UNITED STATES

NUCLEAR REGULATORY COMMISSION

REGION IV

URANIUM RECOVERY FIELD OFFICE
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DENVER, COLORADO 80225

JAN 10 1992

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Docket No. 40-8964
SUA-1578
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04008964011E
04008964015E

MEMORANDUM FOR: Docket File 40-8964

FROM: Joel P. Grimm, Project Manager

SUBJECT: ENVIRONMENTAL ASSESSMENT FOR THE RIO ALGOM MINING CORP. LICENSE APPLICATION, SMITH RANCH IN SITU LEACH MINING PROJECT, CONVERSE COUNTY, WYOMING

Background

On March 31, 1988, predecessors of Rio Algom Mining Corp. (Rio Algom) submitted an application to NRC for a source material license. The application specifically addressed the expansion to commercial scale of the O-Sand research and development (R&D) project conducted at the Smith Ranch site, Converse County, Wyoming. Rio Algom acquired the project and committed to pursue the license application during 1990.

On October 28, 1991, NRC published a draft Finding of No Significant Impact (FONSI) in the Federal Register (56 FR55513) and noticed the availability of an Environmental Assessment (EA) completed in consideration of license issuance. During a 30-day public comment period, no comments or questions were received.

Discussion

Upon preparation of a Safety Evaluation Report, NRC found a need to clarify the terms contained in several proposed license conditions. The conditions involved gathering baseline ground-water quality data, and the establishment of excursion action levels and aquifer restoration criteria. In addition, conditions specifying the State Permit area and the applicant's environmental monitoring program have been added.

NRC has added terms to another license condition to clarify requirements for the protection of cultural resources. Cultural resources were considered

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separately from preparation of the EA, in consultation with the State of Wyoming Historic Preservation Office, the Bureau of Land Management, and the Advisory Council for Historic Preservation. These consultations were performed in accordance with Section 106 of the National Historic Preservation Act.

Finally, a new EA section and license condition concerning reclamation of settling ponds associated with the R&D project has also been added. This condition addresses existing facilities, and is not directly related to the commercial project. The requirement is being added to the forthcoming commercial license in order to facilitate termination of the existing R&D license.

None of the discussed changes affect the FONSI.

Conclusion

The attached EA is hereby placed in the docket file. The staff find Rio Algom's application, as amended, is in accordance with Title 10, Code of Federal Regulations, Part 40. Therefore, the staff recommend that a final FONSI be issued announcing issuance of a source material license approving the activities described in the appl[illegible] The license should include the conditions described in the fina[illegible] with the conditions found in a related Safety Evaluation Repo[illegible]

Joel P. Grimm
Project Manager

Enclosure:
As Stated

Cases Closed: 04008964011E
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bcc:
PDR/DCS
URFO r/f
LJCallan, RIV
RECunningham, NMSS, IMNS
LLUR Branch, LLWM
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8964/JPG/91/12/14/EA MEMO

ENVIRONMENTAL ASSESSMENT
FOR
RIO ALGOM MINING CORPORATION
SMITH RANCH IN SITU LEACH MINING PROJECT
CONVERSE COUNTY, WYOMING

IN CONSIDERATION OF A SOURCE AND
BYPRODUCT MATERIAL LICENSE
APPLICATION

PREPARED BY

THE U.S. NUCLEAR REGULATORY COMMISSION
URANIUM RECOVERY FIELD OFFICE
DENVER, COLORADO

WITH THE COOPERATION OF

THE U.S. BUREAU OF LAND MANAGEMENT
PLATTE RIVER RESOURCE AREA
MILLS, WYOMING

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1. INTRODUCTION

1.1 Background

By letter dated March 31, 1988, Sequoyah Fuels Corporation, a subsidiary of Kerr-McGee Corporation, submitted an application to the NRC for a source material license to commercially produce uranium at its Smith Ranch Project, Converse County, Wyoming (Figure 1.1). The application specifically addressed expansion of an existing licensed pilot project, studying feasibility of uranium recovery from two separate sandstone horizons using in-situ leach methods.

On December 20, 1988, Kerr-McGee Corporation notified NRC it had concluded negotiations for the sale of Smith Ranch project to Rio Algom Ltd., Toronto, Canada, requesting transfer of licensed activities to Rio Algom. Corporate management of the project was retained at Rio Algom Mining Corporation, Oklahoma City, Oklahoma. During and after the interim period, NRC's review of the application was deferred pending Rio Algom's commitment to pursue the license application. NRC's review process was resumed during 1990.

Source Material License SUA-1387 was issued June 2, 1981, for the Smith Ranch research and development (R&D) operation. The license for the R&D project, also known as the O-sand/Q-sand project, was renewed by NRC on January 29, 1988. The commercial operation will expand upon the R&D operation, and will utilize existing surface facilities as well as those of an existing shaft mine. An environmental assessment dated December 18, 1987, was prepared in consideration of renewing SUA-1387 for continued R&D operation. The operation continues to this day, but was placed on standby status during commercial plant expansion.

The plant site is found 17 air miles northeast of Glenrock, Wyoming (Figure 1.1). The pilot project occurs in Sections 26 and 36, Township 36 North, Range 74 West (T36N R74W), in Converse County, Wyoming (Figure 1.2). The proposed commercial project is located in an area to be permitted by the Wyoming Department of Environmental Quality (DEQ) exceeding 16,000 acres. Proposed mining will actually affect approximately 500 acres in Sections 25, 26, 27, 33, 34, 35, and 36 T36N R74W; and Sections 2, 8, 16, 17, 18, and 21 T35N R74W.

Rio Algom proposes to solution mine uranium occurring in sandstone strata of the Wasatch and Fort Union Formations, at depths of 450 to 1000 feet. Ore deposits typically are sinuous with lengths up to several thousand feet and 100- to 300-foot widths. The O-sand and Q-sand pilot projects were conducted approximately 500 and 750 feet deep, respectively.

During the uranium extraction process, Rio Algom will prepare aqueous solutions of sodium carbonate, sodium bicarbonate, carbon dioxide, oxygen, and hydrogen peroxide, adding them to ground water. The mining solution, known as lixiviant, will be pumped down injection wells under pressure into the mineralized zones where it will dissolve uranium from the formation. The uranium-bearing solution will migrate through the formation, will be recovered

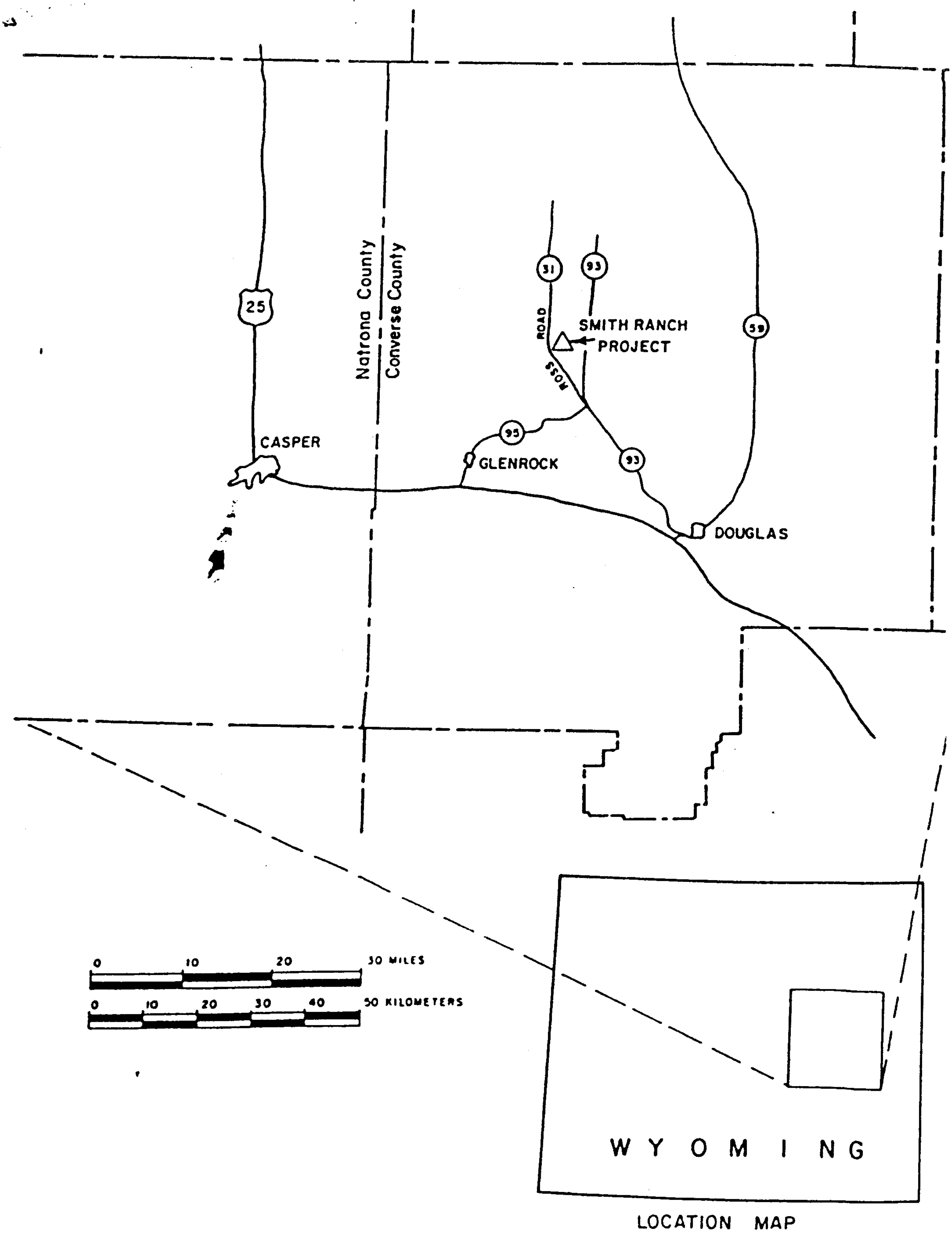


Figure 1.1: Index map of Wyoming showing the location of and access to the Smith Ranch ISL project, Converse County, Wyoming.

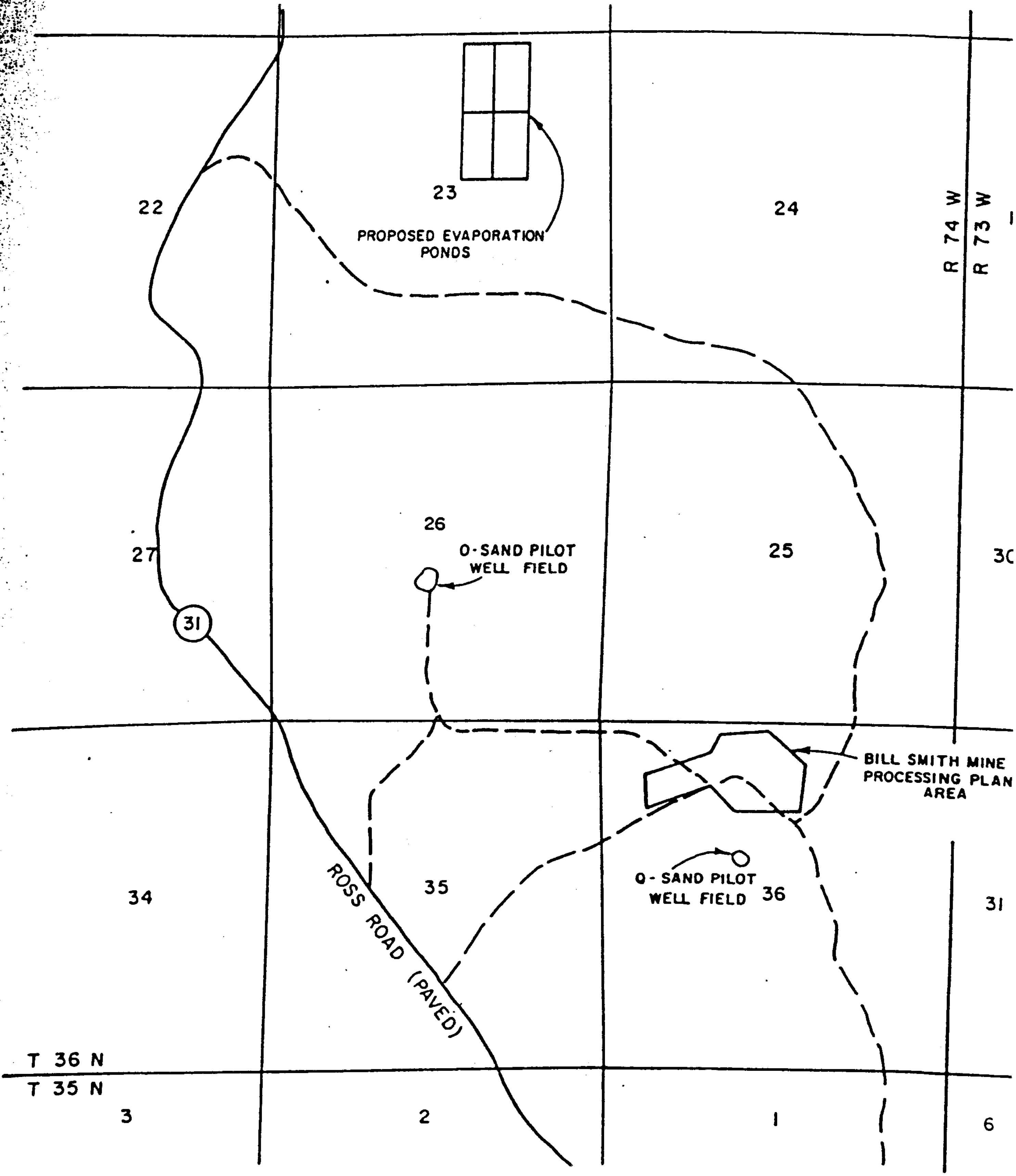


Figure 1.2: Index map of the main portion of the Smith Ranch ISL project, indicating the locations of principal existing and proposed facilities.

from production wells, and the uranium extracted in the processing plant. The leaching solution is then recharged and reused. Well fields will be designed in a five-spot or seven-spot pattern, with each recovery well being located inside a ring of injection wells.

Extracted solutions will be pumped to a processing plant where uranium will be recovered. Following uranium recovery in each individual mining unit, the applicant shall restore ground-water conditions. Restoration will involve ground-water sweep, clean water injection, and geochemical stabilization of the aquifer with a reductant. The goal of ground-water restoration is to return the aquifer to baseline conditions existing prior to mining.

1.2 Proposed Action

By letter dated March 31, 1988, Sequoyah Fuels Corporation submitted Form NRC-2 and text applying for a source material license for the Smith Ranch facility to authorize commercial-scale operations. Page changes to the application were submitted on May 10, June 30, and August 30, 1988; February 15, February 28, March 13, March 20, March 28, April 5, September 30, December 5, and December 10, 1991. In addition, the applicant provided the following commitments in addition to the application:

Submittal Date	Description
July 13, 1990	Responses to NRC comments and questions, including aquifer pump-test analyses, and monitor-well-spacing calculations.
October 4, 1990	Cover letter submitting MILDOS-Area Predictions of Radiation Dose.
April 5, 1991	Letter providing proposal for waste byproduct material disposal.
May 7, 1991	Cover letter transmitting consulting historian's report and recommendations, proposing changes to the mine facilities layout.
July 12, 1991	O-Sand deferral and interim environmental monitoring plan.
September 3, 1991	Cover letter assigning new Radiation Safety Officer for the Smith Ranch project.

This environmental assessment (EA) addresses the site characteristics and proposed operations of the commercial project and summarizes the foreseen associated environmental effects. Additional information concerning safety aspects of the proposed action is found in an accompanying safety evaluation report (SER).

1.3 Review Scope

1.3.1 Federal and State Authority

In compliance with Part 40 of Title 10 of the Code of Federal Regulations (10 CFR 40, "Domestic Licensing of Source Material"), an NRC license is required to " . . . receive, possess, use, transfer, or deliver . . . any source material . . . ." In addition, the Uranium Mill Tailings Radiation Control Act (UMTRCA) of 1978 and Atomic Energy Act of 1954 require persons who conduct uranium source material operations to obtain a byproduct material license to own, use, or process tailings and wastes generated by the operation, including above-ground wastes from ISL operations.

In accordance with 10 CFR Part 51, this EA serves to: (1) briefly provide sufficient evidence and analysis for determining whether to prepare an environmental impact statement (EIS) or a finding of no significant impact, (2) fulfill the NRC's compliance with the National Environmental Policy Act when no EIS is necessary, and (3) facilitate preparation of an EIS when one is necessary. Should the NRC issue a finding of no significant impact, no EIS would be prepared and the commercial source material license would be granted subject to operating conditions contained in the source and byproduct material license.

The State of Wyoming, Department of Environmental Quality (WDEQ), administers and implements the State's rules and regulations. Rio Algom has applied for, and will be required to receive, a mining permit from the state prior to commencing proposed commercial operations. This EA will commonly refer to the permit area for convenience, even though it does not represent Federal jurisdiction limits.

Additionally, the U.S. Bureau of Land Management (BLM) supported the preparation of this EA because Federal lands occur in the proposed mining area. The BLM is involved only with federal surface in the mine area and its concern are limited to (1) undue and unnecessary degradation of this land; (2) threatened and endangered species under the Endangered Species Act of 1973, as amended by public law 97-304 of 1982; and (3) cultural and historic resources that qualify for the National Historic Register of Historic Places as outlined under 36 CFR Part 800 and the implementing regulations for Section 106 of the National Historic Preservation Act of 1966.

1.3.2 Basis for NRC Review

The NRC is preparing this EA in review of the proposed licensing action, in accordance with 10 CFR 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions." In conducting this assessment, the staff considered the following:

- Environmental information submitted in an application March 31, 1988, as amended, to support Rio Algom's application for a commercial license.

- Operational history of the R&D operations, including inspection reports, environmental monitoring reports, radiological safety audits, and well-field restoration information.
- Information supplied in discussions with the WDEQ and the State Historic Preservation Office (SHPO), relating to the state permitting actions and and protection of cultural resources.
- Cooperation, reviews, and inputs to the EA by BLM.
- Information derived from professional papers, journals, and textbooks; as well as NRC regulations and regulatory guides.

2.0 SITE DESCRIPTION

2.1 Location and Land Use

The proposed facility and associated well-fields are located in east central Wyoming, 23 miles by highway northeast of Glenrock. No active residences occur in the permit area. The land has been used mainly for sheep and cattle grazing. In the past, some areas were settled by homesteaders for dry farming, but most of these farms are now abandoned. Rio Algom and other firms have conducted uranium exploration and production in the region for several decades. Rio Algom has two pilot projects located within the permit area. The company intends to return individual well fields to agricultural uses after the site is restored.

