. ISR-specific types of source terms, such as production wells and restoration wells are included in the updated version. Modeling assumptions and parameters are addressed below.

METEOROLOGY

Meteorological conditions greatly influence dispersion of radionuclides from estimated releases during the year. LC ISR, LLC has a meteorological station about 9.5 miles northeast of the Lost Creek Permit Area (Premit Area) that records wind speed, wind direction, and stability class simultaneously. Data for the period April 2006 through April 2007 were converted to the site-specific joint frequency distribution (STAR file) required as input by MILDOS. These calculations were performed using the STARMD program which is based on the Sigma-Theta method in the Environmental Protection Agency (EPA) 454/R-99-005 (EPA, 1987). STAR data represent percentages of time for each wind direction (16 compass points) in particular wind speed and stability classes.

INPUT PARAMETERS

Important parameters for various source types are shown in **Table 2**. Size and mine unit-dependent parameters are given in **Table 3**. The specific mine unit parameters include location relative to the Central Plant or Ion Exchange Facility.

Table 2 Important input parameters.

All sources	Thickness of orebody	3.7 m
	Density of orebody	1.94 g/L
New Well sources	Number of mud pits/yr	935
	Ore material added to mudpits	2.3E5 kg per year
	Duration of storage in mudpit	4 days
	percent U_3O_8	0.055percent
Production Mine Unit sources	Emanation fraction	0.25
	Fraction of radon in solution	0.80
	Rate of radon venting	0.01 per day
	Treated water purge rate	3.3E5 liters per day
	Percent U_3O_8	0.055percent
	Volume in circulation	Varies with size of unit
Ion Exchange columns	Column volume	1.41E5 liters
	Column unloading rate	0.68 per day
	Porosity of resin	0.4
	percent U_3O_8	0.055percent
Restoration mine unit sources	Emanation fraction	0.25
	Volume in circulation	Varies with size of unit
	Operating days	365 per year
	Treated water purge rate	7.63E5 liters

Table 3 Mine unit-specific parameters.

Mine Unit	MU-1	MU-2	MU-3	MU-4	MU-5	MU-6
X (km)*	0.29	0.96	-0.51	1.02	-1.27	1.90
Y (km)*	-0,80	-0.83	-1.14	-0.55	-1.32	-0.77
Z (m)*	-13.4	-11.3	-10.7	-5.8	-14.9	-4.6
Area of active drilling (m^2)	1.66E5	1.62E5	1.55E5	1.69E5	1.88E5	1.88E5
Volume in circulation (L)	6.53E5	7.57E5	9.52E5	1.16E6	1.40E6	1.47E6
* Relative to IX plant (0,0,0)						

RECEPTOR LOCATIONS

There are no nearby permanent residents near the facility, so receptors were placed at the property boundary as listed in **Table 4**.

Table 4 Receptor locations.

Receptor	X (km)	Y (km)	Z (m)
NB	0.00	0.33	0.61
NEB	0.66	0.66	9.14
EB1	3.80	0.92	-3.96
EB2	3.81	0.11	3.66
EB3	3.81	-0.69	-8.53
SEB1	2.26	-0.71	-11.6
SEB2	2.26	-1.16	-17.7
SEB3	0.73	-1.18	-15.2
SB	0	-2.41	-45.1
ALT Plant (Site 2)	0.74	-1.77	-36.0
SWB1	-0.66	-2.42	-39.0
SWB2	-0.64	-4.06	-60.4
SWB3	-2.57	-4.07	-57.3
SWB4	-2.58	-2.58	-33.2
WB	-2.61	0	9,75
NWB	-0.33	0.33	3.66
PREF Plant (Site 1)	0	0	0

Locations of proposed Plants and centroids of the various mine units, as well as specific receptor locations are also shown **Figure 2**.

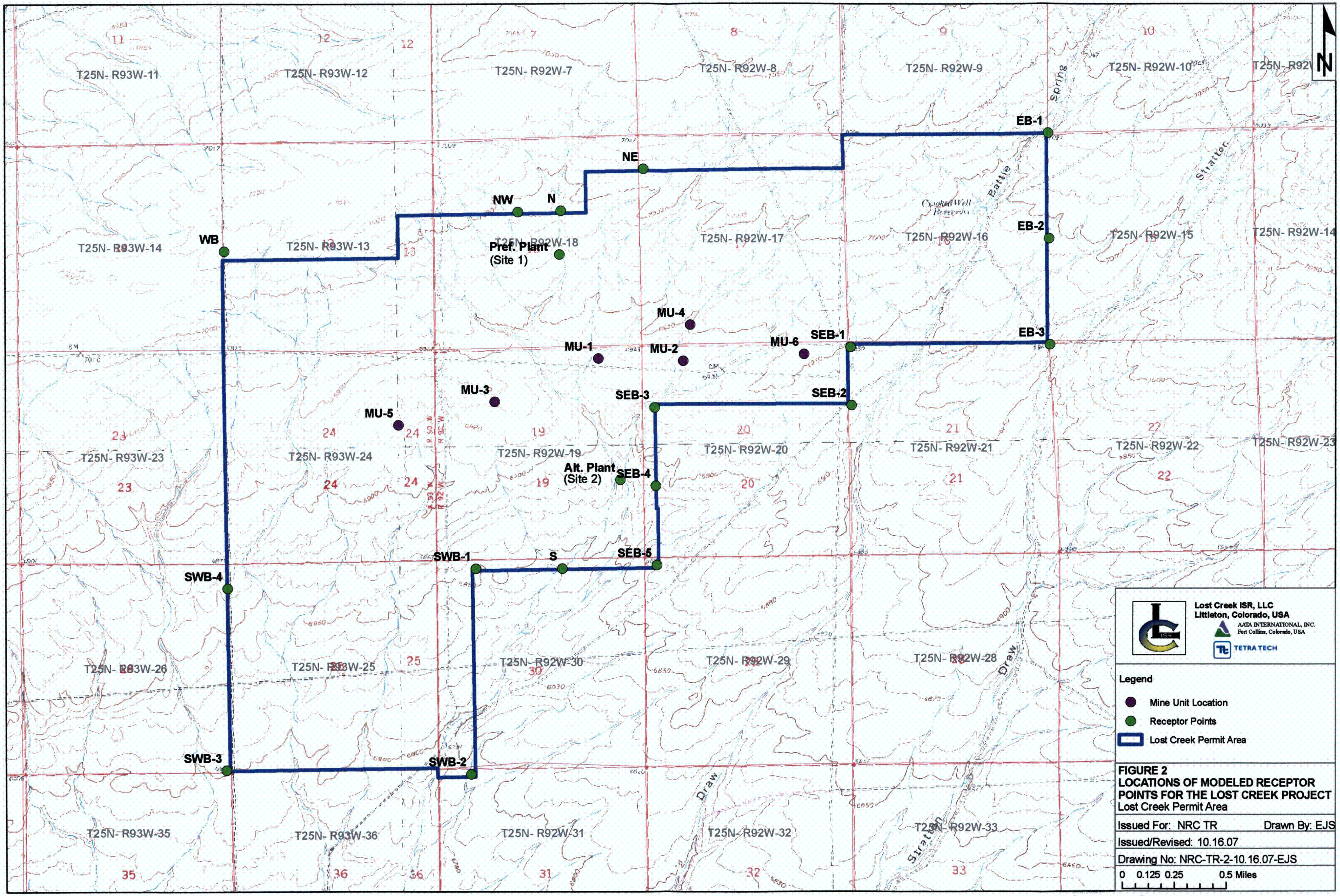

FIGURE 2
LOCATIONS OF MODELED RECEPTOR POINTS FOR THE LOST CREEK PROJECT
Lost Creek Permit Area

POPULATION DISTRIBUTION

There are no towns of any size within 30 km from the proposed site. However, towns within 80 km from the Permit Area include Rawlins, Jeffrey City, Wamsutter, and Bairoil. Directions, distances and census data are listed in Table 5.

