DISTRIBUTION

Docket File 40-8768
PDR/DCS
DBangart, RIV
SGrace
WDEQ (2)
JHaes, RCPD, WY
LLO Branch, LLWM
URFO r/f

40-8768/SRG/87/12/10/0

DEC 18 1987

URFO:SRG
Docket No. 40-8768
License No. SUA-1387
04008768551E

MEMORANDUM FOR: Docket File No. 40-8768

FROM: Scott R. Grace, Project Manager
Licensing Branch 1
Uranium Recovery Field Office, Region IV

SUBJECT: ENVIRONMENTAL ASSESSMENT (EA) FOR THE RENEWAL OF SEQUOYAH FUELS CORPORATION, Q-SAND/O-SAND R&D ISL PROJECT

Attached is the Environmental Assessment (EA) prepared in support of the renewal of Source Material License SUA-1387 for Sequoyah Fuels Corporation, Q-Sand/O-Sand R&D ISL Project, located in Converse County, Wyoming.

/s/

Scott R. Grace, Project Manager
Licensing Branch 1
Uranium Recovery Field Office
Region IV

Approved by: /s/
Edward F. Hawkins, Chief
Licensing Branch 1
Uranium Recovery Field Office, Region IV

Attachment: Sequoyah Fuels Corporation, Q-Sand/O-Sand EA

Case Closed: 04008768551E

OFC	URFO SRG	URFO EHA			
NAME	SGrace/lv	EHawkins			
DATE	87/12/10	12/18/87			

ENVIRONMENTAL ASSESSMENT

FOR

SEQUOYAH FUELS CORPORATION'S

Q-SAND/O-SAND R&D ISL PROJECT

CONVERSE COUNTY, WYOMING

DOCKET NO. 40-8768

LICENSE NO. SUA-1387

CONTENTS

TABLE OF CONTENTS (cont.)

INDEX OF FIGURES

INDEX OF TABLES

1.0 INTRODUCTION

1.1 Background

Sequoyah Fuels Corporation (SFC) applied to the USNRC for renewal of Source Material License SUA-1387. The facility, known as the Q-Sand/O-Sand in situ leach project, is a research and development scale operation.

The project is situated on approximately 10 acres in west-central Converse County, Wyoming, approximately 17 miles northeast of the town of Glenrock. SFC shall restrict activities to this location.

The R&D project consists of two ore zones, the Q-Sand and the O-Sand. The Q-Sand well field was in operation from October 1981 through March 1986, and was determined to be restored by the USNRC on August 11, 1987. This Environmental Assessment (EA) primarily covers the renewal of activities of the O-Sand well field and the uranium recovery plant. Although the Q-Sand well field has been restored, the surface areas have not been determined to have been returned to preoperational radiological activities, nor have the wells been plugged and abandoned. Therefore, this EA will also cover decommissioning and cleanup of the Q-Sand area well field. Operation of the O-Sand well field is expected to continue into 1988, when restoration will commence.

The uranium recovery plant has operated at a maximum average flow rate of 250 gpm, 100 gpm for the Q-Sand well field and 150 gpm for the O-Sand well field. With restoration of the Q-Sand, the plant is proposed to continue to operate at a flow rate of 250 gallons per minute (gpm).

1.2 Proposed Action

By letter dated May 27, 1986, SFC submitted an application for renewal of Source Material License SUA-1387. On July 9, 1986, the USNRC issued its notice of timely renewal to SFC until such time as a final renewal decision is made. SFC submitted additional renewal material on June 15, September 17, and December 14, 1987. The purpose of the renewal is to continue the operation of the R&D in situ pilot plant for the O-Sand well field in accordance with the statements, representations, and conditions contained in the submittals.

This EA discusses the environmental aspects of the renewal application proposal. Additional information concerning the safety aspects of the proposed renewal is contained in the accompanying Safety Evaluation Report (SER). The proposed action would be to renew the existing source material license to allow continued

operation of the O-Sand well field. The license would allow the pilot plant to continue to be operated at 250 gpm.