The environmental assessment of the project is based upon a license application. The application is valid only for the activities described in it and in supplemental submittals. To assure that environmental disturbance is not created without sufficient assessment, Rio Algom will be required by license condition to environmentally evaluate future activities in light of the original application and this assessment. Activities or potential disturbance not originally foreseen will require review and approval in the form of a license amendment.

Total land area to be enclosed by the state permit exceeds 16,000 acres. Of this, Rio Algom estimates approximately 500 acres will be disturbed during the project. Activity at the site will be limited by license condition to the geographical area specified in the license application.

2.2 Geology and Hydrogeology of the Ore Zones

2.2.1 Stratigraphic Setting

The permit area occurs at the southern end of the Powder River Basin. Rocks exposed in the basin consist mainly of Tertiary-age clastic sediments deposited in fluvial environments. Older rocks are found on the flanks of the basin. The basin is, in turn, surrounded by structural uplifts. Most of the background information for this description is derived from Sharp and Gibbons (1964).

During Paleocene time, uplifts resulted in the rise of the Laramie Mountains and shedding of granitic sediments into the Powder River Basin. Fine-grained clastics were transported toward the center. They were intermittently transected by streams carrying coarser sediments. Thus, the Fort Union Formation consists of alternating and discontinuous mudstones and siltstones with lenticular beds of coarser arkosic sandstones. In addition, disconnected drainage systems resulted in swampy environments, and coal seams are commonly found through the Fort Union.

Overlying the Fort Union, rocks of the Eocene Wasatch Formation underlie most of the permit area surface (Figure 2.1). The Wasatch consists of nearly 1000 feet accumulation of claystones and siltstones with widespread discontinuous lenses of coarse arkosic sandstone. These deposits also were derived from an ancestral Laramie uplift to the near south. Fine-grained deposits represent overbank deposits of streams that once drained from the uplift. Sandstone lenses were deposited in former channels of the rivers as they altered their paths across an alluvial plain. Grain size of Wasatch rocks decreases northward, farther from the source area of the sediment.

During late Eocene and Oligocene time, large accumulations of sediment from volcanic sources entered the basin and were deposited as the White River Group. These sediments, along with tuffaceous and ackosic lithologies in other Tertiary rocks, were the source of uranium in the region. The White River subsequently has mostly been eroded from the basin and it no longer occurs in the permit area.

Unconsolidated materials in the area consist mainly of locally derived colluvium on hill slopes and alluvial deposits along water courses. Thickness of these deposits ranges from 0 to 10 feet or more. Playa deposits are also found in closed depressions. They also are derived from local bedrock, but also contain alkaline evaporite mineralization.

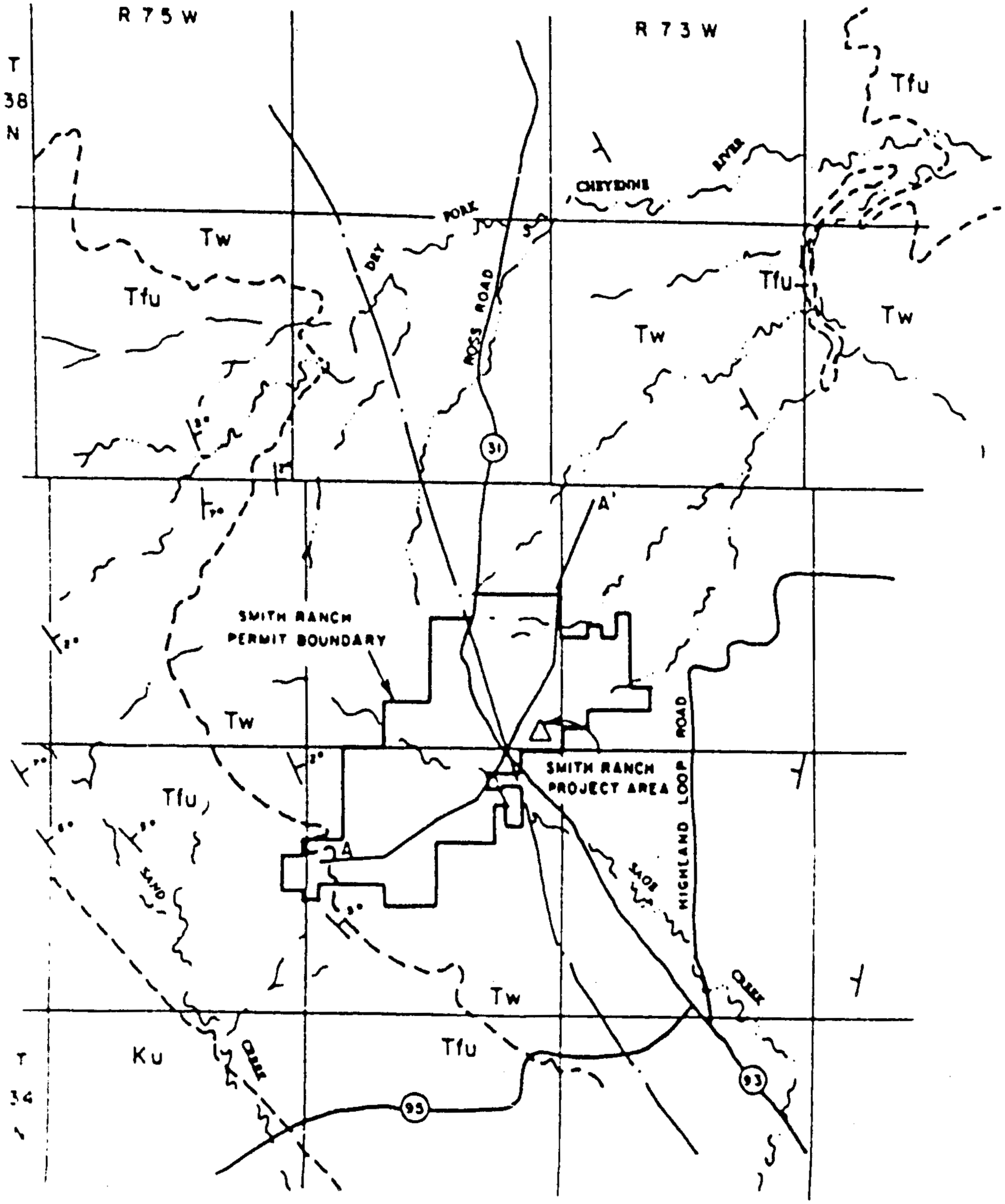
2.2.2 Structural Setting

The Powder River Basin is an assymetrical depression in the Precambrian basement rocks, having an axis oriented from east central Wyoming northwestward into Montana. The axis lies on the western side of the basin, evidenced by rocks dipping more steeply, up to 20 degrees, on the western flank than the east where dip typically is only 1 or 2 degrees. The basin is filled with up to 15,000 feet of sedimentary rocks which have accumulated episodically since Paleozoic time.

Episodes of uplift and erosion are evident by unconformable contacts between the Fort Union, Wasatch, and White River strata. Removal of the White River rocks and continued erosion in the basin is evidence that uplift is continuing today.

2.2.3 Site Stratigraphy

Wasatch Formation rocks are found at the surface in all of the permit area except the southwestern corner (Figure 2.1). The Fort Union Formation



LEGEND

Tw	WASATCH FORMATION: IRREGULARLY STRATIFIED CLAYSTONES, SILTSTONES, AND SANDSTONES, WITH MINOR THIN LIMESTONES AND COALS.
Tfu	FORT UNION FORMATION: INTERBEDDED CLAYSTONES, SILTSTONES, AND SANDSTONES WITH THICK COAL BEDS.
Ku	CRETACEOUS DEPOSITS UNDIVIDED: SHALE AND MASSIVE LENTICULAR CONCRETIONARY SANDSTONE WITH THIN COAL BEDS IN LOWER HALF.
	GEOLOGIC CONTACT: APPROXIMATELY LOCATED.
	STRIKE OF GEOLOGIC FORMATION: SHOWS DIRECTION AND AMOUNT OF DIP WHEN KNOWN.
	SYNCLINAL AXIS: POWDER RIVER BASIN (LOCATED ON SURFACE OF PRECAMBRIAN BASEMENT COMPLEX).
A—A'	LOCATION OF GEOLOGIC CROSS SECTION.

SOURCE: FIELD WORK CONDUCTED BY WCC FOR THIS INVESTIGATION; U.S. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION, 1973; DOBBIN, ET AL., 1975; LOVE AND WEITZ, 1951.

Figure 2.1: Geological map of the Smith Ranch project vicinity showing locations of Cretaceous and Tertiary strata, drainage, geological structures, and principal features of the site.

underlies the Wasatch. The basin axis runs through the permit area. Therefore, rocks to the southwest dip toward the northeast at 2 to 5 degrees. Meanwhile, strata underlying the center of the permit area dip a few degrees northward, along the plunge of the basin axis, while under the eastern portion of the area strata dip 1 or 2 degrees to the west.

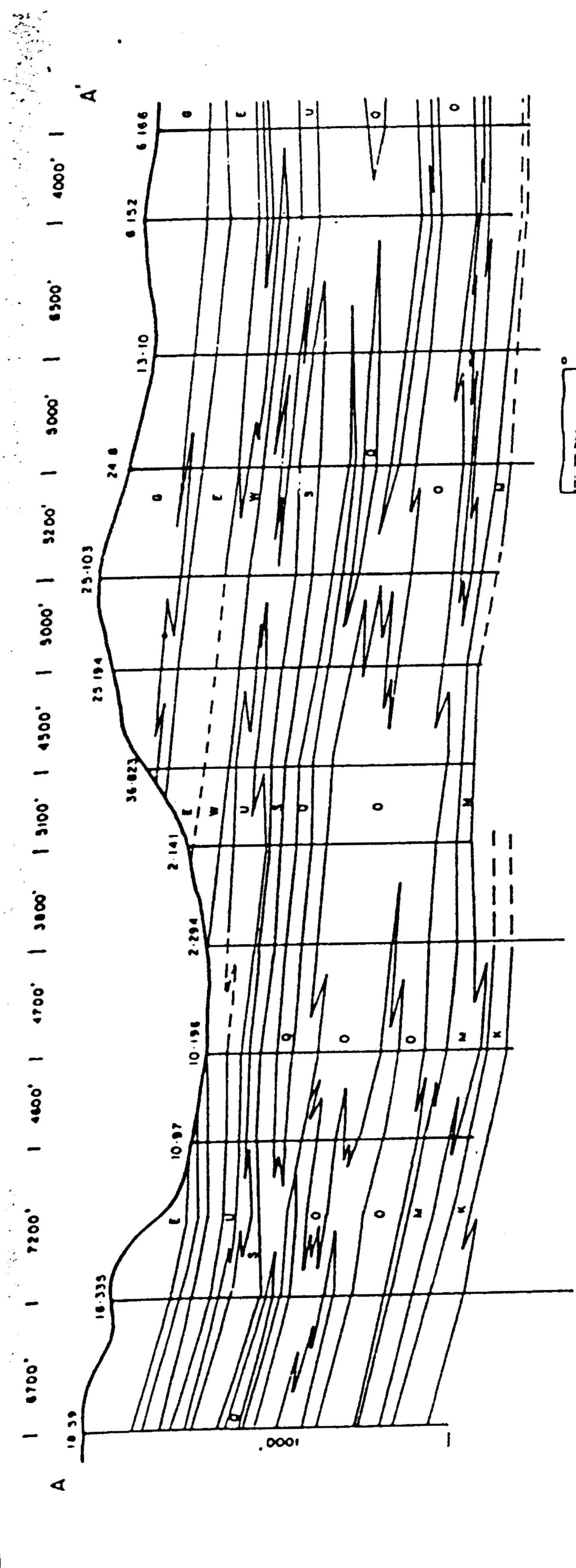
Detailed stratigraphic data on the site was derived from original uranium exploration, development of the Bill Smith mine, and development of the O-Sand/Q-Sand pilot projects. Rio Algom developed its own stratigraphic nomenclature system (Figure 2.2) for individual zones in the contact area of the Wasatch and Fort Union Formations. The P-shale is found continuously below the site area and is chosen arbitrarily as the uppermost Fort Union marker bed. Pilot projects recovered uranium from the Q-sand above, and the O-sand below. The present application is for continued mining in the Q-sand, several interconnected O-sand ore zones, and new mine development in the underlying M-sand.

Ore bodies found in the Q-Sand occur at depths of 450 to 550 feet. Most other mineralization occurs in the O-Sand at depths of 700 to 900 feet. In general, all strata are shallower as one moves up-dip to the southwest.

2.2.4 Ore Occurrence

Uranium deposits occurring in most of the region are roll-front types. Roll fronts occur in areas where ground water infiltrated from the surface or migrated through an aquifer composed of sediment containing minerals with slight amounts of uranium. Near the surface, oxidizing conditions result in weathering of the minerals like feldspar and volcanic ash and mobilization of minute concentrations of uranium in solution. The White River formation appears to be the principal source of uranium minerals in this region. As ground water continued to migrate, it encountered reducing conditions where uranium is no longer stable in solution. The reducing environment may be a result of H_2S, pyrite, or organic material existing in the aquifer. As a result, uranium precipitated from the ground water and formed coatings of minerals like uraninite or coffinite on the sediment grains in the formation. The roll front extends farther in the middle of an aquifer (Figure 2.3). Therefore, uranium minerals occur concentrated in the direction of flow, with limbs trailing backwards at the top and bottom of the aquifer, resulting in typical distorted C-shape deposits. With time, increasing volumes of slightly mineralized ground water flow through the reducing zone, and uranium precipitates become concentrated. Individual fronts range in thickness from 2 to more than 25 feet. Mineral ore may exist laterally along a front hundreds of feet long, and fronts may coalesce to form ore bodies miles in length. Thin mineralized trails and more finely disseminated minerals are found branching off the main front and located between fronts. In general, eastern Wyoming uranium deposits average about 0.20 percent uranium oxide.

The physical shape of the ore deposit is dependent on the local permeability of the sandstone matrix, its continuity and distribution in the geologic unit, as well as the former oxidation/reduction front in the aquifer. The recoverable



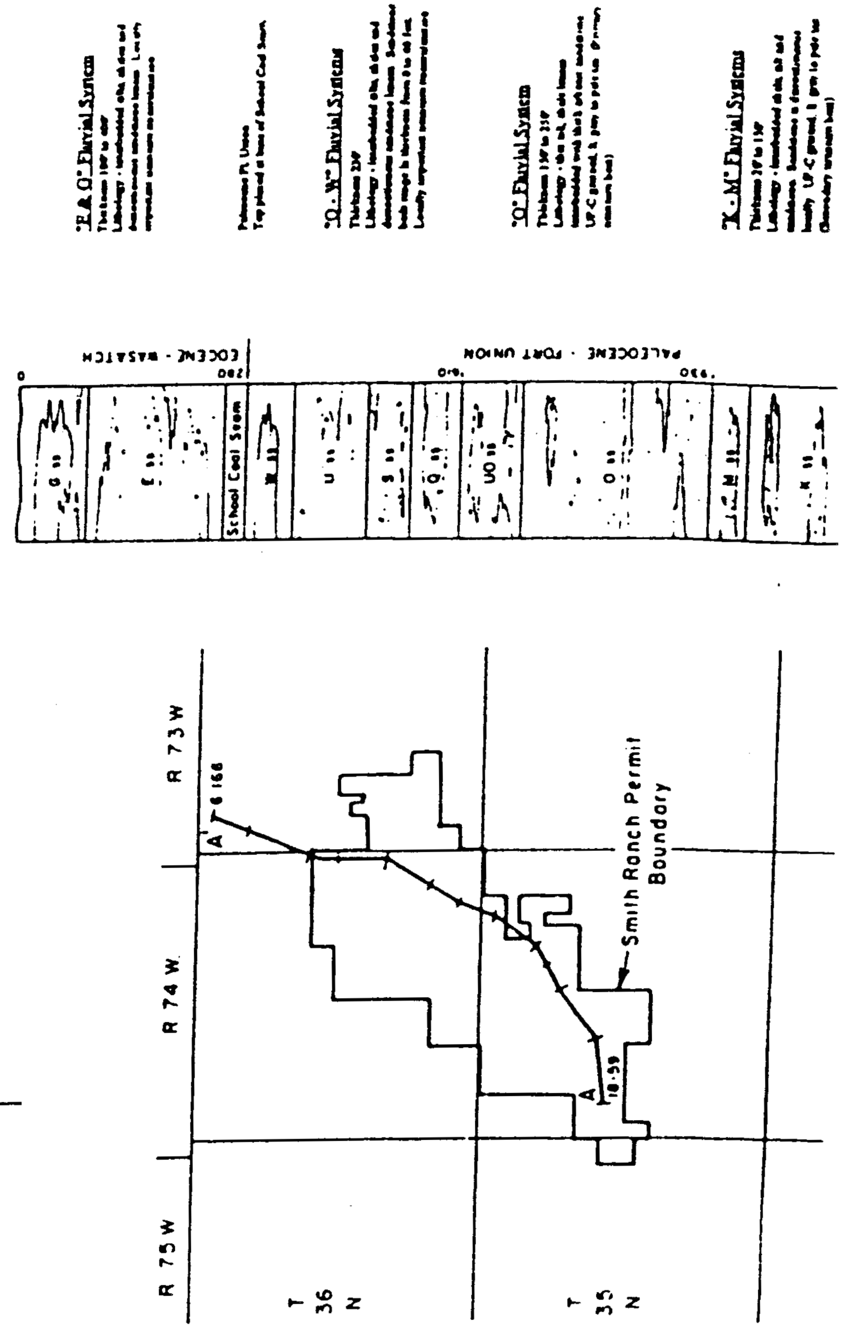


Figure 2.2: Topographic profile and geologica cross-section of the Fort Union a Wasatch formations showing the principal sandstone units. Unlab units consist of intervening confining shale units.