Table 5 Population distribution surrounding the Lost Creek site.

Town	Direction	Distance (km)	Population
Rawlins	SE	75	8500
Jeffrey City	NNE	40	110
Wamsutter	S	50	275
Bairoil	ENE	35	100

SOURCE STRENGTH

The QADJUST factor in MILDOS was used to adjust the timing and fraction of a year that various sources operated in keeping with the pattern shown in **Figure 1**. The annual rate of release from a specific mine unit was varied depending timing of the release. For example, if a source operated for only 0.75 year, QADJUST was set at 0.75 to account for that diminished output on a yearly basis. By varying QADJUST in this way, it was possible to plot the variation in dose as the project progresses.

MODELING ASSUMPTIONS

Sources were modeled according to the staging shown in **Figure 1**. New wells, producing mine units, and restoration were modeled using the MILDOS-prescribed format and inputs for that type of source. Releases from the Ion Exchange columns were modeled as a point source with an average Rn-222 release rate as calculated by the MILDOS production well model. Venting from producing mine units and restoration wells were calculated assuming that the venting occurred at the centroid of the mine unit under consideration. Because no water is released at the location of the mine unit, purge water for the producing mine unit and restoration wells was assumed to occur at the location of the Ion Exchange columns.

Two sites were modeled for the location of the Ion Exchange columns and the purge water releases. Site 1 is situated in the Northwest Quarter of the Southweast Quarter of Section 18, Township 25 north, Range 92 west and is the 0,0 point for the MILDOS modeling. Site 2 is situated in the Southeast Quarter of the Northeast Quarter of Section 18, Township 25 north, Range 92 west. Hence, Site 2 is located -1.736 km (to the south), 0.478 km (to the east) from the Site 1 location. Results are summarized below for both sites.

MODEL RUNS

Dose modeling was conducted in several MILDOS Code runs as follows.

- New Wells were modeled for each of the six proposed mine units over a total period of seven annual time steps beginning in 2009.
- Production Wells were modeled for each mine unit over a total period of eight annual time steps from 2009 through 2016. Venting and water purging were modeled separately because of the different release locations for those activities.
- Ion Exchange Facility operation was modeled over a series of eight annual time steps from 2009 to 2016.
- Restoration was modeled for each mine unit over a total period of seven annual time steps from 2011 to 2017.
-

As described above, the period of each year in which dose was calculated was varied using the QADJUST factor. So, for some time steps, certain mine units would be turned on or off depending on the staging shown in **Figure 1** above.

MODELING RESULTS

INDIVIDUAL RECEPTOR LOCATIONS

Site 1 Plant Location

Estimated annual doses at individual receptor locations from the Site 1 location for the Ion Exchange columns are shown below in **Table 6** and **Figure 3**. The total effective dose equivalent (TEDE) for the north boundary (NB) location exceeds the 10 CFR 20 allowable level of 100 mrem/yr for year 2012 to 2015, with 2014 being the maximum year. This dose results exclusively from exposure to radon decay products, since there are no particulate releases from the facility. For this reason, the 40 CFR 190 annual dose commitments are zero in all cases. The TEDE result is understandable because the potential plant site is located only 300 m south of the NB receptor location. For this plant location, no other property boundary receptor exceeds 100 mrem/yr. As mentioned above there are no nearby residences.

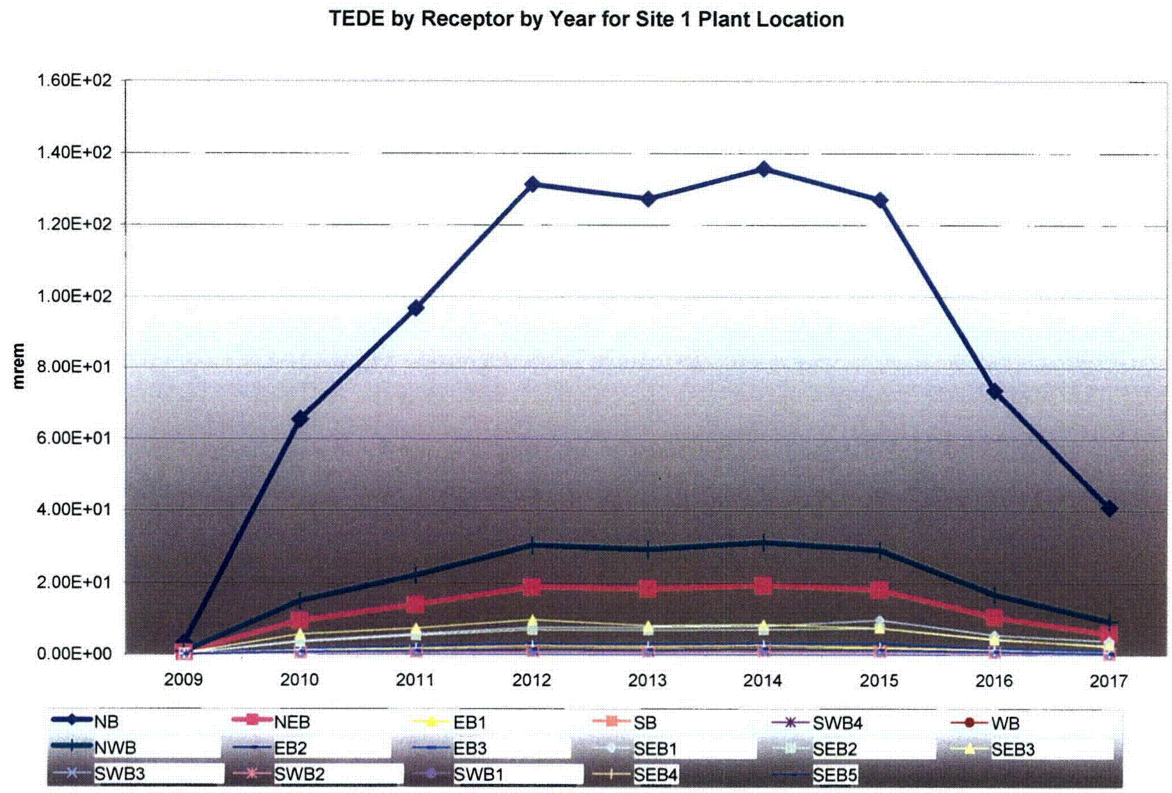

Figure 3. Estimated Dose by Year for the Site 1 Plant Location.

As shown in **Figure 4**, the vast majority of the dose to the NB receptor location results from releases of purge water at the ion exchange plant during production and restoration phases. Again, this is consistent with the relatively close proximity of the proposed plant location to the north boundary of the facility.