1.3 Review Scope

1.3.1 Federal and State Authorization

Under 10 CFR Part 40, a USNRC source material license is required in order to " . . . receive, possess, use, transfer . . . any source material . . ." (i.e., uranium and/or thorium in any form, or ores containing 0.05 percent or more by weight of those substances). In addition, the Uranium Mill Tailing Radiation Control Act of 1978 (UMTRCA) requires persons who conduct uranium source material operations to obtain a byproduct material license to own, use, or possess tailings and wastes generated by the operation (including surface wastes from in situ operations). This Environmental Assessment (EA) has been prepared under Title 10 CFR Part 51. In accordance with 10 CFR Part 51, an EA serves to (a) briefly provide sufficient evidence and analysis for determining whether to prepare an environmental impact statement or a finding of no significant impact, (b) aid the USNRC's compliance with the National Environmental Policy Act (NEPA) when no environmental impact statement is necessary, and (c) facilitate preparation of an environmental impact statement when one is necessary.

The R&D scale operation of the SFC project was previously evaluated in the Environmental Impact Appraisal for the Q-Sand, June 1981, and for the O-Sand, July 1984. A Safety Evaluation Report will accompany this Environmental Assessment. The staff preparation of these two documents will evaluate the potential impacts associated with the operation of the Sequoyah Fuels Corporation O-Sand R&D site as well as decommissioning, cleanup and well abandonment at both the Q-Sand and O-Sand well field areas. Should the USNRC issue a Finding of No Significant Impact, based upon the licensee's renewal application materials and previous operational data and staff recommendations, a renewal source material license to operate the R&D facility would be issued to SFC.

The Wyoming Department of Environmental Quality (WDEQ) administers and implements the State's rules and regulations.

1.3.2 Basis of USNRC Review

An impact appraisal for the license renewal of the SFC site has been performed by the USNRC, Uranium Recovery Field Office. This EA documents that appraisal. The staff has performed the

Q-Sand, primarily due to the recharge of the Q-Sand at the mine shaft. No water level rises have occurred in the U-Sand (see Figure 2.2.01) because the water level in the mine shaft has not risen high enough to directly recharge this strata.

2.2.2 Water Quality

The background water quality of the O-Sand production zone is relatively good with only radium-226 regularly exceeding the EPA primary drinking water standard. Selenium occasionally exceeds the primary standard. Radium-226 values are high, ranging from 61 to 680 picocuries per liter (pCi/l) with a mean value of 276 pCi/l. Table 3.7.01 shows the O-Sand well field baseline data. The O-Sand water is a calcium-sulfate type with total dissolved solids (TDS) ranging from approximately 522 to 656 milligrams per liter (mg/l). Sulfate and TDS regularly exceed the EPA secondary water quality standard, but only by minor quantities. Manganese occasionally exceeds the secondary standard.

2.2.3 Aquifer Testing

Long-term aquifer testing was initially conducted in the O-Sand well field in November 1982. Due to a power failure during the test, the USNRC staff considered the results invalid. Additional long-term testing was conducted in July 1983. The test well field consisted of nine observation wells in addition to the pumped well. A complete analysis of the O-Sand aquifer testing and USNRC staff position is contained in the initial O-Sand EIA. The USNRC staff summarizes the hydrogeological characteristics of the O-Sand well field as follows: The approximate transmissivity of the O-Sand is 468 ft^2/d (5 cm^2/s). The storativity is approximately 1.8E-4. Vertical hydraulic conductivity of the lower O-Shale is in the range of 0.142 to 0.0028 ft/d (10E-5 to 10E-6 cm/s). The vertical hydraulic conductivity of the underlying N-Shale is in the range of 0.0028 to 0.00028 ft/d (10E-6 to 10E-7 cm/s). Vertical hydraulic conductivity of the overlying P-Shale is approximately 1.19E-4 ft/d (4.2E-8 cm/s).