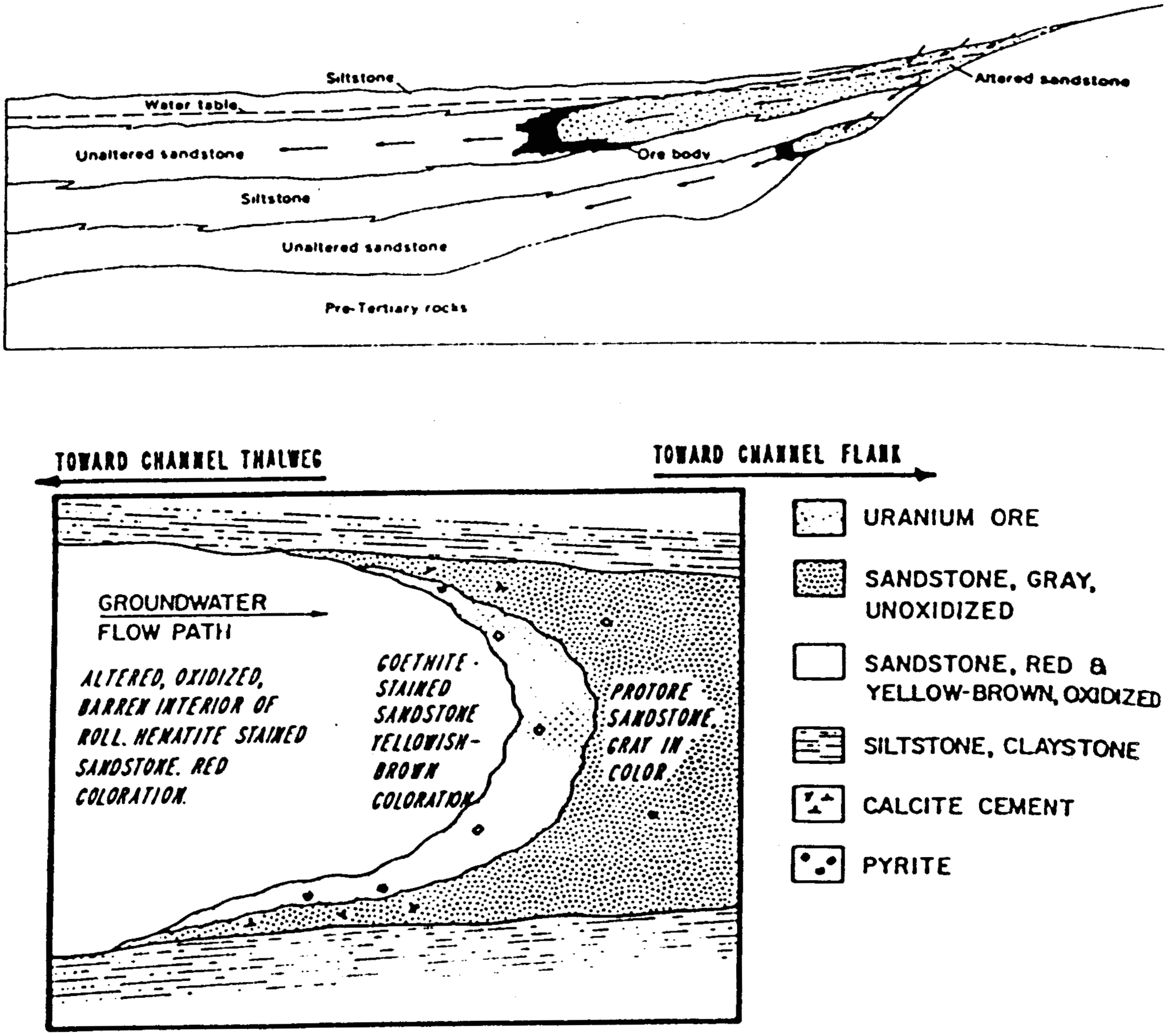


Figure 2.3 - Illustrations of the occurrence of roll-front deposits (a) formed by downgradient migration of mineralized ground water through a regional aquifer (from Levinson, 1974) and (b) formed by migration of mineralized ground water in lenticula channel sandstones (from Dahl and Hagmaier, 1976).

ore is located in portions of the Wasatch and Fort Union Formations extending from depths of 400 to 1000 feet. The roll fronts are long and sinuous, some extending over one mile in length.

For in situ leaching to be successful, the ore deposit must (1) be located in a saturated zone, (2) be bounded above and below by suitable confining layers, (3) have adequate permeability, and (4) be amenable to chemical leaching. As described above, the proposed mining area has favorable hydrogeological and structural characteristics to allow in situ leaching of uranium. The hydrogeology and aquifer characteristics indicate that mining solutions will be contained within the production zone. Further evidence of this is demonstrated by the operational history of the R&D project.

2.2.5 Hydrostatigraphy

Alluvium

Small volumes of ground water exist in unconsolidated alluvial deposits near the ground surface. Total thickness of these deposits is 1 to 30 feet. Small amounts of precipitation infiltrate the alluvium during part of the year and intermittent flows across the alluvium may provide some recharge. The water table, however, is typically more than 100 feet below the land surface throughout most of the permit area. Therefore, most of the recharge flows through the alluvium into the lower formations. In the drainage system in the southwestern portion of the area, perched water in the alluvium may be the source of water discharging from intermittently low-yielding springs. The potential for future development of alluvial ground-water supplies in the permit area is considered very poor.

Wasatch Formation

The Wasatch is one of the most important shallow aquifers in the Powder River Basin. It underlies all except the southwestern edge of the permit area. For the most part, ground water in the Wasatch aquifer occurs under unconfined conditions and its primary use in the permit area is low-yield wells used for watering livestock. Confined zones near the base of the formation are separated from near-surface deposits and from each other by impermeable shale layers.

Fort Union Formation

The top of the Fort Union is exposed at the surface in the southwestern and western portions of the area, but may be at depths of 500 feet or more in the eastern and northeastern part of the permit area. Typically, the Fort Union is comprised of lenticular fine- to coarse-grained sandstones with interbedded claystones, siltstones, and coal. The formation is as much as 3000 feet thick beneath the mine site. The Fort Union Formation is an important aquifer in the Powder River Basin, and nearly all solution mining wells are completed in this formation. While most of the solution mining wells are designated for limited yields (5 to 30 gpm of water), wells completed in the Fort Union associated with the Bill Smith Mine dewatering program have produced as much as 560 gpm.

2.2.6 Water Quality

Rio Algom submitted a compilation of water quality data collected from wells completed in aquifers as part of the O-sand and Q-sand pilot projects. Water quality is relatively good in both aquifers. Only radium-226 routinely exists in concentrations above EPA primary drinking water standards. EPA's standard for radium is 15 picocuries per liter (pCi/l), and baseline data from the O-sand ranged from 61 to 580 pCi/l. The calculated average is 272 pCi/l. Tables 2.1 and 2.2 provide Rio Algom's baseline data derived from the O-sand and Q-sand pilot projects. Both aquifers contain calcium-sulfate type water with total dissolved solids (TDS) ranging from 155 to 673 milligrams per liter (mg/l). Sulfate and TDS routinely are found in O-sand samples exceeding EPA secondary standards, but not by wide margins. In addition, various metals are intermittently found to exceed standards. However, these conditions vary with location and sampling period.

2.2.7 Aquifer Testing

Rio Algom and its predecessors performed an aquifer testing program consisting of five aquifer tests. Testing results were summarized in their submittal dated July 13, 1990. The first was conducted in 1974 to evaluate the excavation and development of the Bill Smith uranium mine shaft. The second test was conducted in April 1981 to demonstrate aquifer suitability for pilot operations in the Q-sand. The third test was conducted in July 1983 to demonstrate aquifer suitability for the O-sand pilot operation. A fourth test was conducted in a number of phases in 1985 to determine aquifer properties of the M-sand, and containment by associated aquitards. This test was known as the Section 35 test. Finally, a fifth test, the Section 25 test, was conducted in phases during 1986 to characterize a lower aquifer horizon in the O-sand, and its associated confining layers.

Repeated scrutiny of the applicant's pump tests and analyses occurred during the licensing phase for each pilot project, during R&D license renewal in 1988, by the State of Wyoming, and by continued reanalysis by the applicant. Analyses of pump tests consistently result in conclusions (Table 2.3) that O-sand and Q-sand hydraulic conductivity does not vary significantly from 1×10^{-3} cm/s. M-sand hydraulic conductivity is slightly lower, at 1×10^{-4} cm/s. Meanwhile, the tests reveal that aquitards between the proposed mining units prevent appreciable hydraulic communication between aquifers (Table 2.4). These theoretical interpretations of test data were verified by R&D mining. To date, no mining solutions have vertically migrated from the mineralized zones. In addition, no excursions of mining solutions have been detected laterally away from the test well fields. This is primarily due to the mineralized zone having permeability which allows mining solutions to be controlled by pumping rates. Based upon the level of stratigraphic detail provided by uranium exploration and pilot operations, the locations of the aquifer tests appear to be representative of the commercial project area through the fifth year of proposed development. Subsequent mine development in the southwestern portion of the permit area will be subject by license condition to further aquifer characterization in that area.

Table 2.1: Baseline ground-water quality data in the Q-Sand pilot well field for selected chemical parameters (from Rio Algom application, March 31, 1988). Units in mg/l, unless specified otherwise.

Parameter	Range	Mean
Arsenic	.001-.013	.004
Boron	.002-.70	.15
Calcium	24-171	72
Iron	.01-.27	.025
Magnesium	3-22	16
Manganese	.01-.077	.023
Selenium	.001-.024	.004
Uranium	.001-3.1	.28
Chloride	4-65	18
Bicarbonate (HCO_3)	129-245	199
Carbonate (CO_3)	nd-75	18
Potassium	7-34	12
Sodium	19-87	28
Sulfate	100-200	124
TDS	155-673	388
Spec. Conductivity (μmhos/cm)	518-689	582
pH (standard units)	7.5-9.4	8.0
Radium-226 (pCi/l)	6-1132	1.03
Thorium-230 (pCi/l)	.027-4.65	340

nd = not detected

Table 2.2: Baseline ground-water quality data in the O-Sand pilot well field for selected chemical parameters (from Rio Algom's application, March 31, 1988). Units in mg/l, unless specified otherwise.

Parameter	Range	Mean
Arsenic	.001-.016	.004
Boron	.01-.3	.14
Calcium	83-122	107
Iron	.01-.32	.06
Magnesium	21-32	26
Manganese	.01-.31	.03
Selenium	.001-.046	.005
Uranium	.003-1.68	.252
Chloride	2-8	4
Bicarbonate (HCO_3)	146-234	204
Carbonate (CO_3)	not detected	
Potassium	6-25	13
Sodium	24-32	27
Sulfate	244-310	268
TDS	522-656	583
Spec. Conductivity (μmho/cm)	636-978	778
pH (standard units)	7.31-8.16	7.69
Radium-226 (pCi/l)	61-680	272
Thorium-230 (pCi/l)	.0-5.6	1.1

nd = not detected

Table 2.3: Summary of Aquifer Hydraulic Conductivities
Smith Ranch ISL Project (all values in cm/s)

	High	Low	Average
Q-Sand - test calculations from one pumping well and five observation wells	1.5×10^{-3}	1.8×10^{-3}	1.6×10^{-3}
O-Sand - calculations based on one pumping well and nine observation wells	1.3×10^{-3}	1.3×10^{-5}	6.3×10^{-4}
Lower O-Sand - one pumping well and three observations wells, tested in four phases	3.6×10^{-3}	4.1×10^{-5}	1.1×10^{-3}
M-Sand - one pumping well and three observation wells in two phases	1.2×10^{-4}	2.1×10^{-5}	7.6×10^{-5}

In summary, the results of aquifer analysis and pilot operations indicate that the Q-, O-, and M-sands are nonleaky, confined aquifers. Representative hydraulic properties of each are summarized in Tables 2.3 and 2.4. In all cases, the aquifers exhibit approximate hydraulic conductivity ranging from 1×10^{-3} to 1×10^{-4} cm/s. The vertical hydraulic conductivity of the confining layers all fall in a range from 1.7×10^{-9} to 4.9×10^{-8} cm/s (see Table 2.4).

The upper confinement for the project is composed of the Wasatch Formation above the Q-sand interval. Most ground water in the Wasatch occurs under unconfined conditions. Confined zones are found deep, near the base of the formation, and are separated from the shallow aquifers by impermeable shale layers. These shale layers isolate the lower ore zones under several hundred feet of various lithologies. The most distinctive confining layer found in the permit area is the P-shale (Figure 2.2). This shale persists throughout the area, averaging 60 feet in thickness, and provides the lower confining layer for the Q-sand, and upper confinement above the O-sand. Its calculated vertical hydraulic conductivity is 4.8×10^{-8} cm/s.

The lower confinement is provided by the L-shale underlying the M-sand. The L-shale was penetrated by Well No. 741, used in the M-sand (Section 35) aquifer tests. Its penetrated thickness is about 50 feet. Its vertical hydraulic conductivity is 1.7×10^{-9} cm/s. Deeper confining layers have not been characterized.

Lateral confinement of the ore zones has been successfully accomplished artificially by overpumping the recovery wells. That is, more fluid is pumped out than injected. This procedure maintains a small cone of depression around each production well and the well field as a whole. To detect lixiviant that might migrate to areas of the formation where it would be considered to have caused an excursion, the staff will continue to require by license condition that the monitor wells and trend wells be monitored above and below, as well as around the perimeter of the mining units. Additionally, the staff will continue to require that any confirmed excursion be followed by appropriate preapproved corrective actions. The results of the corrective actions shall be reported to the NRC for review.

Aquifer testing theoretically indicates that ground-water flow would be contained by the confining strata and concentrated within the production zone. The confining characteristics, associated hydraulic conductivities and the continuous extent of the confining beds assure vertical control of the mining solutions. Further evidence of the confining characteristics associated with the strata bounding the production zone has been demonstrated by the lack of vertical migration during operation of the R&D project.

2.3 Archaeological and Historical Resources

Rio Algom's application includes Class III Cultural Resource Inventory reports for the areas of planned disturbance by the proposed mining project. As a result of the discovery of sites eligible for the National Register of Historic Places (Register), NRC conducted a consultative process with the BLM, the

Table 2.4: Summary of aquitard hydraulic conductivities, Smith Ranch ISL project, determined by the applicant based on pumping tests.

Aquitard	Well No.	Vertical Hydraulic Conductivity (Cm/Sec)
Upper O-Sand	593	$4.9x10^{-8}$
Lower N-Shale	582-A	$2.4x10^{-8}$
Upper N-Shale	742	$1.1x10^{-8}$
Lower L-Shale	737-A	$1.7x10^{-9}$
P-Shale	OMP-1	$4.8x10^{-8}$
O-Shale	OMO-1	$4.6x10^{-8}$

Wyoming State Historic Preservation Office (SHPO), and other potentially interested parties. The purpose of the consultation was to comply with Section 106 of the National Historic Preservation Act. The goal of the process was to evaluate the eligibility of various historic and prehistoric sites for inclusion on the Register, evaluate the potential effects of the licensed activities upon the eligible sites, and to obtain the concurrence of the interested parties on methods to avoid, reduce and mitigate those effects. The detailed results of the process are documented as correspondence amongst the consulting parties, and are maintained separately in NRC's docket files. The general results are reported here.

The cultural resource inventory located a total of 18 sites and 25 isolated artifacts. Other inventory projects conducted in the immediate area have located 9 additional sites for a total of 27 sites. 14 sites were historic, one of which has been determined to be eligible for nomination to the Register, one is presently unevaluated, and 12 were found to be nonsignificant. Thirteen prehistoric sites were present, of which four were eligible for nomination to the Register, one was of unknown eligibility, and eight were ineligible. None of the isolated artifacts are eligible for nomination to the Register.

The significant historic site in the permit area consists of six discontinuous segments of the Bozeman Trail (48CO165). The trail generally trends northward along the existing paved Ross Road in the northern portion of the permit area. Rio Algom had the sites reevaluated in 1991, by Rosenberg Historical Consultants. The Rosenberg report concluded that three segments, A, B, and E, contribute to the overall significance of the trail, and two portions, segments C and D, are noncontributing segments. Segments A, B, and E occur in the midst of the applicant's O-Sand pilot project and proposed mining well fields. The Holdup Hollow segment, listed on the Register, is located to the north of the proposed mining activities. A large portion of Rio Algom's permit area is visible from Holdup Hollow.

Unevaluated site 48CO1226, assumed to be a segment of Richards Bridge branch, is found midway between the two main mining areas. On-going solution mining activities will not directly affect this site, but it lies adjacent to a dirt road which will provide access to the southwestern mining area. Eligibility of site 48CO1226 has not been carefully addressed because it lies outside the proposed solution mining areas. It was recorded in 1985, as part of an oil well location and access road inventory (Aivazian, 1985). This site appears to be associated with a nonsignificant ranch road, evaluated as site number 48CO1296 by Rosenberg (1991).

Four significant prehistoric sites have been recorded in or adjacent to the solution mining areas. Sites 48CO1288, 48CO1289, and 48CO1291 were reported in the Rio Algom's cultural resource inventory (Waite, 1985). Another site, 48CO352, was documented for the nearby Dave Johnston Mine inventory (Western Cultural Resource Management, 1980). Of these four sites, 48CO352 and 48CO1289 may be directly affected by well-field activities south and west of Ross Road. Sites 48CO1288 and 48CO1291 lie near but outside of projected well field areas.

See section 4.5 of this report for an evaluation of the project's potential effects on the cultural resources of the area.

3.0 PROCESS DESCRIPTION

3.1 In Situ Leaching Process

The in situ leach method of uranium recovery was first applied in south Texas in 1975. Since that time, numerous other facilities have been developed not only on the research and development but also the commercial scale. For the most part, these ventures have shown that uranium can be economically recovered and ground-water quality restored to baseline or premining class of use standards.

There are many environmental advantages to in situ leaching of uranium over conventional mining methods. Open pits, mine dewatering, spoil piles, and other features of conventional mining methods create significant impacts on the environment. The greatest impact of the in situ leach extraction method is a temporary impact to the ore zone ground-water quality. This impact is termed temporary because, in most instances, the ground water can be restored to its baseline quality, premining use, or potential use category. In situ leaching permits economic recovery of deep, low-grade sandstone uranium deposits currently economically unrecoverable by conventional mining methods. The extent to which in situ leaching can be conducted is limited in that the ore zone conditions must be suitable for containing and controlling lixiviant during the leaching process.

The mechanics of in situ leaching are relatively simple in theory. An oxidant-charged lixiviant (Figure 3.1) is injected into the production zone aquifer through injection wells. With slight pH adjustments, the reduced mineralized uranium is oxidized and dissolved when contacted by the lixiviant. Following this, the uranium-rich solution is drawn to the recovery wells where it is pumped to the surface and transferred to the processing facility.

During production, mining solution continually moves through the aquifer from the outlying injection wells to the internal recovery wells. The wells can be arranged in a number of geometric patterns depending on ore body configuration, aquifer permeability and operator preference. Most often, they are in a five- or seven-spot pattern. Monitor wells surround the well-field pattern area, both vertically and horizontally, and are screened in appropriate stratigraphic horizons to detect any lixiviant in case it migrates out of the production zone. Due to confining layers above and below the mining zone and the continual movement of lixiviant to centrally located recovery wells, excursions of mining solutions are rare.