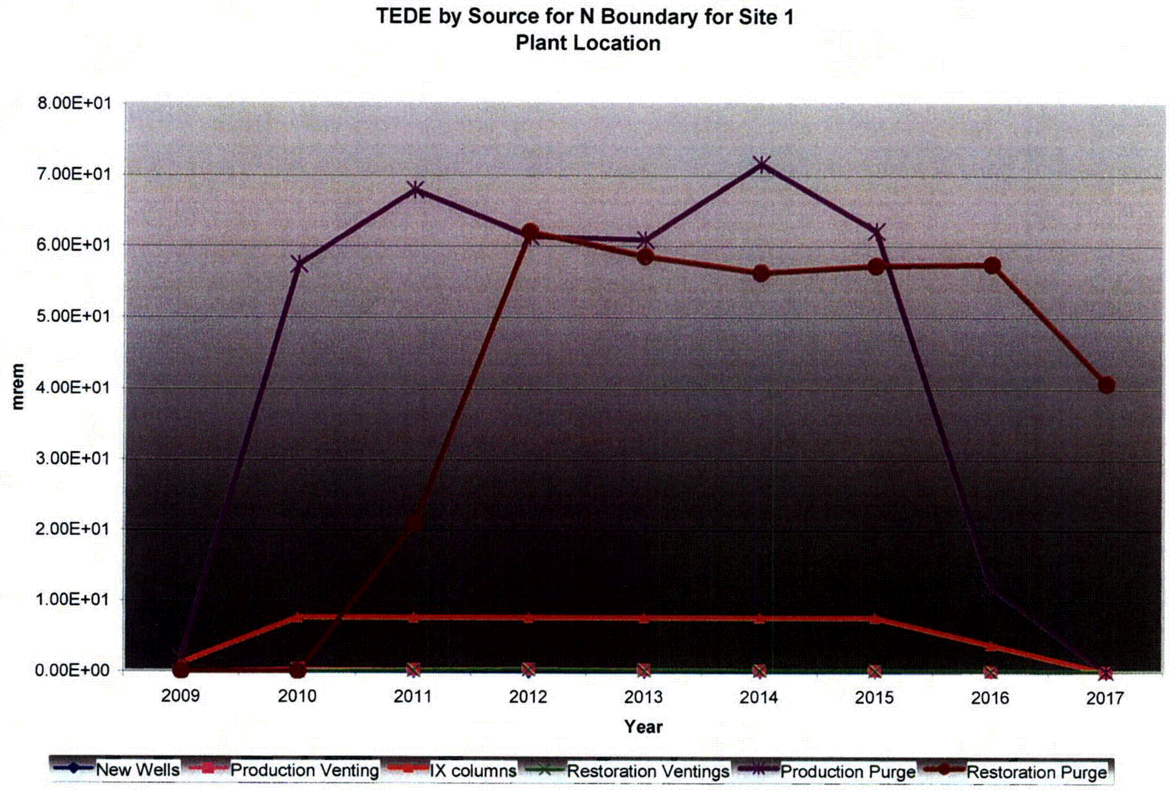

Figure 4 Estimated Dose for North Boundary for Site 1 Plant Location

Because of the proximity of the Site 1 Plant Location to the north boundary, the decrease in dose with distance from the north boundary was also evaluated. As shown in **Figure 5**, the estimated dose decreases rapidly, and is below 40 mrem/yr within about 1,000 feet of the boundary.

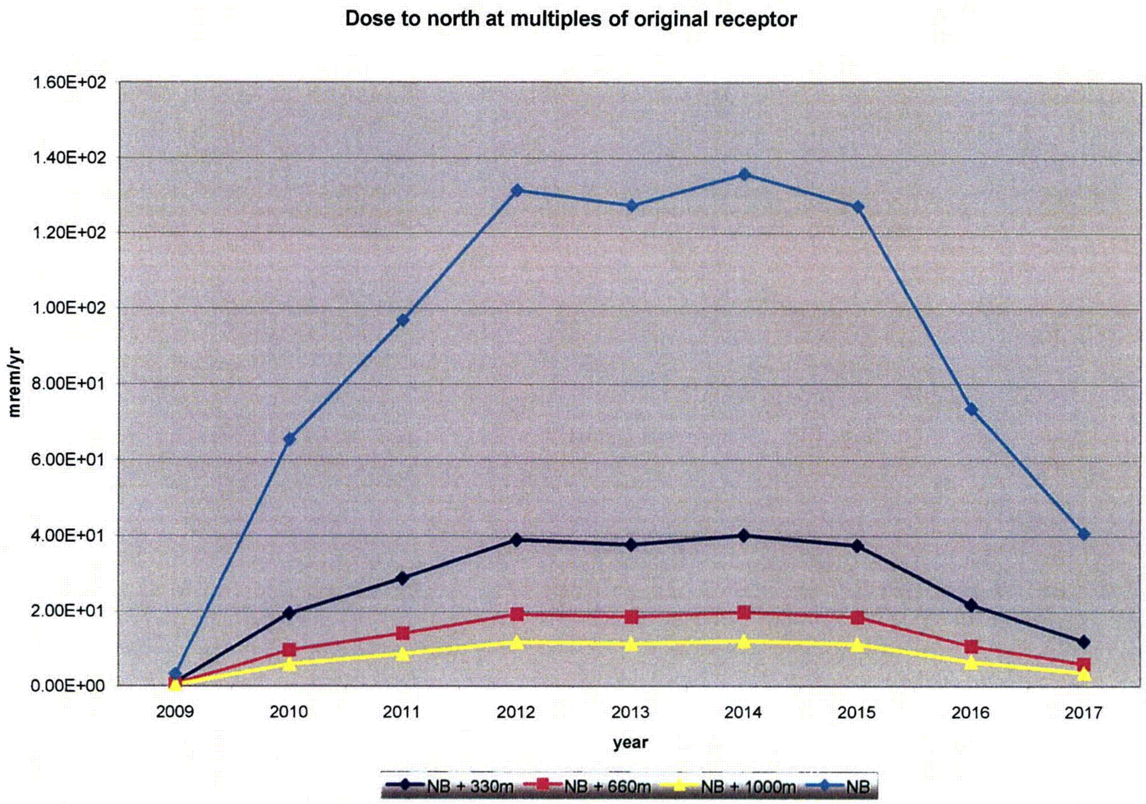

Figure 5 **Estimated Dose for North Boundary for Site 1 Plant Location**

Site 2 Plant Location

Estimated annual doses at individual receptor locations assuming the Ion Exchange columns are located at Site 2 are shown below in **Table 7** and **Figure 6**. The maximum TEDE for any receptor assuming the Site 2 Ion Exchange Facility location is at SEB3 with an annual estimated dose less than 40 mrem in 2012. SEB3 is approximately due east of the Mine Unit 3 centroid and to the northeast of the Site 2 Plant location. This dose results exclusively from exposure to radon decay products, since there are no particulate releases from the facility. For this plant location, no other property boundary receptor exceeds 25 mrem/yr. As mentioned above there are no nearby residences.