2.2.4 Confinement of the Ore Zone

To date, there have been no actual excursions in either the O-Sand or the Q-Sand well fields. Confinement of the ore zones is accomplished by the adjacent strata that have very low hydraulic conductivities relative to the mining zone, as well as well-field overproduction. Overproduction is the

hydrogeologic conditions are favorable, the impacts from solution mining are significantly less. The greatest impact of the in situ leach extraction method is to the ore zone ground-water quality which, in most instances, can be restored to essentially baseline quality. Compared with conventional uranium mining and milling operations, in situ leaching also permits economical recovery of currently unrecoverable (deep or low-grade) sandstone uranium deposits. The extent to which in situ mining can be conducted is limited to ore zone conditions that are suitable for containing and controlling leach solutions during the mining process. The ore bodies at the SFC site, based upon past operations, exhibit favorable conditions for in situ mining operations.

3.2 The Ore Body

Geochemical inplacement of the uranium minerals in the ore zone is believed to have occurred when uranium-rich oxidized ground water moved down gradient into a reducing (oxygen-poor) ground-water environment where the uranium precipitated out of solution. This interface is referred to as an oxidizing front. The physical shape of this type of ore zone is dependent on the local hydrological characteristics and areal extent of the receiving sandstone. This type of ore zone is usually called a roll-front deposit. Roll-front ore bodies are prevalent in most of the established uranium mining districts in the western United States. In situ leaching is feasible only on those ore deposits that meet certain criteria. These criteria generally include: (1) the ore deposit must be located in a saturated zone, (2) the ore deposit must be confined both above and below v low permeability strata, (3) the ore deposit must have adequate permeability, and (4) the ore deposit must be amenable to chemical leaching.

The ore of the O-Sand and Q-Sand sandstones is believed to have been deposited as described above. Previous operational data confirms that the deposits have the chemical characteristics necessary to allow in situ leaching of uranium. Aquifer testing indicates the ore zone is saturated, hydraulic conductivity is adequate, and the ore zone is adequately confined. The capacity of the low hydraulic conductivity strata (aquitards) to confine lixiviant movement to the ore zone and the reaction of the ore to chemical leaching have been demonstrated by previous operations at the Q-Sand/O-Sand project.

3.3 Well Field Design and Operation

The O-Sand well field is located approximately 5500 feet northwest of the recovery plant and consists of 11 injection, 6 production, and 10 monitor wells in a conventional 5-spot configuration as shown in Figure 2.2.02. A small header building is located in the well

field and houses individual well metering and control equipment. Individual flow lines are buried and well heads are covered with insulated boxes to prevent freezing during the winter months. The uranium-rich solution recovered from the production zone is pumped via the header building to the recovery plant in a buried pipeline. Regenerated lixiviant is returned to the injection wells via the header building through buried pipeline. A system bleed of up to 5 gpm (less than or equal to approximately 3 percent of total flow) has been determined to be sufficient to provide the necessary control to ensure that the ground-water gradient is toward the well field area. Figure 2.1.02 shows the well field in relation to the recovery plant.

Injection well head pressures will be restricted by license condition not to exceed the pressures maintained during the well integrity testing program as shown on Table 3.3.01. Additionally, SFC will be required by license condition to perform integrity tests at any time a recovery well is converted to an injection well and after each incidence of well work-over or any other operation involving insertion of drill rods or related equipment in PVC- or fiberglass-cased wells. If a well fails the integrity test, as described in the license condition, the well shall not be used for injection.

SFC shall also be required by license condition to measure and record flow rates on each production and injection well at least once per day.

3.4 Lixiviant Chemistry

The lixiviant used for dissolution and recovery of uranium from the sandstone host will be produced by employing either dissolved oxygen (O_2) or hydrogen peroxide (H_2O_2) as the oxidizing agent, in a solution of formation water and sodium bicarbonate ($NaHCO_3$). The sodium bicarbonate and oxidant is introduced into circulating water pumped from the ore zone aquifer and reinjected into the ore zone. The licensee will be restricted by license condition to use of this specific lixiviant. A change in lixiviant will require review and approval in the form of a license amendment.