3.2 Well Field Design and Operation

The proposed mining project involves approximately 25 individual mining units. When the project is fully operational, about 2 years after licensing, approximately five mining units will be in production at a time (Figure 3.2). Well field installation and testing for each unit is slated to require a year

Figure 3.1

PRIMARY CHEMICAL REACTIONS EXPECTED IN THE AQUIFER
SMITH RANCH IN SITU URANIUM MINING
CONVERSE COUNTY, WYOMING

Uranium Extraction

H_2O_2 hydrogen peroxide	-->	$\frac{1}{2}O_2$ oxygen	+	H_2O water				
UO_2 uranium in reduced state	+	$\frac{1}{2}O_2$ oxygen	-->	UO_3 uranium in oxidized state				
UO_3 oxidized uranium	+	Na_2CO_3 sodium carbonate	+	$2NaHCO_3$ sodium bicarbonate	-->	$Na_4UO_2(CO_3)_3$ sodium uranyl tricarbonate	+	H_2O water

The soluble uranyl tricarbonate complex moves to the production wells in solution and is recovered in the process plant.

Calcium Carbonate Scale

Ca-clay calcium clays	+	Na_2CO_3 sodium carbonate	-->	Na_2-clay sodium on clays	+	$CaCO_3$ calcium carbonate

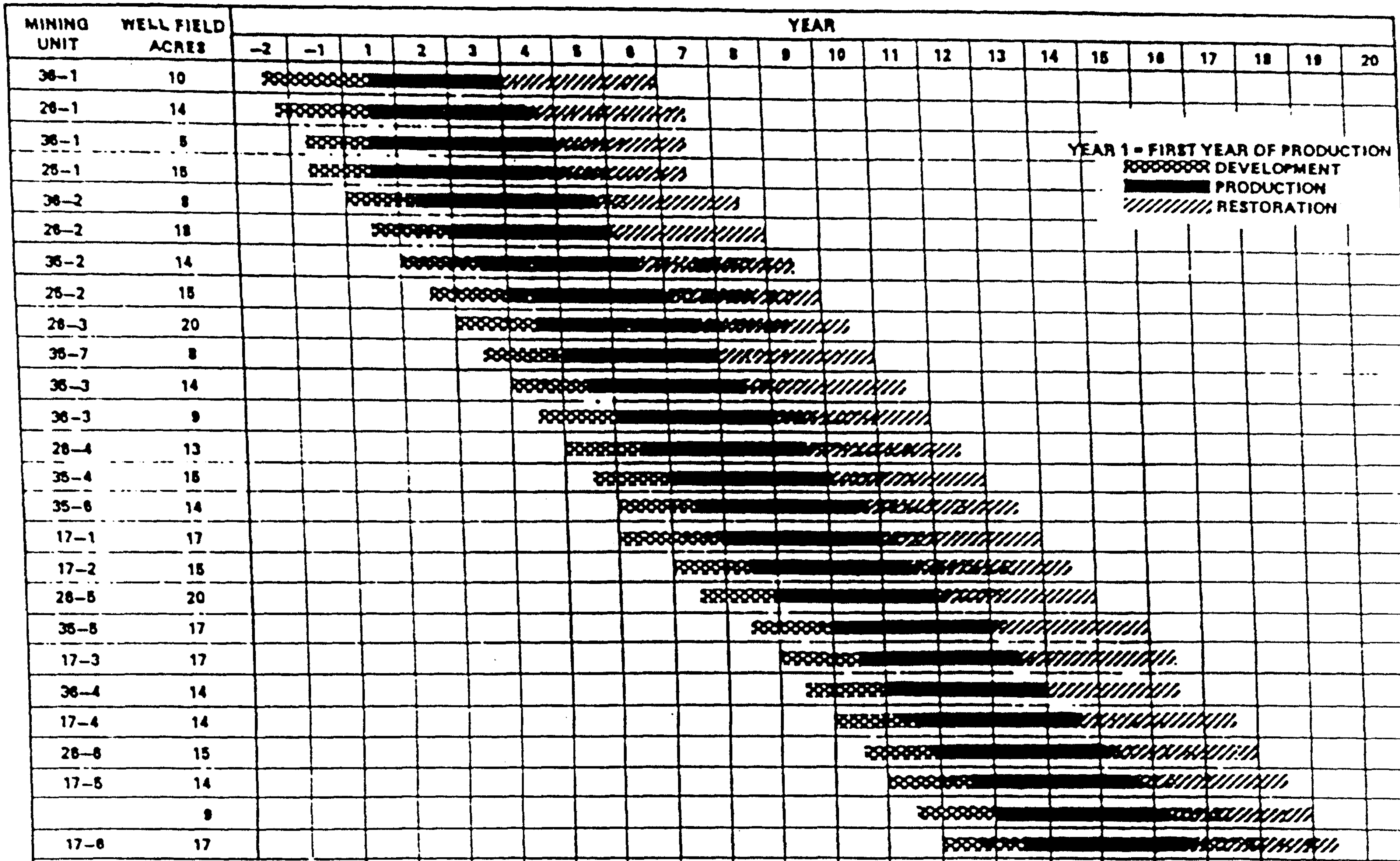
The calcium carbonate is soluble in the solution; however, after it reaches a certain concentration, a change in pressure or temperature may cause it to precipitate as scale.

Pyrite Reaction

$2FeS_2$ pyrite	+	$19H_2O_2$ hydrogen peroxide	+	8Na sodium ions	-->	$2Fe(OH)_3$ ferric hydroxide	+	$4Na_2SO_4$ sodium sulfate	+	$16H_2O$ water

The ferric hydroxide will precipitate when formed. The sodium ions in the above reaction could be replaced by calcium in certain conditions resulting in calcium sulfate instead of sodium sulfate. Calcium sulfate, with changes in temperature and/or pressure, can precipitate as a scale.

PROJECTED DEVELOPMENT SCHEDULE BY MINING UNIT
SMITH RANCH PROJECT



EOY STATUS OF OPERATION	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
IN PRODUCTION – ACRES			44	52	84	90	89	79	73	83	81	96	82	91	83	55	26	–	–	–	–	
IN RESTORATION – ACRES			–	–	–	39	52	84	75	89	79	73	83	81	96	82	91	69	55	26	–	
RESTORED – ACRES			–	–	–	–	–	–	44	52	84	119	141	163	192	224	244	292	306	335	361	

Figure 3.2: Rio Algom's projected mine development chart indicating various mining units and when they will have well fields installed, operated, and restored.

and a half. Mining will proceed approximately 3 years in each unit, followed by an equivalent period of unit restoration and surveillance monitoring. Rio Algom's proposed schedule covers a total of about 20 years. The exact locations and boundaries at each mining unit are likely to be adjusted as more detailed stratigraphic and ore-occurrence data are collected during well field construction. A single well pattern consists of four to six injection wells arranged in a polygon surrounding a centrally placed recovery well. Spacing between wells will vary from 75 to 100 feet depending on characteristics of the ore body, the aquifer, and topography. Figure 3.3 exhibits a typical well field pattern which was employed for the pilot project. Well patterns may be altered to fit the size, shape, and boundaries of individual ore bodies.

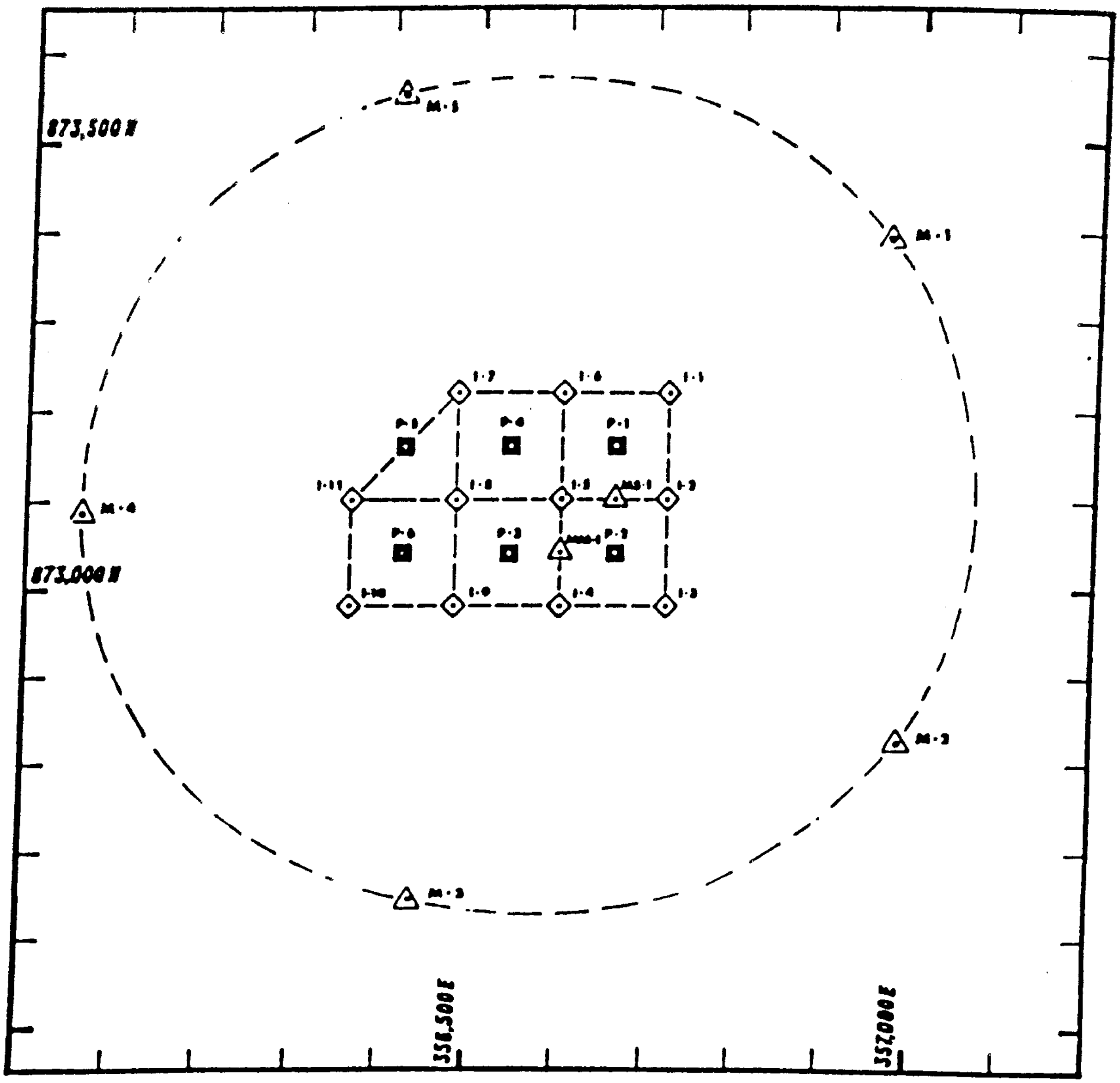
Figure 3.2 provides Rio Algom's proposed mining schedule. The schedule is based on known ore zones and projected capacity of the uranium recovery plant. The applicant originally proposed to run the plant at a rate of 5000 gallons per minute (gpm). In addition, the applicant intends to install a satellite ion-exchange unit in the well fields having a capacity for 3000 gpm. The applicant's calculation of radiological effluents, however, has been based on two ion-exchange units, each operating at 3000 gpm, producing two million pounds of yellowcake per year. Therefore, the licensee will be limited by license condition to annual production of two million pounds of yellowcake, and a total well-field production rate of 6000 gpm.

Each injection, production and monitor well will be constructed alike. First, each hole will be drilled through the expected ore zone employing mud rotary methods with a 5-inch diameter drill bit. After drilling to the proper depth, a hole will be logged. If all logs indicate the hole is suitable for its intended purpose, it will then be reamed a second time to 7- to 10-inch diameter to the top of the ore zone. Casing will be placed to the top of the ore and cemented in place. Cementing will be completed by injecting the cement under pressure down the casing, out the bottom, with return to the surface through the annulus. When the cement has set for a number of days, it will be drilled out of the casing. At this time, the ore zone will be under reamed if desired, and cleaned out. Finally, a recoverable screen string will be lowered through the casing into the ore zone, with packers sealing it against the interior of the casing string. A typical completed well is illustrated in Figure 3.4.

Each well will be integrity tested prior to use in the well field. An integrity test utilizes a packer just above the screen and another at the well head. These packers will segregate the nonperforated section of the well casing. The test consists of pressurizing the segregated portion of the casing to a level which simulates the maximum anticipated operating pressure plus an engineering safety factor. If more than a 5 percent pressure loss occurs during 10 minutes, the well will fail the integrity test. Wells not passing the integrity tests are commonly reworked and tested again. Repeated failure of the integrity testing will result in the well being abandoned. The integrity testing program will ensure that fluids injected and recovered during mining are not lost from the well due to failure in the casing.

"O" SAND WELL PATTERN

Section 26, T-36N; R-74W



Legend

- Monitor Well
- Production Well
- Injection Well
- Upper Zone Monitor Well
- Lower Zone Monitor Well

120 ft. Spacing Between Injection Wells

NORTH

Figure 3.3: Diagram of the existing O-Sand pilot well field indicating the typical arrangement of injection, production, and monitor wells.

WELL COMPLETION METHOD

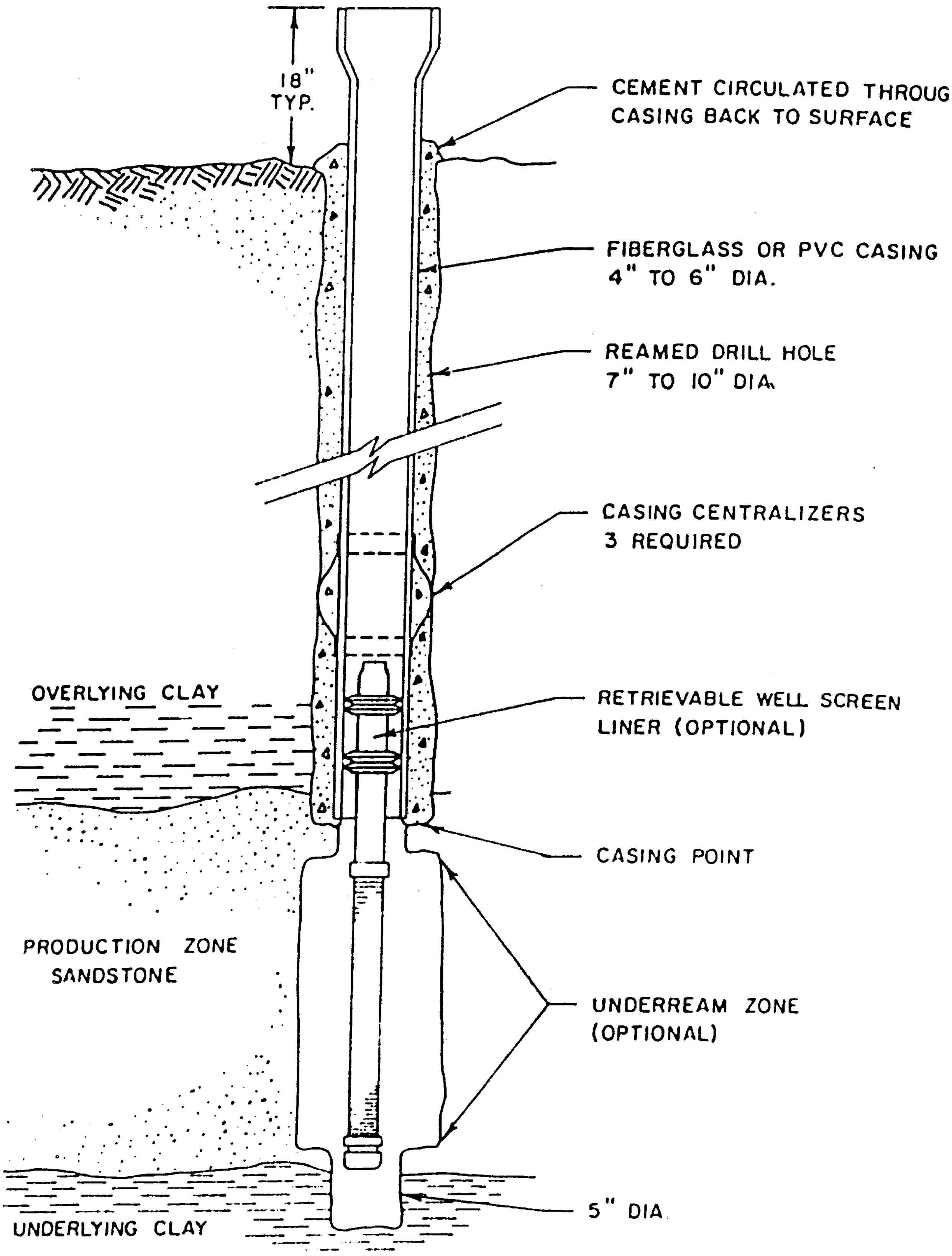


Figure 3.4: Generalized diagram of Rio Algom's proposed well completion method indicating relationships between the drilled hole, casing, packers, and ore zone.

In addition to initial integrity testing, the license will require that wells be retested for integrity after any well servicing that could cause casing damage. Repeated integrity testing will also be required for operating wells on a schedule of once each 5 years. Any unsuitable holes or abandoned wells shall be plugged in accordance with Wyoming DEQ requirements.

Each well will be connected to the respective injection or production manifold in a well field header building. The manifolds will route solution to the pipelines to and from the recovery plant. Meters and control valves in individual well lines will monitor and control flow rates and pressures for each well. Well-field piping is expected to be high density polyethylene pipe, PVC and/or steel. The individual well lines and the trunk lines to the recovery plant will be buried to prevent freezing. The use of field header buildings and buried lines has been proven an effective method of protecting the pipelines. Pilot programs have operated continuously through the past 6 years without freeze-ups or other significant weather related problems.

3.3 Lixiviant Chemistry

The proposed chemicals to be mixed with the recirculated ground water will consist of sodium and carbonate species along with oxygen or hydrogen peroxide, and carbon dioxide. The expected lixiviant concentration and composition is shown in Table 3.1. No other form of lixiviant will be permitted at the site without approval as a license amendment.

3.4 Uranium Recovery Process

Uranium solution will be conducted from several mining units at once to the processing plant. The plant is schematically illustrated in Figure 3.5, and will process solution at a flow rate not to exceed 6000 gpm. This environmental analysis is based, in part, on this process diagram. Therefore, any significant changes to the process will require an amendment to the license.

During mining, the well field waters will be enriched with uranium as well as several other metals associated with the bedrock minerals. Data from the R&D project indicate that trace metals such as arsenic, selenium, vanadium, iron and manganese are liberated during the leaching process and are mobilized with the uranium. Once the solution reaches the plant, it is stored in a surge tank or is pumped directly into a series of ion exchange (IX) columns. It is here that the uranium and, to a lesser extent, other metals are absorbed onto the resin beads. The resulting barren solution exits the IX columns, is recharged with additional oxidizing and complexing agents, and is reinjected in the well field.

Once the majority of the ion exchange sites on the IX column resin are filled with uranium, the column is taken off stream for elution. In the elution process, the uranium is stripped from the resin beads with a concentrated solution of sodium chloride. The resulting pregnant eluant is discharged into a holding tank.