Table 7. Summary - TEDE to Maximum Individual by Location & Year (mrem/yr)

Receptor	2009	2010	2011	2012	2013	2014	2015	2016	2017
NB	1.40E-01	2.65E+00	3.75E+00	5.21E+00	4.85E+00	5.13E+00	4.70E+00	2.71E+00	1.48E+00
NEB	1.28E-01	2.46E+00	3.62E+00	4.84E+00	4.77E+00	4.86E+00	4.57E+00	2.56E+00	1.42E+00
EB1	3.86E-02	7.68E-01	1.16E+00	1.55E+00	1.52E+00	1.59E+00	1.58E+00	8.99E-01	5.28E-01
SB	5.31E-02	1.25E+00	1.79E+00	2.44E+00	2.11E+00	2.71E+00	2.11E+00	1.41E+00	5.50E-01
SWB4	1.53E-02	3.15E-01	4.63E-01	6.32E-01	5.94E-01	6.70E-01	5.91E-01	3.56E-01	1.78E-01
WB	2.77E-02	5.42E-01	7.99E-01	1.11E+00	1.06E+00	1.18E+00	1.07E+00	6.31E-01	3.29E-01
NWB	1.03E-01	1.96E+00	2.81E+00	4.06E+00	3.73E+00	4.00E+00	3.59E+00	2.09E+00	1.12E+00
EB2	1.28E-02	8.09E-02	8.18E-02	8.28E-02	8.27E-02	8.29E-02	8.27E-02	4.17E-02	1.15E-03
EB3	4.40E-02	8.61E-01	1.30E+00	1.73E+00	1.74E+00	1.78E+00	1.84E+00	1.03E+00	6.27E-01
SEB1	9.90E-02	1.97E+00	3.06E+00	4.00E+00	4.19E+00	4.24E+00	6.26E+00	3.45E+00	2.67E+00
SEB2	1.10E-01	2.21E+00	3.50E+00	4.48E+00	4.53E+00	4.48E+00	5.06E+00	2.81E+00	1.84E+00
SEB3	8.94E-01	1.96E+01	2.81E+01	3.80E+01	3.26E+01	3.63E+01	2.95E+01	1.85E+01	8.43E+00
SWB3	9.02E-03	2.01E-01	3.00E-01	4.10E-01	3.83E-01	4.27E-01	3.77E-01	2.27E-01	1.17E-01
SWB2	1.28E-02	3.05E-01	4.51E-01	6.18E-01	5.64E-01	6.53E-01	5.56E-01	3.45E-01	1.66E-01
SWB1	4.22E-02	9.28E-01	1.35E+00	1.84E+00	1.67E+00	2.03E+00	1.69E+00	1.08E+00	4.74E-01
SEB4	4.68E-01	1.26E+01	1.62E+01	2.15E+01	1.43E+01	2.36E+01	1.43E+01	1.22E+01	2.05E+00
SEB5	1.19E-01	2.78E+00	3.95E+00	5.34E+00	4.54E+00	5.67E+00	4.39E+00	2.91E+00	1.16E+00
Maximum	8.94E-01	1.96E+01	2.81E+01	3.80E+01	3.26E+01	3.63E+01	2.95E+01	1.85E+01	8.43E+00

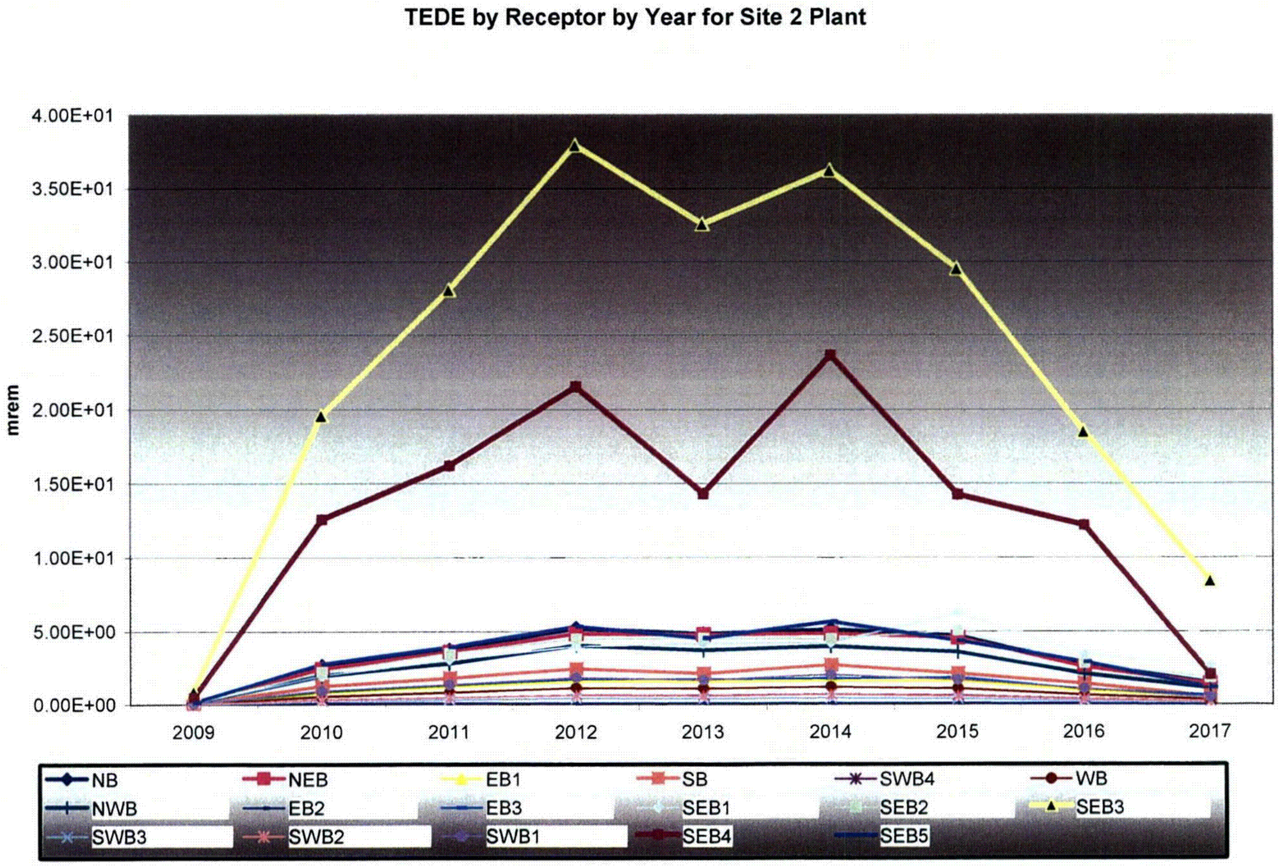

Figure 6 Estimated Dose by Year for the Site 2 Plant Location.

The vast majority of the dose to the SEB3 receptor location results from releases of purge water at the ion exchange plant during production and restoration phases, as shown in **Figure 7**. Doses from other sources are a few mrem/yr.