3.5 Uranium Recovery Process

The uranium, mobilized as a carbonate-complex will be directed, at a flow rate less than the maximum plant capacity of 250 gpm, to the ion exchange columns housed in the recovery plant. There the extracted uranium will be absorbed by the ion exchange medium, eluted (stripped), acidified, precipitated, and then partially dewatered for packaging and shipment.

In this process, the uranium-laden production water is pumped through a series of ion exchange columns where the uranium is adsorbed onto a strong base anion exchange resin. The reactions that takes place during the loading cycle can be represented by the following equations:

$$4\ RCl + [UO_2(CO_3)_3]^{-4} \dashrightarrow [R_4O_2(CO_3)_3] + 4\ Cl^-$$
(Resin) (Uranyl tricarbonate) (loaded Resin) (exchanged ion)

OR

$$2\ RCl + [UO_2(CO_3)_2]^{-2} \dashrightarrow [R_2UO_2(CO_3)_2] + 2\ Cl^-$$
(Resin) (Uranyl dicarbonate) (loaded Resin) (exchanged ion)

The sorbed carbonate complex is then eluted, or "stripped" from the resin, by increasing the chloride concentration with the addition of a strong sodium chloride or hydrochloric acid solution to the elution stream. The chloride ions replace the uranyl carbonate complexes on the resin, forming a concentrated uranium bearing solution that is then pumped to the precipitation circuit where, by the addition of hydrochloric acid, sodium hydroxide, and hydrogen peroxide, the uranium is precipitated in the form of uranium peroxide (UO_4). The precipitate (yellowcake) is partially dewatered by use of a filter press and shipped in a wet slurry form to either a nearby mill for drying and packaging or is shipped to a uranium processing facility. All yellowcake shipments will be made in compliance with applicable regulations. A schematic of the uranium recovery process circuit is shown in Figure 3.5.01.

3.6 Description of Process Plant and Support Facilities, Ponds, and Wastes

3.6.1 The Process Plant and Support Facilities

The authorized flow for both the Q- and O-Sands was 250 gpm (100 gpm for the Q-Sand and 150 gpm for the O-Sand well field). With restoration of the Q-Sand, the O-Sand well field flow rate is being increased to 250 gpm so that the recovery plant can continue to run at the same flow rate. SFC will be restricted by license condition to 250 gpm as the maximum flow rate as well as maximum pressure in each well (see Table 3.3.01). The solution processing equipment, laboratory, showers, restroom and office space are located as shown in Figure 3.6.01. The licensee will be required by license condition that any major changes in the process circuit or plant layout as illustrated

in Figures 3.5.01 and 3.6.01 shall require prior approval of the RSO and the USNRC in the form of a license amendment.

3.6.2 Solar Evaporation Ponds

The existing solar evaporation ponds located near the plant (see Figure 3.6.02) are used to collect and evaporate process (eluant) waste waters. There are two cells, each approximately 100 feet by 100 feet. Each cell is lined with a hypalon liner and equipped with a leak detection system.

SFC will be required by license condition to: (1) provide at least three (3) feet of freeboard in their ponds to allow for pumping of the contents of one pond into the other in the event of a leak, (2) maintain a fence around the ponds that prevents the intrusion of game animals, (3) conduct daily visual inspections of all pond embankments and to check the standpipes for leaks, and (4) if more than 3 inches of water in leak detection systems, analyze for certain parameters.

Should analyses indicate that the pond is leaking, SFC will be required to notify the USNRC by telephone within 48 hours of leak verification, and the pond fluid level of the leaking pond will be lowered by transferring its contents into the non-leaking cell so that repairs can be made. During any leak period, water quality samples will be taken at the standpipes at least weekly, or more frequently if conditions warrant it and for at least 2 weeks following repairs. SFC will be required to report the results of such action to the USNRC, Uranium Recovery Field Office, within 30 days of first notifying the USNRC of a leak.

Discharges to the evaporation pond will also be required to be sampled semi-annually and analyzed for calcium, chloride, bicarbonate, sodium, specific conductance, thorium-230, radium-226, sulfate, and uranium.