Table 3.1: Anticipated concentration ranges of principal chemical species in Rio Algom's lixiviant injectant and/or feed solution from the well fields for processing. Concentrations are given in milligrams per liter (mg/l) unless specified otherwise. Values represent normal operating conditions and include maxima based on individual wells, but not background aquifer conditions. Data are based on R&D project observations.

Species	Minimum	Maximum
Na	200	800
Ca	100	500
Mg	20	150
K	20	50
CO_3	0	500
HCO_3	1500	3000
Cl	100	600
SO_4	200	1500
U	1	1000
V	1	25
TDS	2000	5000
pH (standard units)	6.0	9.0

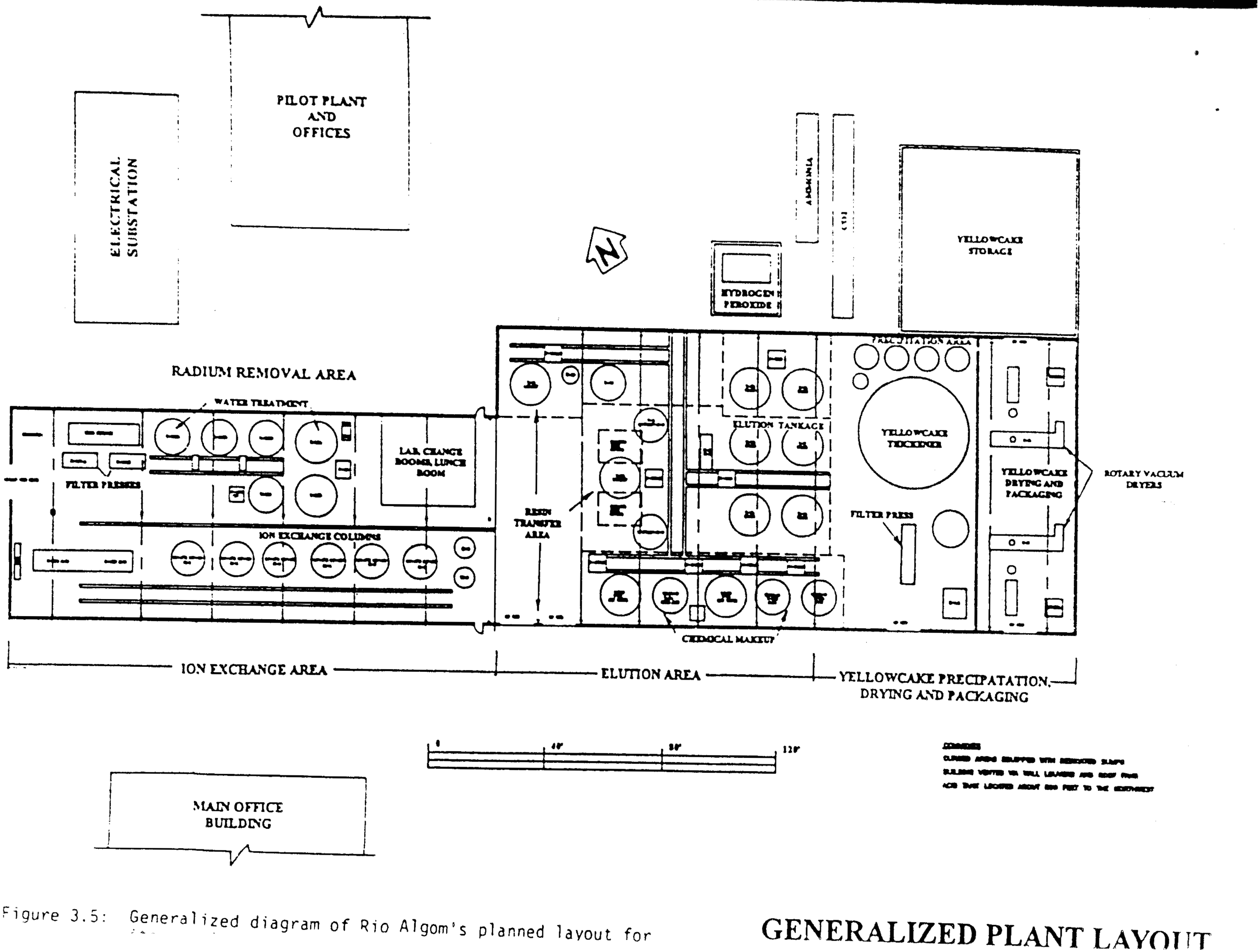


Figure 3.5: Generalized diagram of Rio Algom's planned layout for

When a sufficient volume of pregnant eluant is held in storage, it will be acidified to destroy the uranyl carbonate complex ion. Hydrogen peroxide or ammonia will then be added to the solution to precipitate the uranium. The precipitated uranyl peroxide slurry (yellowcake) is pH-adjusted and allowed to settle. Following this, the clear solution is decanted and either recirculated back to the barren eluant storage tank or treated as a waste and sent to evaporation ponds. The yellowcake is further dewatered and washed using a vacuum belt filter or equivalent and dried. Rio Algom expects to recover approximately 2,000,000 pounds of yellowcake per year.

3.5 Description of Processing Plant, Ponds, and Waste

3.5.1 The Processing Plant

The applicant proposes to expand the former Bill Smith mine equipment building as its ISL processing plant. The processing plant will conduct solutions in three main circuits (Figure 3.6).

The ion exchange (IX) circuit will consist of a series of columns containing IX resin, tanks to store solutions, and pumps. Lixiviant will be pumped through the columns where uranyl carbonate complexes will be removed. Barren lixiviant is then returned to the well field injection system. When a resin column becomes fully charged with uranyl complex, it will be taken off line to begin the elution/precipitation circuit. Lean eluant will be pumped from barren eluant tanks to the IX column and the resulting pregnant eluant will be transferred to the acidizer/precipitator where uranium is precipitated. The precipitated uranium then begins the final drying circuit, where it is dewatered and washed. Finally, the uranium will be vacuum dried on site and packaged for storage and shipment.

3.5.2 Wastes

Liquid and solid wastes will be generated at the Smith Ranch facility. Operating the processing plant will result in two major liquid effluent streams: the production bleed and the eluant bleed. These streams will be routed to water treatment units or to evaporation ponds. Rio Algom proposed that production bleed be treated to remove radium, and then discharged to evaporation ponds or another State-approved discharge point. For an assumed total production rate of 4000 gpm, bleed from eluant, precipitation, and water softener recharging will be discharged to evaporation ponds or an approved disposal well at 18 gpm (9.5 million gallons per year). A generalized mining water effluent budget is displayed in Figure 3.7.

Two additional waste streams will occur when aquifer restoration is underway. The first effluent stream will stem from mine-unit water cleaned of dissolved solids by a combination of IX columns and/or in an electrodialysis or reverse osmosis (erd/ro) unit. The stream will then be treated for radium removal, and discharged at 800 gpm, for an assumed recovery plant operation rate of 4000 gpm. The resulting brine will contain concentrated total dissolved solids and will be discharged at about 100 gpm to the evaporation ponds. Additional erd/ro water will be recycled through the aquifer restoration system. The restoration water effluent budget is displayed in Figure 3.7.

RECOVERY PLANT FLOW PROCESS SCHEMATIC

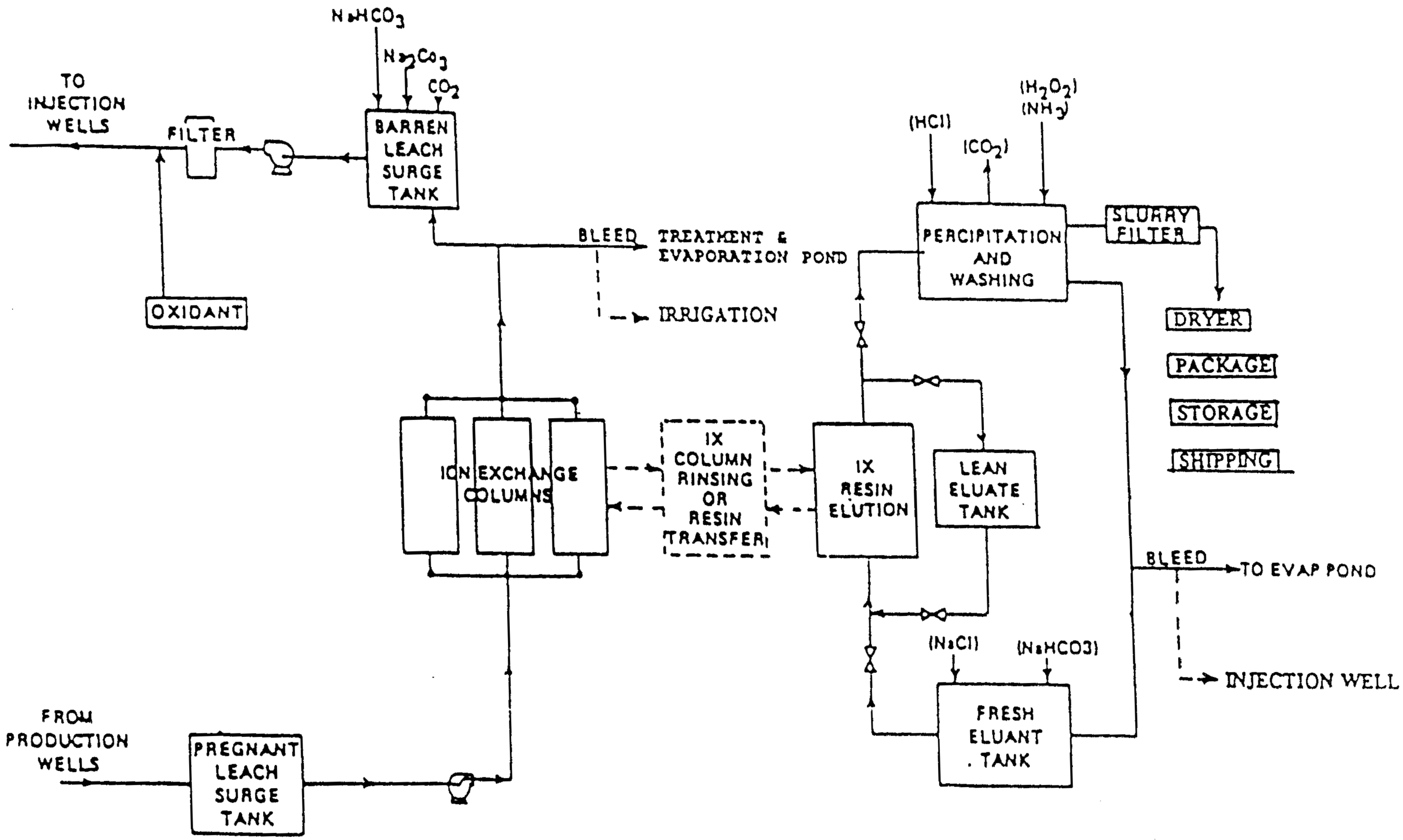


Figure 3.6: Schematic flow chart exhibiting the proposed path of processing solutions for the Smith Ranch ISL processing plant.

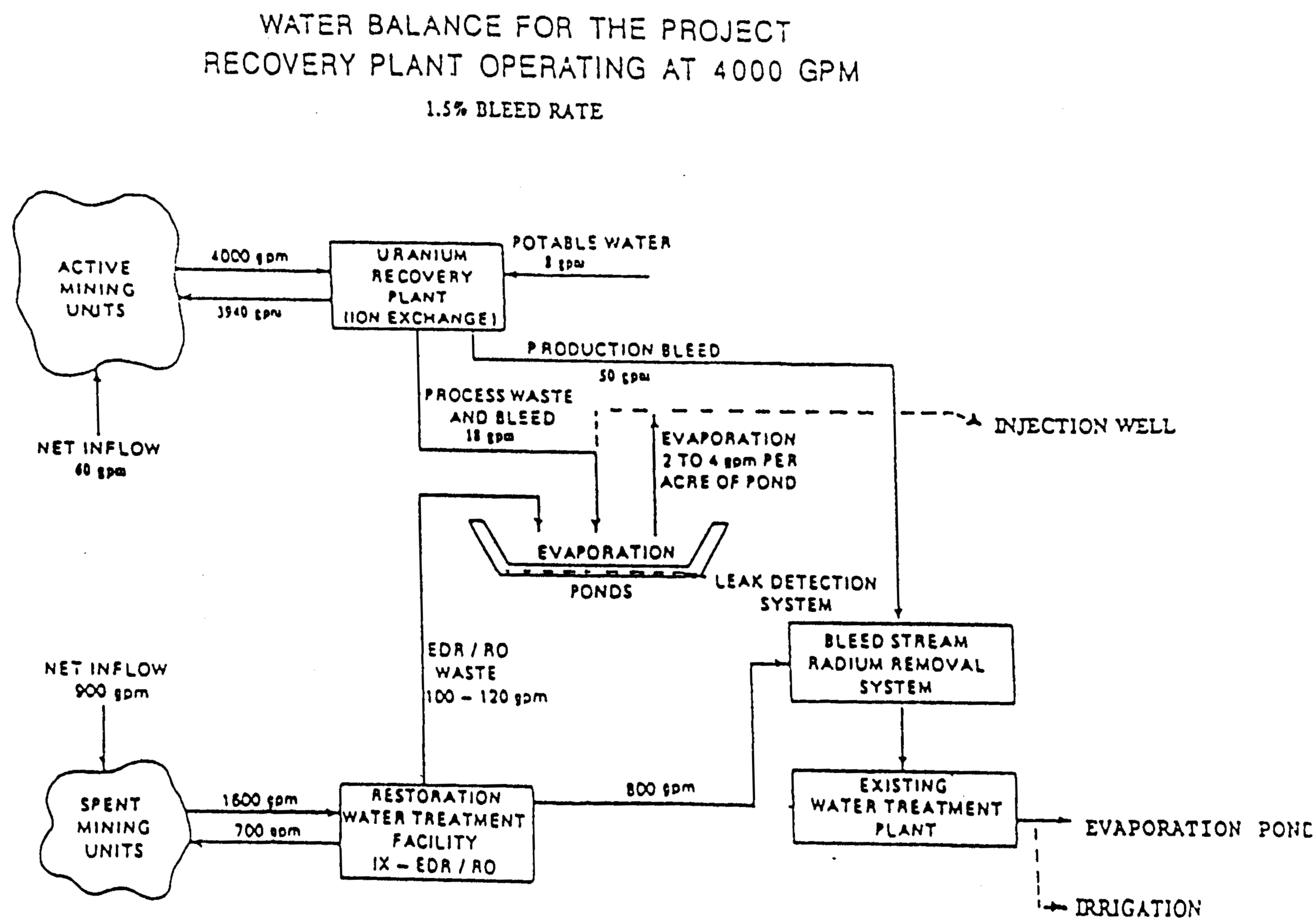


Figure 3.7: Schematic flow chart exhibiting Rio Algom's proposed flow budget for solutions in different components of the processing plant. Budget assumes operations at a total production rate of 4000 gallons per minute.

To assure that all liquid wastes are accounted for, Rio Algom will be required by license condition to return all liquid effluents to the process circuit or to an approved disposal system. Land application or deep-well injection of excess water produced during restoration has not yet been requested. These effluent disposal methods, however, have been in use at other uranium recovery facilities, and are being considered as alternatives by Rio Algom. Water will require treatment to maximum constituent standards. Optional disposal methods will require an amendment to the license, an environmental assessment, and Wyoming DEQ approval.

Sanitary wastes from the restrooms and lunchroom will be disposed of in an approved existing septic system. The septic system is subject to continued approval by the State of Wyoming.

Solid wastes generated at the site will consist of spent resin, empty reagent containers, miscellaneous pipes and fittings, and domestic trash. These wastes will be classified as contaminated or noncontaminated waste, according to their radiological survey results. Noncontaminated waste will be disposed of in the site's existing solid waste facility as authorized by the Wyoming DEQ.

Contaminated solid waste will be separated into two categories. The first category will be waste which has some salvage value and can be decontaminated to unrestricted release limits of noncontaminated waste. This type of waste may include piping, valves, instruments, equipment and any other item which can be decontaminated. Decontaminated materials will have radiation levels lower than those specified in NRC Branch Technical Position "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material." All decontaminated wastes will be inspected and surveyed by the radiation safety officer or health physics technician prior to their release from the site to assure that appropriate decontamination procedures have been observed.

An alternative method of disposing of contaminated materials may be to sell the equipment and building to a holder of another source material license. This method would involve minimal contamination removal from equipment and associated structures prior to shipping. Although final radiation levels may be higher than for unrestricted release, all equipment shall be shipped according to U.S. Department of Transportation requirements.

The second category of waste will include items which have no salvage value and have been contaminated during uranium recovery operations. The most common type of this material is radium contaminated filters. These materials will be stored within a restricted area until they can be shipped to a licensed waste disposal site or licensed mill tailings facility for disposal. Rio Algom proposes that all waste byproduct material will be disposed of at the Quivira Mining Company tailings pile in New Mexico.

3.5.3 Evaporation Ponds

A minimum of two evaporation cells will be constructed for ISL operations. Additional cells will be constructed as needed. Cell dimensions will be approximately 550 feet by 1000 feet, or about 12.5 acres. Construction will be similar to existing ponds. Embankments will be constructed of clay and sandy clay excavated onsite. Each cell shall be lined synthetically and include a leak detection system. All embankments are to be constructed to divert surface runoff away from the ponds and to prevent embankment erosion. In addition, ponds are to be fenced to exclude domestic animals and wild game.

Absolute freeboard requirements have not been determined by the applicant. Therefore, all detailed evaporation pond designs will be subject to NRC approval in the form of a license amendment prior to injection of lixiviant for commercial production. Freeboard capacity will be required to accommodate a Probable Maximum Precipitation event, maximum wind-generated wave runup, and include an engineering safety factor of 1.8. In addition, pond capacities will be limited such that any one pond may be drained into the others in case liner repairs become necessary. All designs will be required to meet NRC Regulatory Guide 3.11, Staff Technical Position Paper No. WM-8101, and WDEQ requirements.

3.5.4 Existing Settling Ponds

Rio Algom's previous activities at the Smith Ranch site included mining from both the pilot ISL project and the adjacent Bill Smith shaft mine. Shaft mining activities are not subject to NRC regulation. Each mining project produced liquid effluent to the environment. The shaft mine was dewatered to prevent underground flooding, while the ISL project produced an appropriate well field bleed. Rio Algom routed these effluents to a series of radium settling ponds, and then released them under an NPDES permit issued by the State.

In 1986, the NRC came to understand that the two projects' effluent streams were first commingled, then treated with barium chloride (BaCl) for radium removal. After treatment, the combined effluent was released to the ponds where barium sulfate ($BaSO_4$) and radium precipitates were allowed to settle, resulting in an accumulation of byproduct waste material in an unposted area. Rio Algom's response to the NRC's findings provided a commitment to post the evaporation ponds as areas containing radioactive materials. Because of NRC's concern over mixing the two waste streams, the licensee submitted a proposal to remove radium from the ISL bleed stream prior to commingling with the shaft mine water. Approval of this plan was granted in NRC's license renewal on January 29, 1988 (SUA-1387, License Condition No. 17).