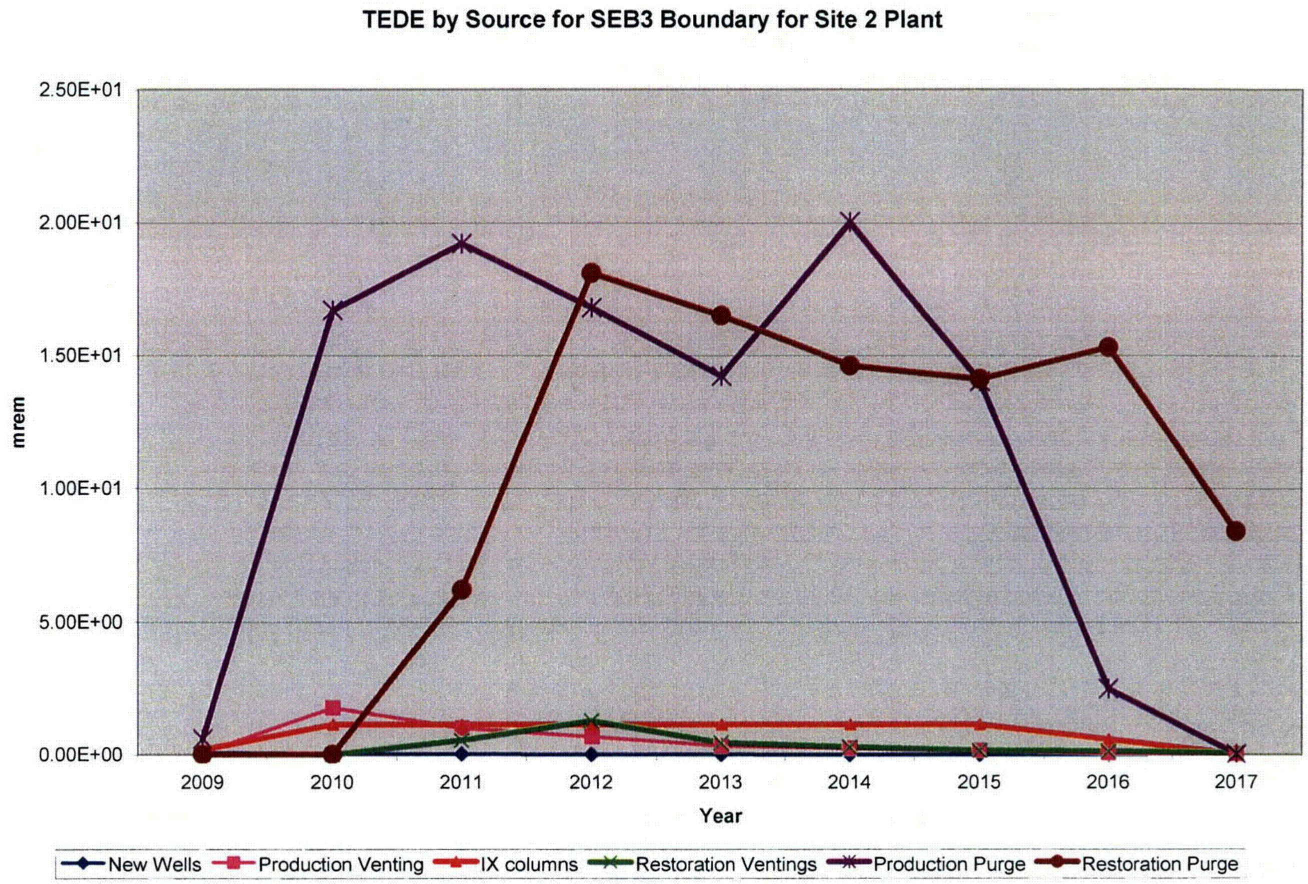

Figure 7 Estimated Dose for SEB3 Receptor Location from Site 2 Plant Location

Potential Radon Releases from Storage Ponds

Two Storage Ponds are proposed for the site. In total, they encompass approximately 1.85 acres (7.5E3 m^2). The ponds will continuously contain water a minimum of one foot deep with a maximum depth of 4 feet. Water contained in the ponds will have a concentration of approximately 950 pCi/L of Ra-226. Potential releases from the ponds were calculated using the web-based Uranium Mill Tailings Radon Flux Calculator (http://www.wise-uranium.org/ctb.html?unit=c) and making conservative assumptions for every parameter.

The calculator is designed to estimate radon flux from either bare or water-covered uranium mill tailings, but input parameters were varied to simulate a pond. It uses the calculations described in Nielson (1986), although this was not verified with the original reference. Key parameters are as follows:

- tailings concentrations: 500 pCi per gram;
- fraction of pond area less than one meter deep: 1.0;
- Average depth of ponds: 0.6 meters;
- Ra-226 concentration in pond water: 951 pCi/L based on analytical data from the site;
- Effective stagnant water transport coefficient: 3E-7 m^2 per second (m^2/s). The web site cites Nielson (1986);
- Pond surface area: 7.5E-3 m^2; and
- Rn-222 effective diffusion coefficient: 1e-10 m^2/s. This is the coefficient for fully saturated soil material, so it is likely adequate to estimate diffusion in water.

Based on the above parameters, the equation estimates a Rn-222 release from the ponds of 1.2 Curies per year (Ci/y). This represents roughly 0.5percent of the annual total that results from the ion exchange columns (224 Ci/y). In terms of dose, this means that doses from the evaporation ponds would represent 0.18 mrem/yr to the maximum receptor if released at the Plant 1 location and 0.06 mrem/yr to the maximum receptor if released at the Plant 2 location. These releases and doses are negligible and were not modeled using MILDOS.

POPULATION DOSES

Using populations as shown in **Table 5** above, population doses (person-rem/yr) from Site 1 releases were calculated for both total effective dose equivalent (TEDE) and the dose to the bronchial epithelium of receptors. Population dose results are summarized in **Table 8**. The maximum estimated annual population dose, 0.13 person-rem within 80 km and 45.6 person-rem to all populations, occurs in 2014 as expected, based on results for individual receptors. While there is no regulatory limit for population dose, it is interesting to compare results in **Table 6** to exposures from natural background. Again using the population data in **Table 5**, and assuming 350 mrem/yr from natural background, the natural background population dose would be approximately 3.1E3 person-rem/yr, or approximately 24,000 times higher than the maximum year of the Project. Population doses from releases from the Site 2 placement of the plant are effectively the same, which is understandable given the minimal change in distance relative to the population distribution.

Table 8 **Dose to populations surrounding the proposed site.**

	2009	2010	2011	2012	2013	2014	2015	2016	2017
	Total Effective Dose Equivalent (person-rem)								
Population within 80 km	3.25E-03	6.40E-02	9.48E-02	1.28E-01	1.25E-01	1.33E-01	1.26E-01	7.29E-02	4.01E-02
Population outside 80 km	1.11E+00	2.18E+01	3.24E+01	4.39E+01	4.27E+01	4.54E+01	4.29E+01	2.47E+01	1.37E+01
All populations	1.11E+00	2.19E+01	3.25E+01	4.40E+01	4.29E+01	4.56E+01	4.30E+01	2.48E+01	1.37E+01
	Bronchial Dose (person-rem)								
Population within 80 km	1.12E-01	2.20E+00	3.26E+00	4.41E+00	4.30E+00	4.56E+00	4.31E+00	2.47E+00	1.37E+00
Population outside 80 km	4.62E+00	9.10E+01	1.35E+02	1.83E+02	1.79E+02	1.90E+02	1.79E+02	1.03E+02	5.73E+01
All populations	4.73E+00	9.32E+01	1.39E+02	1.88E+02	1.83E+02	1.94E+02	1.83E+02	1.06E+02	5.86E+01

OCCUPATIONAL DOSES

Potential annual doses to a worker at the facility were modeled using MILDOS by creating a hypothetical receptor nearby the Site 1 plant. Four locations of the worker were defined by varying the (x,y) coordinates in km as (0.1, 0.1), (0.1, -0.1), (-0.1, -0.1) and (-0.1, 0.1). The hypothetical worker is therefore located 141 meters NE, SE, SW, and NW from the plant. Annual doses were calculated to each worker location, multiplied by 0.22 (2000/8760) and averaged (**Table 9, Figure 8**). Calculated doses peak in 2014 and are well below occupational limits. For the specific locations modeled, these doses likely overestimate worker doses, because MILDOS includes food intake pathways that would not be applicable to the milling facility.