To address byproduct radium material that remained in the pond sludge, Rio Algom submitted calculations of the mass and concentrations of radium-226 in the settling ponds derived from the ISL bleed and the Bill Smith mine water. It was not clear from the submittals if the concentration of byproduct radium-226 in the pond sludge was in excess of 10 CFR Part 40, Appendix A, Criterion 6 standards. Rio Algom used these data to support consideration of the settling ponds as a disposal site for the byproduct radium. Following a series of correspondence and less formal conversations, Rio Algom formally

submitted a license amendment request on March 23, 1988. The request included a provision for variance from 10 CFR Part 40, Appendix A, Criteria 2 and 6, regarding disposal of byproduct radium-226 in the settling ponds.

Supporting data included radium-226 analyses for sediment samples from the ponds. From six sediment samples in each pond, Pond 1 exhibited an average total radium concentration of 96.9 picocuries per gram (pCi/g). The Pond 2 value was 82.6 pCi/g, while Pond 3's mean was 13.9 pCi/g. Assuming all radium in the ponds is byproduct material, Rio Algom's proposal contained neither sufficient site characterization data, nor disposal site design specifications, to show that long-term stability requirements in Criterion 6, can be met. In addition, designation of the reclaimed ponds as a byproduct disposal area would be contrary to the disposal site nonproliferation provisions in Criterion 2.

In light of the application for a commercial license, NRC will transfer all monitoring and reclamation requirements of the R&D facility to the new license. Because it was not clear that the criteria of Appendix A would be met by the applicant's earlier proposal, Rio Algom will be required by condition of its forthcoming commercial license, to propose an alternate means of disposal. The proposal shall confirm characterization of the byproduct contamination, propose an acceptable disposal option, and a reclamation schedule. Finally, the license condition will require submittal and approval of the plan prior to commercial production of source material at the Smith Ranch ISL project.

3.6 Ground-Water Restoration, Reclamation, and Decommissioning

3.6.1 Ground-Water Restoration

The primary goal of restoration is to return all ground water affected by the mining to baseline conditions. Rio Algom proposed to return water quality of the affected ground water to the premining quality of use. This proposal is not entirely consistent with the primary restoration criteria of returning water to baseline quality. Therefore, Rio Algom will be required by license condition to use baseline conditions as its primary restoration target. As evidenced in the R&D restoration demonstration, baseline levels for all ground-water parameters cannot always be reasonably met. Therefore, a secondary ground-water restoration goal of returning the water to a quality consistent with its premining use will be established. To assure that the staff has sufficient time to review all restoration plans, the license will stipulate that all ground-water restoration plans be submitted for NRC review at least three months prior to starting restoration of each mine unit.

Rio Algom proposes that the restoration criteria be established on a mine-unit average basis for each parameter. This is consistent with current ISL restoration practices. Rio Algom's planned well fields average 13 acres in size, ranging between 5 and 20 acres apiece. Baseline for each mine unit will be established by ten wells evenly distributed. Those units exceeding ten acres will have additional baseline data generated by one well for every two additional acres. From each well, three samples will be collected and analyzed for the parameters listed in Table 3.2. Laboratory results for each parameter

Table 3.2: Baseline parameters to be analyzed in each ground-water monitor well, Smith Ranch ISL project, Converse County, Wyoming.

A. Common Constituents
(in milligrams per liter)

Bicarbonate	Magnesium
Calcium	Potassium
Carbonate	Sodium
Chloride	Sulfate
Fluoride	Nitrate (as N)
Ammonia	

B. Trace and Minor Elements
(in miligrams per liter)

Aluminum	Manganese
Arsenic	Mercury
Barium	Molybdenum
Boron	Nickel
Cadmium	Selenium
Chromium	Uranium
Copper	Vanadium
Iron	Zinc
Lead	

Radium-226 in picoCuries per liter

C. Physical Parameters

Total Dissolved Solids - mg/l
Temperature - F°
Specific Conductivity - umhos @25°C pH - units

will be used to arrive at a mine-unit mean. These numerical values will establish the primary restoration goal, recognizing spatial and temporal variations.

Rio Algom proposes to use essentially the same restoration methodology in the commercial operation as was used for the R&D project. Ground-water restoration conducted at the R&D operation utilized ground-water sweep, permeate injection, reductant injection, and aquifer recirculation.

Ground-water sweep draws well field waters as well as natural ground water toward the center of the mining unit. This procedure is generally done without any well field injection. Thus, a cone of depression is established causing waters to flow into the mining unit. During the R&D operation, this stage was continued until the majority of the injected solution was recovered from the area surrounding the well field. Samples from the injection wells and comparative volume calculations are utilized to determine when this phase is complete.

After ground-water sweep has been completed, the permeate injection/reductant stage will be initiated. In this stage, the water recovered from the well field will be processed by ion exchange to remove remnant amounts of uranium, and then electrodialysis or reverse osmosis (edr/ro) treatment will remove other dissolved solids. The resulting permeate, or other clean water can then be injected into the well field. Brine solutions from edr/ro treatment will be routed to an evaporation pond. If required, this flushing process will be followed by reductant injection. Its purpose is to re-establish reducing conditions in the aquifer; immobilizing metals like arsenic, molybdenum, selenium, uranium, and vanadium. Prior to commencing restoration, the licensee will be required by license condition to have an approved occupational safety plan in place concerning the use of chemical reductants in the plant or well field. Finally, clean water is again circulated through the aquifer to reduce the dissolved solids introduced during the reductant phase. Rio Algom estimates six pore-volumes of water will be circulated through each mining unit as restoration proceeds.

The NRC reviewed the restoration results of the Q-sand project and on August 11, 1987, amended the R&D license to confirm successful restoration of the well field (Table 3.3). One well in the field exhibited values for uranium and nitrate above the targets. The values were below Wyoming DEQ drinking water standards, however, and the well-field averages as a whole were below the targets. The R&D approved restoration criterion was based upon returning the ground water to a category of use standard rather than to the mean of the baseline values. The O-Sand pilot well field was placed on standby status during September 1991. Its restoration requirements are exhibited in Table 3.4.

3.6.2. Decommissioning and Reclamation

When the project is fully operational, Rio Algom expects approximately 15 mining units will be in development, mining, or restoration at any one time. Therefore, reclamation will occur in interim steps to minimize environmental

Table 3.3: Baseline ground-water conditions, aquifer restoration goals, and actual final restoration values approved by NRC for the Q-Sand pilot well field (from Rio Algom's application, March 31, 1988). All values in mg/l. unless specified otherwise.

Parameter	Range	Mean	Restoration Goal	Actual Restoration
Arsenic	.001-.013	.004	.05	.008
Boron	.002-.70	.15	.54	.14
Calcium	24-171	72	120	78
Iron	.01-.27	.025	.3	.24
Magnesium	3-22	16	.092	.06
Manganese	.01-.077	.023	n/a	.1
Selenium	.001-.024	.004	.029	.003
Uranium	.001-3.1	.28	3.7	1.45
Chloride	4-65	18	250	15
Bicarbonate (HCO_3)	129-245	199	294	254
Carbonate (CO_3)	nd-75	18	15	nd
Nitrate	.1-1.0	.4	na	.13
Potassium	7-34	12	23	8
Sodium	19-87	28	41	38
Sulfate	100-200	124	250	128
TDS	155-673	388	571	443
Spec. Conductivity (µmhos/cm)	518-689	582	827	642
pH (standard units)	7.5-9.4	8.0	6.5-8.6	7.0
Radium-226 (pCi/l)	6-1132	340	923	477
Thorium-230 (pCi/l)	.027-4.65	1.03	5.62	3.4

Table 3.4: Baseline ground-water conditions and aquifer restoration values for the O-Sand pilot well field (from Rio Algom's application, March 31, 1988). Units in mg/l, unless specified otherwise.

Parameter	Range	Mean	Restoration Requirement
Arsenic	.001-.016	.004	.05
Boron	.01-.3	.14	.36
Calcium	83-122	107	146
Iron	.01-.32	.06	.38
Magnesium	21-32	26	38
Manganese	.01-.31	.03	.37
Selenium	.001-.046	.005	.055
Uranium	.003-1.68	.252	2.02
Chloride	2-8	4	250
Bicarbonate (HCO_3)	146-234	204	281
Carbonate (CO_3)	not detected	--	--
Nitrate	.2-.74	.46	2
Potassium	6-25	13	30
Sodium	24-32	27	38
Sulfate	244-310	268	372
TDS	522-656	583	787
Spec. Conductivity (μmho/cm)	636-978	778	1174
pH (standard units)	7.31-8.16	7.69	8.5
Radium-226 (pCi/l)	61-680	272	816
Thorium-230 (pCi/l)	.0-5.6	1.1	6.7

impacts during and after mining takes place, and will restore disturbed land to its premining use. A final decommissioning plan will be required by license condition at least 12 months prior to license termination, for NRC review and approval.

The most prominent surface disturbance will occur at the evaporation ponds. Foundations, buildings, storage areas, and parking lots for the processing plant already exist at the former Bill Smith Mine site (Fig. 1.2). Surface disturbance will also occur during the well drilling programs, pipeline installations, road construction, and header building construction. These disturbances, however, involve relatively small areas or have very short-term impacts.

Topsoil Handling

Soil disturbances caused by the mining operation will be kept to a minimum. Topsoil from the existing mine facility was stockpiled and seeded with a cover crop to control erosion. Topsoil from future disturbed areas will be removed and stockpiled. Stockpiles will be located, shaped, and seeded with a cover crop and crimp mulched to minimize erosion. Topsoil signs will also be placed on each stockpile.

In the well fields, topsoil will be removed from new access roads and well header building sites and stockpiled as discussed above. If unanticipated high traffic roadways are developed, the topsoil on such roadways shall be subject to the same preservation program. For areas where only limited disturbance occurs, such as well sites and pipeline routes, topsoil will be bladed to one side and then re-spread over the area as soon as construction is completed. These areas will then be stubble mulched. If topsoil stockpiling or retopsoiling of an area is completed in the winter or spring, a stubble crop of oats will normally be planted with the final grass seed mix or a long-term cover seed mix planted in the stubble in the autumn.

Well Fields

After successful restoration of ground water in the mined aquifers, each well field will be decommissioned. All buried well-field lines and pipelines will be removed. In addition, injection, production, and monitor wells will be plugged and abandoned according to Wyoming DEQ requirements. Land owners may negotiate with the applicant to convert monitor wells to water-supply wells provided all materials involved meet standards for release to unrestricted use. After pumps and tubing are removed, each well will be backfilled with approved abandonment mud or cement slurry to within 5 feet of the surface. The casing will then be cut at least 2 feet below the surface, and a cement plug will be placed at the top. The wellhead area will then be backfilled and the surface reclaimed according to the approved plan.

Pad Reclamation

The plant and pond areas will be reclaimed in a similar fashion as the well field areas. Excess soil from the built-up plant base and pond embankments

will be returned to the ponds as fill. Following this, land surface contours will be reestablished. Finally, topsoil will be replaced on all plant and pond disturbed areas. Reseeding of these areas will also follow guidelines in the Wyoming DEQ permit. A period of several years will be required for establishment of viable vegetative cover. The licensee will be required to maintain exclusionary fences and release areas for test grazing according to the State permit.

Decommissioning and Disposal

Dismantled equipment from the processing plant may be disposed of in one of three ways. First, contaminated equipment may be dismantled and sold to another licensed facility. Alternatively, equipment decontaminated in accordance with "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use of Termination of Licenses for Byproduct or Source Material, September, 1984," published by NRC, may be sold for salvage or scrap. Second, decontaminated materials having no resale value, such as building foundations, may be buried on-site. Finally, waste materials that cannot be decontaminated to acceptable levels for release, shall be disposed of in an NRC-licensed facility as discussed in Section 3.5.2.

After all liquid in ponds has been evaporated, decontaminated, or disposed of in a licensed facility, the precipitated solids and the pond liner will be removed and disposed of in a licensed facility. Pond liners cannot typically be economically cleaned to standards required for unrestricted use. The pond area will then be reclaimed as other disturbed areas, discussed in a following section.

Radiation Surveys

After the equipment, buildings, foundations, piping, and associated support facilities have been removed, gamma surveys will be conducted over the areas. In the well fields themselves, gamma surveys will also be conducted during the decommissioning of each mining unit. Gamma survey results will be compared with background values, and soil samples will be obtained from locations which exhibit elevated gamma readings. Soil samples will be analyzed for natural uranium and radium-226 content. Contaminated soil will be excavated as specified in 10 CFR 40 Appendix A, and disposed of in the same manner as other contaminated material. All survey results will be subject to verification by the NRC.

Recontouring

After decommissioning and decontamination have been completed, final reclamation will proceed. Compacted soil along roads and beneath foundations will be ripped. Recontouring the land where disturbance has taken place will restore the surface and provide a terrain consistent with the post mining land use. Because no major changes in the topography will result from the proposed mining operation, a final contour map is not required for this project.

Revegetation

During mining operations the topsoil stockpiles, and other areas disturbed during the interim, will be seeded with a cover crop to minimize erosion.

Long-term cover crop seed mix, unless requested otherwise by the surface owner, is expected to be a mix of western wheatgrass (4 lbs/acre), stream bank wheatgrass (3 lbs/acre) and thickspike wheatgrass (3 lbs/acre). The long-term cover grass mix will be used to protect topsoil stockpiles and/or retopsoiled areas which are expected to remain in place for longer than one year prior to final seeding. These practices, tested and proven in the pilot programs, will provide the needed protection for the topsoil, and will minimize erosion.

When topsoil is replaced during final reclamation, an area normally will be seeded with oats to establish a stubble crop, then reseeded with grasses the next growing season using the pure live seed mixtures shown in Table 3.5.

Reseeding will normally be accomplished by broadcast seeding or drilling with seeding completed before May 1 or after October 15, during the year in which the topsoil is replaced. If drilling is not practical, seeds will be broadcast with a hand spreader, and the area will then be harrowed or raked.

Vegetation in larger reclaimed areas will be protected by fencing until a viable stand of growth is obtained. When vegetation cover and productivity are adequate to support normal grazing, the licensee will apply to the NRC and Wyoming DEQ for bond release.

Table 3.5

Pure live seed (pls) mixtures required for soil revegetation, Smith Ranch ISL Project, Converse County, Wyoming

* Western Wheatgrass (Rosana)	4 lb./acre
* Thickspike Wheatgrass (Critiana)	2 lb./acre
* Streambank Wheatgrass (Sodar)	3 lb./acre
Canby Bluegrass	1 lb./acre
Sheep Fescue (Covar)	2 lb./acre
Sweetclover	0.5 lb./acre
Winterfat	2 lb./acre
	14.5 lb./acre

* Quantity doubled for broadcast seeding.

Alternate species, if any of the non-wheatgrass grasses are unavailable, are as follows:

Indian Ricegrass	3 lb./acre
Prairie Junegrass	0.5 lb./acre
Green Needlegrass	3 lb./acre

4.0 EVALUATION OF ENVIRONMENTAL IMPACTS

4.1 Ground-Water Impacts

4.1.1 Excursions

It is common practice to dramatically degrade the water quality within the mineralized zone during mining. An excursion occurs when lixiviant-fortified ground water moves beyond the expected confines of a mining unit and is

detected in a monitor well. The unexpected migration of mining solutions could be caused by a variety of circumstances. Most excursions result from an improper balance between injection and recovery rates, undetected high-permeability strata or geologic faults, improperly abandoned exploration drill holes, discontinuities in the confining units which allow movement of the lixiviant out of the ore zone, poor well integrity, or hydrofracturing of the ore zone or surrounding units. Aquifer testing and pilot well-field operations have demonstrated that hydrologic and geologic flaws in the aquitards are sparse. Based upon the differential hydraulic conductivities measured at the site, it is improbable that a vertical excursion would occur. Horizontal excursions are a more likely event and are primarily controlled by well-field overproduction. Should overproduction fail, lixiviant fortified waters could move to a monitor well. Should such an event take place, it is easily reversed by increasing the overproduction rate and thereby drawing the lixiviant back into the mining zone. Based on the information previously discussed and operational controls to be implemented, excursions are expected to be rare.

4.1.2 Evaporation Pond Seepage and Spills

Accidental leaks from the evaporation ponds could contaminate shallow aquifers and locally degrade ground-water quality if not contained, detected early, and controlled. The proposed installation of a synthetic bottom liner beneath the evaporation ponds at the Smith Ranch site will provide the containment and detection. Based on the use of a synthetic pond liner as well as the leak monitoring and repair program, the impact of pond leaks on ground-water quality will be minimal or nonexistent.

Spills from the evaporation ponds resulting from embankment failure could result in unacceptable contamination of surface and ground waters. Because the pond embankments and the minimum acceptable freeboard from the top of the berms to the ponds' free water surfaces will be designed to conform with NRC design standards, spills from the evaporation ponds or embankment failures are extremely unlikely. The licensee will be required to regularly inspect all embankments and make repairs as necessary.

4.1.3 Ground-Water Restoration

Ground-water restoration will include ground-water sweep, permeate and reductant injection, and aquifer recirculation. Each of these stages of restoration modifies the water quality of the mining zone. As previously discussed, the R&D operation was successful in restoring the ground-water quality to below baseline concentrations for the majority of the constituents as well as to baseline concentrations for several other constituents. There are also a minimal number of constituents which had their concentrations raised slightly during the mining/restoration effort. No premining uses of the water, however, were precluded.

Restoration of the mining zone will result in varying water quality within the aquifer. This is due, in part, to the complex mixing that will take place and the change in oxidation state that will result from the injection of mining solutions. The commercial license will require a restoration goal of returning

the aquifer to baseline water quality. Based on the R&D demonstration, as well as restoration efforts at other in-situ mining operations, no unacceptable impacts on the aquifer are expected.

4.2 Offsite Radiological Impacts (MILDOS-AREA Dose Assessment)

4.2.1 Introduction

Rio Algom operations will produce two primary sources of radiological impact to the environment. First, in situ mining process fluids will release radon which will be vented to the atmosphere. Second, Rio Algom proposes to dry and package the finished product, yellowcake, which will produce radionuclide particulate air emissions. Radionuclides released to the environment will be Rn-222, U-238, Th-230, Ra-226, and Pb-210. Rn-222 gas is dissolved in the fluids brought to the surface during in situ mining. Radon is vented at relief valves on ground-water wells and later during processing at the plant. Radon accumulation in the plant will be removed by a negative pressure ventilation system. Yellowcake dust is also released to the environment during drying and packaging. Releases of yellowcake should be extremely small during normal operations.