Table 9 Dose to "Worker" Locations Calculated by MILDOS.

	TEDE (mrem/yr)								
Location	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
NE (0.1, 0.1, 1)	2.93E+00	5.91E+01	8.77E+01	1.19E+02	1.15E+02	1.23E+02	1.15E+02	6.68E+01	3.70E+01
SE (0.1, -0.1, 1)	3.80E+00	7.65E+01	1.14E+02	1.54E+02	1.49E+02	1.59E+02	1.49E+02	8.63E+01	4.80E+01
SW (-0.1, -0.1, 1)	1.47E+00	2.96E+01	4.39E+01	5.98E+01	5.79E+01	6.18E+01	5.79E+01	3.33E+01	1.85E+01
NW (-0.1, -.1, 1)	8.40E-01	1.70E+01	2.51E+01	3.41E+01	3.30E+01	3.52E+01	3.29E+01	1.90E+01	1.06E+01
Average	2.26E+00	4.55E+01	6.76E+01	9.18E+01	8.90E+01	9.49E+01	8.89E+01	5.14E+01	2.85E+01

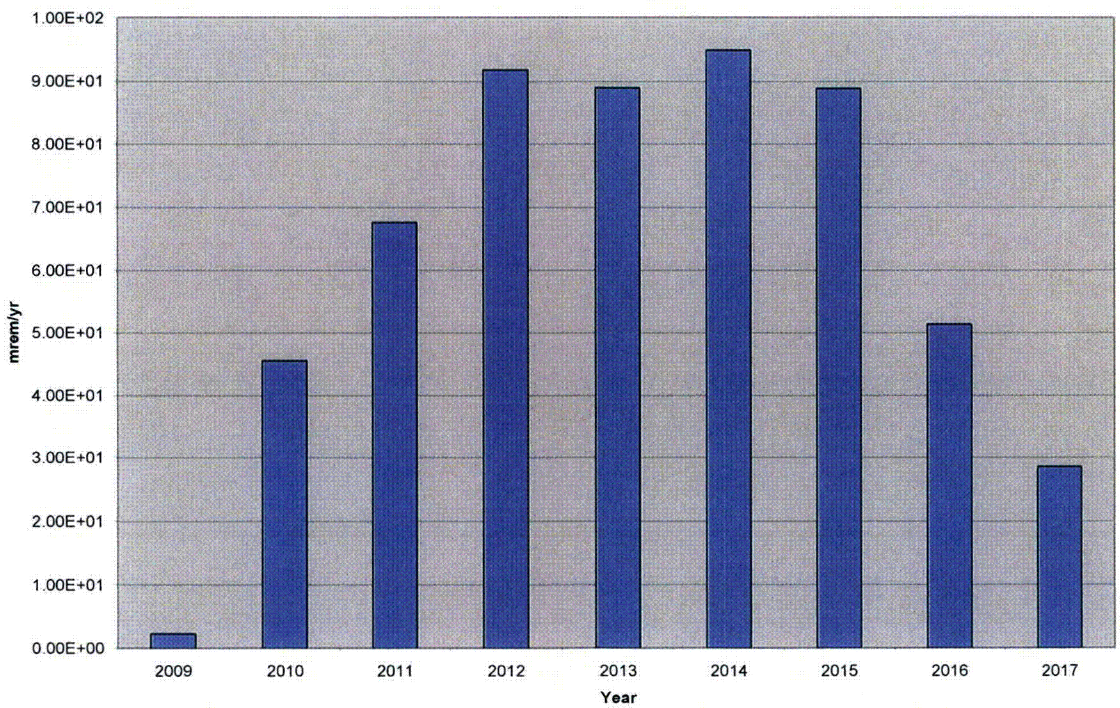

Figure 8 MILDOS-calculated doses to hypothetical worker 140 m from Site 1 Plant Location.

SUMMARY

Results of MILDOS modeling show that north boundary receptors exceed the 10 CFR 20 limit of 100 mrem per year total effective dose equivalent (TEDE) when the plant is placed at the Site 1 location. The Site 2 location results in no boundary point exceeding 40 mrem. In both cases, the majority of the dose comes from releases of purge water at the Ion Exchange plant location during production and restoration.

Because the region is sparsely populated, very little population dose (person-rem/yr) occurs from the plant regardless where it is placed. Background exposures to surrounding populations far exceed contributions from the proposed facility.

Doses to workers from releases at the facility are expected to be far below occupational dose limits and will be monitored during operations as required to provide actual exposure documentation.

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8.0 ALTERNATIVES

Detailed descriptions of alternatives for the Project are presented in **Section 2.0** of the corresponding Environmental Report for this Project. Upon consultation with NRC during one of the pre-licensing meetings in May 2007, it was agreed that Section 8.0 would not be needed in the Technical Report.

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9.0 COST-BENEFIT ANALYSIS

LC ISR, LLC has evaluated the costs and the benefits associated with uranium mining in order to formulate the Project. Historically, several companies considered mining uranium within the Permit Area; but the costs outweighed the benefits at that time. However, due to the increased demand for uranium, associated price increase, and improved technologies, LC ISR, LLC believes the benefits now outweigh the costs.

Although the specific amount of yellowcake produced will depend on the market price and the cost of production, LC ISR, LLC anticipates producing about one million pounds of uranium per year. Based on current information and projections, the anticipated life of the mine is eight years. Current demand/supply projections indicate that the price should remain sufficiently high to support mining of the Project over that time frame. With appropriate regulatory approval, the Plant could take loaded resins from other ISR sites in the region, even after the ISR operation in the Permit Area is complete.

9.1 Costs

Since exploratory studies of the Permit Area were commenced in the late 1960's, mining methods have been improved to minimize costs. The primary method of mining uranium deposits, such as those in the Permit Area, has shifted from conventional open-pit or underground mining to ISR. Open-pit and underground mining require the ores be physically removed from the ground, which would be associated with not only high operating costs (especially with low-grade ores), but also with increased exposure of radioactive materials to the atmosphere and with significant surface disturbance. In contrast, ISR operations lower the operating cost and minimize disturbance by chemically removing the mineral and leaving the matrix surrounding the ore intact. While some alternatives to various steps in ISR operations have been considered for the Project, such as facility locations, the overall costs do not differ substantially with the choice of alternative.

9.1.1 Health and Environmental Costs

LC ISR, LLC proposes the Project for the societal benefit of a uranium supply, knowing that health and environmental costs will be minimized by ISR operations. The health and environmental costs that were evaluated include:

- disturbance of soil and vegetation,
- disturbance to wildlife and wildlife habitat,

- disturbance of hydrogeology,
- use of groundwater,
- depletion of uranium minerals,
- production of waste,
- potential exposure to radioactive material, and
- impact on aesthetics.