Rio Algom evaluated the radioactive emissions from the facility through the use of the computer program MILDOS-AREA. This second generation program is a refined version of the MILDOS code used to conservatively evaluate radiation doses from uranium recovery operations to selected areas adjacent to the production facility. The model incorporates calculated source terms and an appropriate meteorological parameter to calculate radionuclide concentrations and resulting doses.

4.2.2 Discussion

Rio Algom's modeling was based on flow rates of mine process fluids and restoration water, and pounds of yellowcake processed per day. Rio Algom assumed well-field production would progress at a rate of 37.5 acres yearly for each satellite. Dryer and packaging operations were assumed to be running at 100 percent production from 1995 through 2006. Prior to 1995, production rates were projected to be 37.5 percent for 1992, 50 percent for 1993, and 75 percent for 1994. Well fields and production schedules used to develop the program are presented as Table 1 of the licensee's MILDOS submittal dated October 4, 1990.

The source terms for the mining and processing portions of the operation were based on peak productivity. These parameters were adjusted to reflect the source terms through time as the project develops and then declines towards depletion of the ore body and completion of activities. Calculations of source terms were based on the parameters and assumptions provided in the licensee's October 4, 1991, submittal, Appendix A. The following major parameters were included in the program:

1. Radium-226 concentration in the ore
2. Emanation coefficient
3. Porosity
4. Radon-222 half-life
5. Ore zone thickness
6. Well spacing
7. Ore density
8. Production flow rates
9. Dryer throughput
10. Packaging throughput

Other parameters used by Rio Algom for use in the Smith Ranch MILDOS-AREA run include population distribution parameters. These data are specific to the site area, and describe the receptors of radiation doses, such as permit area locations, single family residences, and population clusters. Meteorological parameters including wind direction, windspeed class, and atmospheric stability class were taken from data collected at Casper, Wyoming. Also, food pathway parameters were developed for items in the local food chain. Of these parameters, livestock feed and the subsequent meat pathway were modeled. Milk and vegetable production are not significant pathways for this local site area.

The MILDOS-AREA computer code estimates radiological impacts of airborne emissions and presents these impacts as dose commitments. The licensee produced dose commitments to two general populations; (1) individuals and clustered populations within 80 km of the source, and (2) clustered populations beyond 80 km from the source. Specific dose commitments were developed for nearest residences, the restricted area boundary, and the State permit area boundary. Dose commitments were also developed for three population clusters; Glenrock, Douglas, and Casper, Wyoming.

4.2.3 Results

The licensee calculated the dose commitments using the releases formulated for a period of maximum activity and production. Therefore, the model maximizes the predicted dosages and increases the conservative nature of the MILDOS-AREA calculations. From these conditions and parameters, the concentrations for particulates and working levels for radon at the nearest downwind resident are well under 1 percent of the maximum permissible concentrations. For radon, the calculated value was 6.41×10^{-5} working levels (WL) as compared to an allowable concentration in 10 CFR 20 of 3.33×10^{-2} WL. For U-238, the concentration was modeled at 4.257×10^{-4} pCi/m^3 as compared to an allowable limit of 5 pCi/m^3. The dose commitment to the most sensitive organ (bronchial epithelium) calculated for this receptor was 19 mRem/year.

Working levels predicted by the model for all receptors will be less than 1 percent of the MPC. Further, the air concentrations for particulates produced during drying and packaging yellowcake are less than 10 percent of the MPC's for each specified substance.

Radon concentrations and particulate concentrations for U-238, Th-230, Ra-226, and Pb-210 were less than 10 percent of the MPC for the restricted boundary

receptors which were nearest to the sources. The permitted area boundary receptors, located farther yet from the sources, were all well under 1 percent of the MPC for all radionuclides of concern. Finally, the population clusters, which included Casper, Douglas, and the nearest city, Glenrock, were all several orders of magnitude below the allowable MPCs.

4.2.4 Summary

Analysis of the results of the MILDOS-AREA model simulation of atmospheric radionuclide emissions from Rio Algom's proposed Smith Ranch in situ uranium mine and processing facility indicates particulate concentrations will be less than the amounts limited by 40 CFR 190. Those limits are 25 mRem to the whole body and 75 mRem to any other organ of any member of the public, at residential receptors. Radon-222 levels were projected to be far less than specified as maximum permissible concentrations under 10 CFR Part 20, which are 3×10^{-9} µCi/ml or 3.33×10^{-2} working levels. The concentrations of radon daughters and particulates from drying and packaging yellowcake also are far below the MPCs.

A review of the parameters and elements used by the licensee to obtain the results of the MILDOS-AREA model appear to be correct, current, and appropriate. Further, the licensee's analysis and conclusions indicate that all current licensing requirements have been met and that all estimates of increases of radioactive materials have been conservative. The conservative nature of the model tends to predict liberal radionuclide concentrations. The values obtained, although conservatively developed, were well below limits specified by 40 CFR 190.

4.3 In-Plant Radiation Safety

Maximum Permissible Concentration limits exist for restricted and unrestricted areas. Although both are continually verified based upon air monitoring, only the restricted area concentrations are routinely utilized to determine individual exposures. The NRC will require the applicant to implement an in-plant radiation safety program to assure that exposures are kept as low as reasonably achievable (ALARA). The basic elements required for an effective ALARA program are known from experience at other uranium in-situ leach operations. The applicant's proposed program shall be scaled to account for the nature of the commercial project. In general, the program will include the following:

- Airborne and surface contamination sampling and monitoring; includes radon and/or radon daughters, and uranium;
- Personnel exposure monitoring; includes TLD badges, breathing-zone sampling for radiation work permits, personnel frisking, and bioassay;
- Qualified management of the safety program and training of personnel;
- Written radiation protection procedures; and

- Periodic audits by qualified outside parties and frequent inspections to assure the program is being conducted in a manner consistent with the ALARA philosophy.

Details of the program are reviewed in NRC's Safety Evaluation Report. The the program of in-plant safety is considered sufficient to protect in-plant personnel by keeping radiation doses as low as reasonably achievable.

4.4 Waste Disposal

Criterion 2 of 10 CFR 40, Appendix A, promotes the disposal of byproduct material from uranium in-situ leach operations at existing tailings disposal sites or other licensed radioactive burial grounds, to avoid proliferation of waste sites. Rio Algom proposes to dispose of waste byproduct material at Quivira Mining Company's uranium mill tailings pile in New Mexico, in accordance with Criterion 2. To assure that all contaminated wastes remain under control of Rio Algom, the license will stipulate that an area within the restricted area be maintained for temporary storage of contaminated materials.

4.5 Cultural Resources

4.5.1 Effects of the Licensing Action

Impact Significance Criteria

Cultural resources are considered significant if they meet the criteria outlined in 36 CFR 60.4. Disturbance of those sites which meet these criteria are considered significant impacts and an adverse effect (36 CFR 800.9). Mitigative measures must be taken.

Direct and Indirect Impacts

Impacts to cultural resources in the Smith Ranch permit area could be either direct or indirect, or both. Direct impacts include physical disturbance caused by construction of roads, wells, pipelines, and other facilities. Direct impacts may also result from naturally occurring erosion and erosion caused by land disturbances. In addition, visual intrusions may result in a direct impact by altering the setting of prehistoric and historic properties. Indirect impacts include potential vandalism and unauthorized collection of artifacts which result from increased access to the area.

Cumulative Impacts

Activities that directly affect cultural resources do so at the time the activity takes place. Conversely, indirect impacts such as erosion, increased visitation, vandalism, and unauthorized artifact collecting can have a cumulative effect, causing gradual degradation of site integrity and diminishment of cultural values.

Unavoidable Impacts

Unavoidable adverse impacts to cultural resources located within the mining area may take two forms. Eligible cultural resources may be affected by drilling, and facility and access road construction if those activities are constrained by topographic or geological conditions. In this situation, consultation conducted through the Section 106 process determines the methods to reduce or mitigate the effects.

The second type of unavoidable adverse impact occurs when previously undiscovered cultural resources are encountered after the project is approved and underway. In such cases, the licensee shall be required by license condition to halt ground-disturbing work at such a site. The BLM Platte River Resource Area Manager shall be notified to arrange an archeological evaluation of the materials, and to determine a mitigation plan, if necessary.

Summary

Adverse impacts to cultural resources can be considered significant if a given site has been determined to meet the criteria outlined in 36 CFR 60.4. Direct and indirect impacts will require some means of mitigation to prevent or minimize degradation of cultural values.

4.5.2 Mitigation of Effects

In association with reviewing Rio Algom's application, NRC consulted with BLM, the Wyoming SHPO, and other interested parties to assess potential effects of issuing a source material license upon the cultural resources identified in Section 2.3 of this EA. Documented separately in accordance with 36 CFR Part 800, NRC issued a finding of No Effect and of No Adverse Effect to the Wyoming SHPO on September 11, 1991.

In accordance with commitments made in its application Rio Algom shall be required to provide 100-foot buffer zones surrounding eligible and listed sites, and prevent surface disturbance of those sites. This stipulation refers specifically to prehistoric site nos. 48CO352, 48CO1288, 48CO1289 and 48CO1291. In addition, this requirement applies to eligible and listed segments of the Bozeman Trail, site no. 48CO165. Site 48CO1282 is presently unevaluated, and its eligibility for the Register shall be evaluated prior to disturbance. In addition, the licensee shall be required to mitigate visual intrusion upon the Bozeman Trail segments by reducing the visibility of its facilities in accordance with recommendations provided in the Rosenberg report (1991). Maintenance or future upgrading of the dirt road passing unevaluated site no. 48CO1226 shall be confined to the existing disturbed corridor in the site vicinity, or the site shall be fully evaluated prior to any disturbance. BLM is available for consultation for mitigation of the above sites.

NRC and BLM have determined that all actions associated with the proposed mining project will be completed in compliance with the National Historic Preservation Act (as amended) and its implementing regulations (36 CFR 800), the Archaeological Resources Protection Act (as amended), and its implementing regulations (43 CFR 7). Further, guidelines such as the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation

and the Bureau of Land Management 8100 manual series will be followed where appropriate. Disturbance of the above sites, without required mitigation, will constitute a violation of the NRC license and the Archaeological Resources Protection Act of 1979.

Through compliance with the laws, regulations, and guidance noted above, all effects on cultural resources should be mitigated. This preferably will be accomplished by avoiding the effects. Alternatively, a data recovery plan will be developed in accordance with the regulatory statutes and guidelines.

5.0 MONITORING

5.1 Ground Water

Ground water will be monitored prior to, during, and after the proposed operation. Prior to well-field installation, ground-water data will be collected to determine water quality and define aquifer properties. This regional data is built upon during well-field development when data is collected to establish upper control limits and restoration criteria. During and following mining and restoration, additional ground-water monitoring is performed to verify the effect, if any, on the aquifer.

5.1.1 Water Quality Monitoring

Numerous water quality monitoring wells will be located in and around the various well fields. Additional monitoring systems will be installed underlying all evaporation ponds. All monitor wells will be sampled on a routine basis during mining to determine if solutions are being contained within the mining zone. Monitoring for vertical excursions will take place in the first saturated aquifers overlying and underlying the mineralized zone. Monitors for horizontal excursions will encircle the various mining units with wells completed in the mineralized formations at a distance not to exceed 500 feet downgradient, 1000 feet upgradient, and spaced not more than 500 feet apart.

Excursion indicators will include chloride, conductivity, and alkalinity. Biweekly samples for these parameters will be collected from monitor wells associated with well fields during mining and restoration. An excursion will be declared if any two excursion indicators in any monitor well exceed their respective upper control limits (UCLs) or a single excursion indicator exceeds its UCL by 5 standard deviations. The UCLs for each excursion indicator will be defined as the mean baseline water quality value plus 5 standard deviations.

If a lixiviant excursion is indicated, a verification sample will be taken within 24 hours after results of the first analyses are received. If the second sample does not indicate exceedance of the UCLs, a third sample will be taken within 48 hours after the second sampling data is acquired. If neither the second nor third sample indicate exceedance of the UCLs, the first sample shall be considered in error. If the second or third sample contains the indicators above UCLs. an excursion will be confirmed.

When excursion status is confirmed, corrective action will be required to return the water quality to baseline concentrations. During corrective action, sample frequency will be increased to weekly for the excursion indicators until the excursion is concluded.

If corrective actions are not effective within 60 days since the first excursion verification, injection of lixiviant within the well field on excursion shall be suspended until the problem is solved and aquifer cleanup is complete. Because ground-water travel times are relatively slow in these formations, the amount of lixiviant involved in the excursion will generally be small, and several weeks will be required for water quality to begin to improve. Therefore, a 60-day time limit is appropriate.

Quality Assurance (QA) programs will be maintained by the Radiation Safety Officer. All QA programs will be conducted according to the Regulatory Guide 4.15 "Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment." Standard QA procedures will be maintained throughout the project life.

5.1.2 Evaporation Pond Leak Detection Monitoring

Rio Algom has proposed daily inspections of the leak detection system sumps during operations. If water levels greater than 6 inches are detected in the sump, chemical assays for specific conductance and chloride will be used to confirm the source of the water. Elevated levels of these constituents shall confirm a liner leak, and will be reported to the NRC within 48 hours. Corrective actions shall commence upon leak confirmation, consisting of transferring the solution to another pond so that repairs can be made. All assay results will be reported in writing as soon as they are available.

5.2 Environmental Monitoring

Rio Algom conducts a radiological monitoring program in accordance with the requirements of its R&D license. The program includes monitoring surface water, soils and sediments, direct radiation, radon, and ground water at multiple sites. The radiological monitoring program for commercial operation is an outgrowth of the R&D plan. The license will require Rio Algom to monitor the various environs and report the results semiannually. In addition, they will be required by license condition to maintain all monitoring records for a minimum of 5 years.

An outline of an environmental monitoring program is displayed in Table 5.1. Environmental monitoring is designed to determine if the environmental assessment of the project accurately represents the impact on the environment. To assure that a high quality sampling and analytical program is maintained, Rio Algom will be required by license condition to prepare, review, and update standard operating procedures for all environmental monitoring required for the operation. These standard operating procedures will be reviewed by the Radiation Safety Officer to determine if proper radiation-protection measurements are being applied.

TABLE 5.1

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM
(10 CFR 40.65)

Type of Sample	Number	Sample Collection: Location	Sample Collection: Method	Sample Collection: Frequency	Sample Analysis: Frequency	Sample Analysis: Type of Analysis
AIR						
Particulates	Three	Nearest Downwind Residence (Vollman Ranch)	Continuous air sampler	Filter changes every two weeks (maximum)	Quarterly composite of filters	Natural Uranium Thorium-230, Radium-226, Pb-210
		Downwind Restricted Area Boundary (fence line)	Same	Same	Same	Same
		Upwind Control (Dave's Water Well)	Same	Same	Same	Same
Radon	Three	Same as air particulates	Continuous (Terradex cups)	Quarterly	Each sample	Rn-222
WATER						
Ground water	(Progresses with operation)	Operating livestock or domestic wells within 1 km of operating wellfields	Grab	Quarterly	Each sample	Natural uranium, Ra-226
Surface water	Two from Sage Creek	One upstream, one downstream from restricted area (when flow is available)	Grab	Quarterly	Each sample	Natural uranium, Ra-226
	One	Outfall from treatment plant	Grab	Same	Each sample	Same

TABLE 5.1 (continued)

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM
(10 CFR 40.65)
(continued)

Type of Sample	Number	Sample Collection: Location	Sample Collection: Method	Sample Collection: Frequency	Sample Analysis: Frequency	Sample Analysis: Type of Analysis
SOIL						
	One	Downwind restricted area air sampling station	Grab	Annual	Annual	Natural uranium, Ra-226, Pb-210
VEGETATION						
	One	Animal grazing areas in direction of prevailing wind	Composite of dominant vegetation present	Annual	Annual	Natural uranium, Ra-226, Th-230, Pb-210
DIRECT RADIATION						
	Three	Air sampling stations	Continuous (dosimeter)	Quarterly	Each TLD	Gamma exposure rate, uR/hr
	One	Evaporation pond area, downwind	Same	Same	Same	Same
	One each	Mining units	Same	Same	Same	Same
STACKS Particulates						
	One for each stack	Yellowcake vacuum dryers, central plant	Isokinetic	Quarterly	Each sample	Natural uranium, Th-230, Ra-226, and Pb-210. Flow rate measured semiannually

6.0 ALTERNATIVES

6.1 Introduction

The action that the Commission is considering is the issuance of a source material license pursuant to Title 10, Code of Federal Regulations, Part 40. The alternatives available to the Commission are:

- Issue the license; or
- Deny the application and not issue the license.

The selection of either alternative is based on a consideration of a number of factors related to protection of health, safety and the environment. Section 40.32 of 10 CFR 40 states that an application for a specific license will be approved if, among other things:

- The application is for a purpose authorized by the Atomic Energy Act;
- The applicant is qualified by reason of training and experience to use the source material for the purpose requested in such a manner as to protect health and minimize danger to life or property;
- The applicant's proposed equipment, facilities, and procedures are adequate to protect health and minimize danger to life and property; and
- The issuance of the license will not be inimical to the common defense and security or to the health and safety of the public.

In determining if these stipulations will be met, pursuant to 10 CFR Part 51, an environmental assessment is performed to determine if an environmental impact statement is required or if a finding of no significant impact can be determined. If the stipulations discussed above are met and either a finding of no significant impact is made or the environmental impact statement finds that the impact is acceptable after weighing the environmental, economic, technical, and other benefits against environmental costs, and considering available alternatives, then the action called for is the issuance of the proposed license, with any appropriate conditions to protect environmental values.

6.2 No License Alternative

If any of the stipulations are not met, including the environmental considerations discussed above, denial of the proposed license would result.

7.0 SUMMARY AND ENVIRONMENTAL FINDINGS

Based on evaluation of the Rio Algom application for commercial operation, the operational history of the R&D site, and the input and cooperation of the State of Wyoming, Bureau of Land Management, and other Federal agencies, the NRC has determined that the proper action is to issue a finding of no significant impact in the Federal Register. The following statements support the finding of no significant impact and summarize the conclusions resulting from the environmental assessment.

A. Aquifer testing indicates that the production zone is adequately confined, providing reasonable assurance that hydrologic control of mining solutions will be maintained. Furthermore, the ground-water monitoring program proposed by Rio Algom is sufficient to monitor the operations and will provide a warning system that will minimize any impact on ground water.

B. Radiological effluents from the proposed operation of the well field and processing plant are predicted to be only small percentages of regulatory limits and will be continuously monitored.

C. The environmental monitoring program is comprehensive and will detect radiological releases resulting from the operation.

D. Radioactive wastes will be minimal and will be disposed of at an approved site in accordance with applicable Federal and State regulations.

E. Ground water, based upon previous testing, can be restored to baseline concentrations or applicable class of use standards.