The soil, vegetation, hydrology, wildlife, and wildlife habitat will be temporarily disturbed during mining. These natural resources were characterized during studies of the baseline conditions in the Permit Area, which are summarized in **Section 2** of this report. The resources will be reclaimed to support the approved post-mining land use of livestock and wildlife grazing, which is similar to the pre-mining land use, in accordance with applicable standards and regulations. Reclamation activities are described in more detail in **Section 6** of this report. Because ISR operations are conducted in a series of mine units, which are installed, mined, and reclaimed sequentially, only portions of the Permit Area will be disturbed at a given time.

Inherent to the proposed action, the uranium mineral will be depleted. However, mining this mineral will provide a source of fuel for producing nuclear energy. Currently, the nation and the public are strongly supporting alternative sources of energy, including nuclear energy, to reduce dependence on foreign petroleum supplies and to reduce carbon emissions. The proposed action will remove uranium, in a safe and controlled manner, from the geological formation in which it naturally occurs. By doing so, the radioactivity of the material associated with uranium will be reduced. This will improve the health of humans and the environment that may otherwise be exposed to the ores.

Groundwater will serve as a tool to recover uranium. Groundwater will be: pumped from the production wells in the ore zone, oxidized by the addition of lixiviant (a bicarbonate-based solution), re-introduced to the ore zone through the injection wells, recovered from the production wells, treated at the Plant for removal of uranium, and circulated through this system again and again. Ultimately, the majority of the water will be restored and returned to the aquifer containing the ore zone. A fraction of the groundwater will be consumed as waste. This fraction of consumed groundwater will be minimized by concentrating the waste through multiple wastewater treatments where feasible.

Various types of wastes will be produced from the Project. These wastes may be categorized as domestic sewage, non-radiological wastes, and radiological wastes. Materials will be decontaminated or treated to reduce the volume of waste. Radiological waste will be removed from the Permit Area and disposed at an NRC-licensed facility in accordance with current regulations. All other wastes will be disposed of according to the applicable local, state, and federal regulations.

Exposures to radioactive materials were estimated using results from the radiation survey and the MILDOS model. Estimated public exposure to radioactive materials is negligible due to the remote location of the Permit Area, the nature of ISR operations, and the ore processing technologies. Occupational exposure will be reduced or eliminated by providing the proper training, guidance, and PPE to safely handle, store, decontaminate, and/or dispose waste materials.

Interference with other uses of the Permit Area will be limited due to the lack of development in the area and the reclamation requirements. For example, due to limited development of groundwater in the area to date, minimal impact to other water users outside the Permit Area is anticipated. As another example, hunting will be restricted at the Permit Area during mining and reclamation to reduce safety concerns; but in the long term, hunting access will be improved due to road construction and maintenance. To ensure that future users of the Permit Area are aware of the presence of abandoned wells, a deed notice of the mine unit locations will be required. Any decreases in aesthetics at the Permit Area, such as increased noise, will be minimal due to the remoteness of the Permit Area, the nature of ISR operations, improved technologies, and required reclamation. In addition, the activities at the Permit Area, such as well installation, are similar to the activities associated with other extractive industries in the region (e.g., oil and gas drilling).

9.1.2 Internal Costs

In order to quantitatively compare the costs to the benefits of the Project, internal and external costs were estimated. Internal costs impact LC ISR, LLC and cover the construction, operation, and reclamation phases of the Project.

The primary internal costs will include:

- capital costs associated with obtaining the right to mine, including claims, permits, and environmental studies;
- capital costs of facility construction;
- operation and maintenance costs;
- costs of groundwater restoration;
- costs of facility decommissioning, including radiological decontamination; and
- costs of surface reclamation.

These estimated costs are provided in **Table 9.1-1**. Because of the sequential development of mine units during ISR operations, some of the facility construction costs are distributed throughout the life of the Project rather than concentrated during the initial Project development.

9.1.3 External costs

External costs impact the local economy and include the services and resources of the neighboring communities. The primary external costs will affect:

- housing;
- public facilities and services;
- historic, scenic, and recreational resources; and
- natural and material resources.

As with the internal costs, some of the external costs are distributed throughout the life of the Project due to the nature of ISR operations, rather than concentrated during the initial Project development.

Impacts to housing availability are expected to be dispersed because of the remoteness of the Permit Area, the relatively small number of the workforce (both on payroll and on contract), and the progressive nature of construction and reclamation in the Permit Area. In addition, short-term, overnight housing may also be provided in the remote Permit Area. (Some drillers prefer long workdays to take advantage of daylight and good weather. During production, personnel will be on-site 24 hours per day.) Because of energy-related projects throughout Wyoming, workforce and housing availability has become a critical factor in some locations. However, in response, state and local agencies have been assisting industries and communities to address these issues.

The costs associated with increased demand of public facilities and services are expected to be minimal. Water supply and some waste disposal facilities will need to be developed by the operator of the Project because of the lack of such facilities in the vicinity of the Permit Area (The nearest population center, Bairoil, is about 15 miles to the northeast.). The relatively small increase in the workforce will not overtax education and health resources. Existing emergency response and medical treatment capabilities handle industrial accidents similar to those that could occur in the Permit Area; and a variety of industrial and hazardous materials are transported on Interstate 80 through Rawlins, which is about a 50-mile drive southeast of the Permit Area. Therefore, basic services are already established that can support the Project. Representatives from LC ISR, LLC met with the Sweetwater County commissioners on October 16, 2007. LC ISR, LLC described the operations and schedule of the Project to the commissioners and answered related questions. Additional public consultation was planned in the near future.

Historic, scenic, and recreational resources within the Permit Area were identified during studies of the baseline conditions, as summarized in **Section 2.4** of this report. Of the historical sites identified in the Permit Area, only one in the central portion has the potential for being disturbed by future mine unit development activities. Mitigation plans for sites of historical significance are described in **Section 7** of this report (A detailed discussion on cultural resource impacts, mitigation, and monitoring is presented in **Section 4.8** of the ER.). The limited presence of local residents and/or regular visitors, lack of roads, and austere topography reduces the number of people who might be impacted by noise or facility visibility. The construction equipment and facilities in the landscape (e.g., drilling rigs, header houses and the Plant) are of limited height and will not be visible to bypassing travelers on any major roads. In addition, reclamation is required once the facilities are decommissioned. As noted earlier, hunting, which is the primary recreational activity, will be restricted for safety reasons during operations, but will not be permanently affected, and may be improved due to wildlife habitat reclamation and improved transportation routes.

During the implementation of the Project, natural and material resources will be used. The natural resources include uranium and groundwater. The goal of the Project is to maximize uranium recovery; thus, uranium will be depleted. Groundwater will be used as a medium to mine the uranium; the Project is designed to re-use the groundwater as much as possible and limit losses to waste. Material resources needed for the Project include a variety of industrial products such as automotive fluids, building materials, well casing, piping, and cement, as well as energy. Processing chemicals will also be needed, although most of these are relatively benign.

9.2 Benefits

Outside of the economic benefits to the operator, the estimated community benefits resulting from the Project are shown in **Table 9.2-1**. The local communities within Sweetwater County will benefit economically from the Project development, construction, and operation because of employment opportunities, including skilled jobs on the Project and an improved tax base for other local jobs. The economic benefit of expenditures related to the Project will magnify as funds are dispersed throughout the communities. Approximately 70 to 90 individuals (including both full-time employees and subcontractors) will be employed during the Project. Local businesses will also be subcontracted for many services, such as drilling, and will employ additional individuals. Domestic supplies and equipment will be purchased from local vendors.