F. Rio Algom will be required to provide periodic operational data, in-plant radiological data, and environmental monitoring results for NRC review. In addition, the licensee is subject to inspections for regulatory compliance by both the NRC and State of Wyoming, Department of Environmental Quality.

In accordance with 10 CFR Part 51.33, the Director of NRC's Uranium Recovery Field Office made the determination to issue a draft finding of no significant impact. Concurrent with a final finding of no significant impact, the Uranium Recovery Field Office proposes to issue a source material license authorizing the commercial operation of the Smith Ranch in-situ leach facility, subject, in part, to the following license conditions.

- Authorized place of use shall be the licensee's Smith Ranch facilities in Converse County, Wyoming.

- Authorized use is for uranium recovery from pregnant lixiviant in accordance with statements, descriptions, and representations contained in Sections 3.0, 4.0, 5.0, 6.0, 7.0, 8.0 and 9.0 of the licensee's application submitted by cover letter dated March 31, 1988, as revised by page changes submitted on May 10, June 30, and August 30, 1988;

February 15, February 28, March 13, March 20, March 28, April 5, September 30, December 5, and December 10, 1991. In addition, the licensee shall conduct its activities in accordance with the provisions in the following:

Submittal Date	Description
July 13, 1990	Responses to NRC comments and questions, including aquifer pump-test analyses, and monitor-well-spacing calculations.
October 4, 1990	Cover letter submitting MILDOS-Area Predictions of Radiation Dose.
April 5, 1991	Letter providing proposal for waste byproduct material disposal.
May 7, 1991	Cover letter transmitting consulting historian's report and recommendations, proposing changes to the mine facilities layout.
July 12, 1991	O-Sand deferral and interim environmental monitoring plan.
September 3, 1991	Cover letter assigning new Radiation Safety Officer for the Smith Ranch project.

Notwithstanding the above, the following conditions shall override any conflicting statements contained in the licensee's application and supplements.

- Any significant changes to the State of Wyoming mining permit area illustrated on Map C-1 of the licensee's March 31, 1988, application shall require approval by the NRC, Uranium Recovery Field Office, in the form of a license amendment.

- The licensee is authorized to dispose of waste byproduct material from the Smith Ranch facility at the Quivira Mining Corp. tailings pile, New Mexico. In the event this disposal option becomes unavailable, the licensee is required to notify the NRC, Uranium Recovery Field Office, within 7 working days of the expiration date. A new agreement must be submitted for NRC approval within 90 days of expiration, or the licensee will be prohibited from further lixiviant injection.

Yellowcake and byproduct waste material, other than samples for research, shall not be transferred from the site without specific prior approval of the NRC in the form of a license amendment. The licensee shall maintain permanent record of all transfers made under the provisions of this condition

- Before engaging in any activity not previously assessed by the NRC, including activities outside the State permit area, the licensee shall prepare and record an environmental evaluation of such activity. When the evaluation indicates that such activity may result in a significant adverse environmental impact that was not previously assessed or that is greater than that previously assessed, the licensee shall provide a written evaluation of such activities and obtain prior approval of the NRC in the form of a license amendment.

- No commercial mining shall commence prior to submittal to the NRC, Uranium Recovery Field Office, for review and approval of a disposal plan for byproduct material which may exist in the mine water treatment ponds, formerly utilized in the licensee's pilot project. The submittal shall provide confirming byproduct characterization data, a disposal plan in accordance with 10 CFR Part 40, Appendix A, and a reclamation schedule.

- Release of equipment or packages from the restricted area shall be in accordance with the attachment to this license entitled, "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct or Source Materials," dated September 1984.

- Standard operating procedures (SOPs) shall be established for all operational activities involving radioactive materials that are handled, processed, stored or transported by employees. SOPs for operational activities shall enumerate pertinent radiation safety practices to be followed. In addition, written procedures shall be established for nonoperational activities to include in-plant and environmental monitoring, bioassay analysis, and instrument calibration. An up-to-date copy of each written procedure shall be kept in each area where it is used.

  All written procedures shall be reviewed and approved in writing by the Radiation Safety Officer (RSO) before being implemented and whenever a change in a procedure is proposed. The Radiation Safety Technician shall document that all existing facility procedures are reviewed and approved on an annual basis.

- The licensee shall provide buffer zones and construct its facilities in accordance with the recommendations made in its historical consultant's report submitted May 7, 1991, in order to prevent adverse effects upon historic and prehistoric resources found in the State permit area. Land disturbance plans and well-field facility design shall be coordinated with NRC, Uranium Recovery Field Office, and the Bureau of Land Management.

  Notwithstanding the May 7, 1991, submittal, in order to assure that no disturbance of cultural resources occurs, the licensee shall have an archeological and historical artifact survey and evaluation completed prior to disturbing any areas not fully addressed in its application dated March 31, 1988. The results of the surveys, an evaluation of site eligibility for the National Register of Historic Places, and an analysis

of the project's effect, shall be submitted to NRC, Uranium Recovery Field Office, for review and approval. No disturbance shall occur until the licensee has received authorization from NRC to proceed.

In addition, all work in the immediate vicinity of previously undiscovered buried cultural resources unearthed during the disturbance of land shall cease until approval to proceed has been granted by the NRC.

- The annual throughput shall not exceed an average flow rate of 6000 gallons per minute, exclusive of restoration flow. Annual yellowcake production shall not exceed 2 million pounds.

- Any major changes in the fluid-flow balance or processing plant circuit, as illustrated and described in Figures 3-2 and 4-3 of the licensee's March 31, 1988, application, as amended, shall be reviewed by the RSO and shall be submitted to the NRC, Uranium Recovery Field Office, for prior approval in the form of a license amendment.

- The licensee shall maintain effluent control systems as specified in Section 4.1 of the license application dated March 31, 1988, with the following additions:

  A. Yellowcake drying operations shall be immediately suspended if any of the emission control equipment for the yellowcake drying or packaging areas is not operating within specifications for design performance.

  B. The licensee shall, during all periods of yellowcake drying operations, assure that the manufacturer recommended pressure is maintained in the heating chamber. This shall be accomplished by either (1) performing and documenting checks of air pressure differential approximately every 4 hours during operation, or (2) installing instrumentation which will signal an audible alarm if air pressure differential falls below the manufacturer's recommended levels. If an audible alarm is used, its operation shall be checked and documented daily.

  C. Air pressure differential gauges for other emission control equipment shall be read and the readings documented at least once per shift during operations.

- The licensee shall perform well integrity tests on each injection and production well before the wells are utilized and on wells that have been serviced. The integrity test shall pressurize the well to 125 percent of the maximum operating pressure and shall maintain 95 percent of this pressure for 10 minutes to pass the test. If any well casing failing the integrity test cannot be repaired, the well shall be plugged and abandoned. During well-field operations, injection pressures shall not exceed the integrity test pressure at the injection well heads.

- The licensee shall utilize sodium carbonate/bicarbonate as the lixiviant with an oxygen or hydrogen peroxide oxidant. Any variation from this combination shall require a license amendment.

- No evaporation ponds shall be constructed prior to NRC review and approval of waste water evaporation pond designs and specifications. Pond design shall allow for sufficient reserve capacity in the evaporation pond system to enable the transfer of the contents of a pond to the other ponds. All retention ponds shall be designed to meet requirements of NRC Regulatory Guide 3.11, Staff Position Paper No. WM-8101, and WDEQ.

- The licensee shall maintain an area within the restricted area boundary for storage of contaminated materials prior to their disposal. All contaminated wastes and evaporation pond residues shall be disposed at a licensed radioactive waste disposal site.

- All liquid effluents from process buildings and other process waste streams, with the exception of sanitary wastes, shall be returned to the process circuit, or discharged to the solution evaporation ponds. All changes to the liquid effluent disposal plan shall be approved by license amendment.

- For each mining unit, baseline water quality data for the constituents identified in Table 5.1 of the application dated March 31, 1988, as amended, shall be established prior to mining at the following points: (1) all mining zone perimeter monitor wells; (2) two upper and two lower aquifer monitor wells per mining unit; and (3) one production/injection well per acre in each well field.

- No well-field installation shall be conducted in the southwestern part of the State of Wyoming permit area, T35N R74W, until aquifer characteristics have been determined, and reviewed, and approved by NRC, Uranium Recovery Field Office.

- Effective during the preoperational period of the Smith Ranch project, the licensee's O-sand pilot facility shall remain in stand-by status, in accordance with the licensee's July 12, 1991, submittal.

- Flow rates on each injection and recovery well and manifold pressures on the entire system shall be measured and recorded daily. During well-field operations, injection pressures shall not exceed the integrity test pressure at the well heads.

- The licensee shall perform and document daily visual inspections of the evaporation pond embankments, fences and liners, as well as measurements of pond freeboard and checks of the leak detection system. Any time 6 inches or more of fluid is in the leak detection system standpipes, it shall be analyzed for specific conductance and chloride. If action levels for these parameters are exceeded, a pond leak shall be confirmed. The pond level shall be lowered by transferring its contents into an alternate cell, and repairs undertaken.

- Each monitor well shall be sampled and tested for chloride, conductivity, and alkalinity on a biweekly basis. If two UCLs are exceeded in a well or if a single UCL value is exceeded by five standard deviations or more

above baseline monitoring data, the licensee shall take a confirmation water sample within 24 hours and analyze it for the excursion indicators. If the second sample does not indicate exceedance, a third sample shall be taken within 48 hours. If neither the second or third indicate exceedance, the first sample shall be considered in error.

If the second or third sample indicates an exceedance, the well in question shall be placed on excursion status. During excursion status, sampling and testing frequency shall be increased to weekly for all monitor wells completed in the same monitored zone for the effected mining unit.

- The licensee shall establish an effluent and environmental monitoring program in accordance with Table 5.3 of the application dated March 31, 1988, as amended.

- During the preoperational period of the Smith Ranch project, environmental and in-plant monitoring shall be conducted in accordance with the licensee's July 12, 1991, submittal. All other monitoring requirements in this license shall be suspended where they differ from that submittal. Notwithstanding the submittal, the licensee shall implement the following additions to its stand-by operations:

  A. A ground-water bleed rate shall be established in the O-sand pilot well field sufficient to maintain flow into the well field from all directions. Ground-water gradients shall be monitored by observing water levels monthly in wells OM-1 through OM-5, OI-1, OI-2, OI-10, OI-3, and OT-1. Monitoring data with a water-table map shall be provided in each semiannual environmental monitoring report.

  B. Environmental gamma monitoring shall continue on a quarterly basis at the downwind and background locations.

  C. In-plant gamma surveys shall be completed following completion of yellowcake precipitation and filter press use, or semiannually, whichever is more frequent. Airborne uranium monitoring of the work station and breathing zone shall be conducted on a continuous basis during filter press operation.

- The results of the sampling, analyses, surveys, and monitoring, the calibration of equipment, reports on audits and inspections, all meetings and training courses required by this license, and any subsequent reviews, investigations, and corrective actions, shall be documented. Unless otherwise specified in the NRC regulations, all such documentation shall be maintained for a period of at least 5 years.

- At least 2 months prior to lixiviant injection in each mining unit, baseline water quality data shall be submitted to the NRC, Uranium Recovery Field Office, established at the following points: (1) all mining zone perimeter monitor wells; (2) two upper and two lower aquifer monitor wells per mining unit; and (3) one production/injection well per acre in

each well field. Baseline data, UCLs, and restoration criteria shall be gathered and calculated in accordance with the licensee's application dated March 31, 1988, as amended.

A. The submittal shall propose, in the form of a license amendment, upper control limits (UCLs) for chloride, conductivity, and alkalinity in all monitoring wells for each mining unit.

B. The submittal shall propose, in the form of a license amendment, ground-water restoration criteria for each mining unit.

- The results of effluent and environmental monitoring described in Table 5.3 of the license application shall be reported in accordance with 10 CFR 40, Part 40.65, to the NRC, Uranium Recovery Field Office. The report shall also include injection rates, recovery rates and injection manifold pressures.

- In the event a lixiviant excursion is confirmed by ground-water monitoring, NRC shall be notified by telephone within 24 hours and by letter within 7 days from the time the excursion is confirmed. Upon confirmation of an excursion, the licensee shall implement corrective action. An excursion is considered concluded when the concentrations of excursion indicators are below the concentration levels defining an excursion for three consecutive weekly samples.

  A written report shall be submitted to the NRC, Uranium Recovery Field Office, within 2 months of excursion confirmation. The report shall describe the excursion event, corrective actions taken and results obtained. If wells are still on excursion at the time the report is submitted, injection of lixiviant within the well field on excursion shall be terminated until such time that aquifer cleanup is complete.

- In the event that evaporation pond standpipe water analyses indicate that a pond is leaking, the NRC, Uranium Recovery Field Office, shall be notified by telephone within 48 hours of verification. Standpipe water quality samples shall be analyzed for the above parameters once every 7 days during the leak period and once every 7 days for at least 2 weeks following completion of repairs.

  A written report shall be filed with the NRC, Uranium Recovery Field Office, within 30 days of first notifying the NRC that a leak exists. This report shall include analytical data and describe the mitigative action and the results of that action.

- The licensee shall maintain a log of all significant solution spills and notify the NRC, Uranium Recovery Field Office, by telephone within 48 hours of any failure which may have a radiological impact on the environment. Such notification shall be followed, within 7 days, by submittal of a written report detailing the conditions leading to the failure or potential failure, corrective actions taken and results

achieved. This requirement is in addition to the requirements of 10 CFR Part 20.

- At least three months prior to commencing ground-water restoration in each well field, the licensee shall submit a restoration plan. The restoration plan shall have a goal of returning all affected ground-water constituents to baseline levels. The licensee shall be required to demonstrate baseline conditions are not achievable in order to apply any alternate standard of performance.

- The licensee shall submit a detailed decommissioning plan to the NRC, Uranium Recovery Field Office, for review and approval at least 12 months prior to planned final shutdown of mining operations.

References Cited

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APPENDIX 1

LEGAL LAND DESCRIPTIONS
FOR THE SMITH RANCH PERMIT AREA

Compiled by the U.S. Bureau of Land Management

APPENDIX 1

BLM Compilation of Federal Land, Mineral, and Grazing ownership in the Rio Algom State Permit Area

Legal Description	Acreage	Surface Owner	Mineral Owner	Grazing Lessee
T. 36 N., R. 73 W.				
Section 19,				
SE¼NE¼	40 acres	Private	Private	
SW¼, W½SE¼NE¼SE¼	280 acres	Private	Private	
Section 20,				
E½NW¼, S½SW¼NW¼	100 acres	Private	USA	
SW¼	160 acres	Private	Private	
Section 29,				
NW¼	160 acres	Private	Private	
S½	320 acres	Private	USA	
Section 30,				
E½, NW¼, N½SW¼, SE¼SW¼	600 acres	Private	Private	
Section 31,				
NW¼	160 acres	Private	USA	
T. 35 N., R. 74 W.				
Section 2,				
N½N½	160 acres	USA	Private	Smith Sheep Co.
S½N½	160 acres	Private	Private	
E½SW¼, S½SE¼	160 acres	Private	Private	
Section 3,				
N½	320 acres	State	State	
S½	320 acres	Private	USA	
Section 4,				
NE¼	160 acres	State	State	
W½	320 acres	Private	Private	
SE¼	160 acres	Private	USA	
Section 5,				
Entire	640 acres	Private	USA	
Section 8,				
E½, N½NW¼, SW¼SW¼	440 acres	Private	USA	
S½NW¼, N½SW¼ SE¼SW¼	200 acres	Private	Private	
Section 9,				
E½	320 acres	Private	Private	
W½	320 acres	Private	USA	
Section 10,				
NE¼, W½, N½SE¼	560 acres	Private	USA	
S½SE¼	80 acres	Private	Private	

T. 35 N., R. 74 W. (continued)				
Section 11,				
$SE\frac{1}{4}NE\frac{1}{4}$, $N\frac{1}{2}NE$				
$W\frac{1}{2}$, $NE\frac{1}{4}SE\frac{1}{4}$	480 acres	Private	Private	
Section 16,				
Entire	640 acres	State	State	
Section 17,				
Entire	640 acres	Private	USA	
Section 18,				
Entire	640 acres	Private	USA	
Section 19,				
$W\frac{1}{2}NW\frac{1}{4}$	80 acres	Private	USA	
Section 21,				
$N\frac{1}{2}$	320 acres	Private	Private	
T. 36 N., R. 74 W.				
Section 13,				
$S\frac{1}{2}$	320 acres	Private	Private	
Section 14,				
$S\frac{1}{2}$	320 acres	Private	USA	
Section 22,				
$E\frac{1}{2}$	320 acres	USA	USA	Smith Sheep Co.
$W\frac{1}{2}$	320 acres	Private	USA	
Section 23,				
$N\frac{1}{2}$	320 acres	Private	Private	
$S\frac{1}{2}$	320 acres	Private	USA	
Section 24,				
$E\frac{1}{2}$	320 acres	Private	Private	
$W\frac{1}{2}$	320 acres	Private	USA	
Section 25,				
$E\frac{1}{2}$	320 acres	Private	Private	
$NW\frac{1}{4}$	160 acres	USA	USA	
$SW\frac{1}{4}$	160 acres	USA	Private	
Section 26,				
Entire	640 acres	USA	Private	Smith Sheep Co.
Section 27,				
$E\frac{1}{2}$	320 acres	USA	USA	Smith Sheep Co.
$W\frac{1}{2}$	320 acres	Private	USA	
Section 33,				
$N\frac{1}{2}$	320 acres	USA	USA	Smith Sheep Co.
$N\frac{1}{2}S\frac{1}{2}$, $SE\frac{1}{4}SE\frac{1}{4}$	200 acres	Private	USA	
$S\frac{1}{2}SW\frac{1}{4}$, $SW\frac{1}{4}SE\frac{1}{4}$	120 acres	Private	Private	
Section 34,				
$E\frac{1}{2}$	320 acres	Private	Private	
$E\frac{1}{2}W\frac{1}{2}$, $SW\frac{1}{4}SW\frac{1}{4}$	200 acres	Private	USA	
$W\frac{1}{2}NW\frac{1}{4}$, $NW\frac{1}{4}SW\frac{1}{4}$	120 acres	USA	USA	Smith Sheep Co.

T. 35 N., R. 74 W. (continued)				
Section 35, Entire	640 acres	USA	Private	Smith Sheep Co.
Section 36, Entire	640 acres	State	State	
T. 35 N., R. 75 W.				
Section 13, SE¼	160 acres	Private	USA	
Section 24, N½NE¼	80 acres	Private	USA	

16,220 acres - Total Acreage
1,240 acres - USA Surface and Mineral Ownership
6,780 acres - Private Surface Ownership and USA Minerals
5,000 acres - Private Surface and Private Minerals
1,440 acres - USA Surface and Private Minerals
1,760 acres - State Surface and State Minerals