The local, state, and federal governments will receive various revenues from employee income taxes, severance taxes, ad valorem taxes, and sales taxes. The estimated benefit from taxes is shown in **Table 9.2-1**.

In addition to the specific, tangible Project benefits, the Project also provides more diverse benefits. For example, regional recreation may be enhanced following the reclamation of the disturbed area, because of improved access and the reclamation of the

Permit Area to wildlife and livestock grazing. As another example, due to the remoteness and low population of the basin in which the Project is located, the baseline studies and monitoring associated with the Project have greatly increased the information available on natural resources. Required monitoring during the Project will continue to provide scientific data about this basin.

The Project will support energy-independent and environment-friendly policies. The uranium production will assist to supply a reliable, economical, domestic source of uranium while applying new technologies to minimize disturbance. The Project will also help offset the deficit in annual domestic uranium production and help meet increasing energy demands. Between 1989 and 2003, annual domestic uranium production decreased by 75 percent. The US produces about two percent of the world uranium, while it consumes over 25 percent of the total production. As of 2006, the world produced just over 50 percent of the annual consumption of U_3O_8. The gap between demand and supply has been filled by stockpiles and uranium from non-traditional sources (e.g., dilution of weapon-grade uranium). There are concerns about the long-term availability of uranium from non-traditional sources. The Project, once in full-scale production, will add 1,000,000 pounds of U_3O_8 per year to the market. With appropriate regulatory approval, the processing facilities could also take loaded resins from other ISR sites in the region, even after the ISR operation is complete in the Permit Area.

Table 9.1-1 Estimated Project Costs

Item	Present Worth (US dollars x 1,000)
Obtaining the right to mine (claims & permits)	13,000
Facility construction	68,000
Operation and maintenance	74,000
Ground-water restoration	13,000
Decommissioning (including decontamination)	12,000
Surface reclamation	3,000

Table 9.2-1 Estimated Project Benefits

Item	Present Worth [1] (US dollars x 1,000)
Taxes	73,000
Employment	32,505
Supplies and equipment	56,306
Services	36,493
Improved recreation	43
Improved roads	57
Environmental studies and monitoring	2,000

[1] Assumptions: 58 employees, ten contract drill rigs (3 contractors for each rig) per construction year, and a realized sales price of 60.00 US dollars per pound U_3O_8

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10.0 ENVIRONMENTAL APPROVALS AND CONSULTATIONS 10-1

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10.0 ENVIRONMENTAL APPROVALS AND CONSULTATIONS

Prior to commencing ISR operations, LC ISR, LLC must obtain a License to Mine and Permit to Mine from WDEQ. Since Wyoming is not an NRC Agreement State, a Source and Byproducts Materials License must be obtained from NRC. Other permits that must be obtained prior to the commencement of operations include, but are not limited to, a UIC Class III Permit with aquifer exemption, a Class I UIC Permit with aquifer exemption, an Air Quality Permit, a WYPDES discharge permit, and a Storm Water Discharge Permit. A list of the necessary permits and licenses are provided in **Table 10.0-1**.

Federal regulations that pertain to the Project include the:

- Atomic Energy Act,
- Clean Air Act,
- Clean Water Act,
- Resource Conservation and Recovery Act,
- Low-Level Radioactive Waste Policy Act,
- Emergency Planning and Community Right-to-Know Act,
- Safe Drinking Water Act,
- Noise Control Act,
- National Historic Preservation Act,
- Endangered Species Act,
- Occupational Safety and Health Act, and
- Hazardous Material Transportation Act.

Under Sections 101 and 102 of NEPA, federal agencies are required to interpret and administer the policies, regulations, and public laws of the Act in order to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans. As such, federal agencies must address environmental issues and allow public input in the decision-making processes of major projects under their jurisdiction. The NEPA regulations that are implemented by NRC are contained in 10 CFR Part 51.

Since BLM administers the land encompassing the Permit Area, BLM has the statutory responsibility of regulating mining activities on federal land. The authority of BLM is defined in 43 CFR Part 3590, which concerns the approval of mineral operating leases on federal lands. After consultations with NRC and BLM, it was agreed that NRC will take the lead on implementing the NEPA process for the Project.

In order to perform a NEPA assessment of an ISR project, the applicant must provide the necessary information to the federal agencies. A technical report must be prepared following the guidelines of NUREG-1569. In October 2006, NRC reorganized the review process to facilitate the application review process of proposed ISR facilities. As a result, all new ISR project applicants must prepare an environmental report in addition to a technical report.

LC ISR, LLC has maintained consistent contact with federal and state agencies. Since the beginning of the Project, quarterly meetings have been conducted with NRC, BLM, and WDEQ. LC ISR, LLC has held regular pre-licensing meetings with NRC to discuss baseline survey work plans, proposed hydrogeological programs, permitting schedules and application outlines and preparation. NRC staff members have also been invited to the Permit Area at the beginning and during the baseline surveys. NRC issued a Docket Number (40-9068) and a Technical Assignment Control (TAC) Number (LU0142) for the Project on September 8, 2006.

Other state and federal agencies involved in the permitting and licensing process include the EPA and the WSEO.

Following WDEQ Rules and Regulations, a separate application packet will be prepared and submitted to WDEQ. During this review process, two different public-comment periods will allow individuals to contribute to the Project.

Applicable state and federal agencies were consulted in accordance with the requirements of the Endangered Species Act and the Fish and Wildlife Coordination Act. Personnel were contacted from WGFD in 2006 and 2007. FWS was also contacted. Wildlife surveys were completed according to a work plan developed in consultation with WGFD, WDEQ, and BLM. The scope of field work was finalized in consultation with BLM during February through March of 2006, and field survey protocols were consistent with recommendations from both BLM and WGFD.

A Class I file search was conducted through the Wyoming SHPO Cultural Records Office prior to the archaeological survey, with follow-up research at the BLM Rawlins Field Office. A fieldwork authorization was obtained from BLM prior to the onset of field investigations. Consultation with Native American groups will be conducted by BLM after the archaeological technical report has been received.

Table 10.0-1 Required Permits and Licenses

PERMIT OR LICENSE	REGULATORY AUTHORITY	STATUS
Source and Byproduct Material License	NRC	Application Submitted
Permit to Mine	WDEQ & BLM	Being Prepared
Mineral Exploration Permit	WDEQ	Obtained
License to Mine	WDEQ	Being Prepared
Underground Injection Control Permit Class I (deep disposal wells)	WDEQ	Being Prepared
Aquifer Exemption Permit for Class I injection wells	WDEQ & EPA	Being Prepared
Underground Injection Control Permit Class III (ISR wells)	WDEQ	Being Prepared
Aquifer Exemption Permit for Class III injection wells	WDEQ & EPA	Being Prepared
Permit to Construct Additional Ponds	WDEQ & WSEO	Future Application As Needed
Permit to Appropriate Groundwater for Mine Units	WSEO	Being Prepared
Permit To Construct Sanitary Leach Field	WDEQ	Being Prepared
Air Quality Permit (Fugitive Dust)	WDEQ	Being Prepared
Stormwater Discharge Permit	WDEQ	Being Prepared
County Development Permits	Sweetwater County Planning Commission	Being Prepared

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