3.6.3 Radium Removal From Discharge Water

3.6.3.1 Water Treatment Settling Ponds

Historically, bleed stream discharges from the process plant have been mixed with mine water discharges from the Bill Smith Mine, treated with barium chloride for radium removal, and discharged to the water treatment ponds (Figure 3.6.02) and into the ephemeral streambed under NPDES (National Pollutant Discharge Elimination System) permit No. WY-0022411.

The sludges generated from the past treatment of the process bleed stream in the mine-water treatment settling ponds are, technically, byproduct material and therefore, subject to disposal under USNRC regulations. Since the sludges from the ISL process and the mine discharge are comingled, all of the sludges must be considered byproduct material. However, SFC claims that the sludges generated from the ISL bleed are minimal (less than 2%), in comparison with the sludges generated from the mine water discharges and that burial in-place is equivalent to (to the extent practicable) 10 CFR Part 40, Appendix A requirements. As an alternative to 10 CFR Part 40, Appendix A, SFC has proposed (in their September 17, 1987 submittal) that sludges from ISL waters will be isolated in a separate treatment system and that the mine-water treatment settling ponds be reclaimed in accordance with State requirements for abandoned mine lands.

The separate treatment system for the ISL bleed stream will consist of a mixing chamber and two settling tanks. Final disposal of the existing sludges in the ponds, generated primarily from the mining operations, is regulated by WDEQ under Permit 304C and is scheduled for burial in-place with a minimum of 3 feet of earthen cover. The pond area will then be contoured and reclaimed in accordance with WDEQ criteria and guidelines.

SFC has provided calculations on the volume and activity of the sludges in the ponds and review of this information indicates that the volumes and activities may be too high. This conclusion is based upon information from actual sampling in another mine-water treatment settling pond system, SFC's 28-33 pit. Based upon similar calculations and actual sample values at SFC's 28-33 pit, the activity of the sludges in the Bill Smith Mine-water treatment ponds are expected to be less than 100 pCi/g.

SFC has been requested to sample the sludges in the ponds for confirmation of activity, and SFC's license will contain a condition that requires them to submit a report to the USNRC, detailing the sludges in the ponds (the volumes, weights, and activities). The report will be reviewed and a final decision made by the USNRC as to the final disposition of the sludges in the ponds. If the actual samples indicate low activity, then SFC will be authorized to proceed with their proposed alternative of burial in-place. On the other hand, if the activity of the sludges are high, then SFC will be required to remove

and dispose of the sludges in a USNRC approved disposal site. Regardless, SFC will continue be authorized to discharge the process bleed stream as well as the restoration stream to the settling ponds, however, first the water is to be routed through the ion exchange units for uranium removal and then treated with barium chloride in the settling tank system, prior to mixing with mine water discharge and routing to the settling ponds.

3.6.3.2 Water Treatment Settling Tanks

Once the water treatment settling tanks are operational, SFC will be required to conduct sediment sampling downstream of the settling ponds, to confirm that discharges from the ISL under the NPDES permit have not contaminated the sediments (no more than 5 pCi/g above background values). Removal of the contaminated sediments will be required if the sampling reveals values above the requirements. SFC will submit the results of this survey, in the form of a license amendment, to the USNRC for review.

Since the treatment of ISL process bleed will be required in the water treatment settling tanks, it will, subsequently, no longer be a requirement of SFC's license to monitor the sediments downstream of the three settling ponds. However, in the event that the discharges from the water treatment settling tanks exceeds the release to unrestricted area limits (10 CFR 20, Appendix A), sampling of the sediments downstream of the settling ponds may resume and/or result in confirmation sampling by the USNRC.

3.6.3.3 Non-Radium Discharges

The URFO staff noted in the review of SFC's 1987 first quarter environmental report that the water quality of the plant discharge being mixed with the mine water and discharged to the settling ponds contained significantly high concentrations of the parameters measured, particularly selenium. Table 3.6.01 lists concentrations during the first quarter 1987. Review of additional data submitted by SFC (July 6, 1987 letter from SFC to WDEQ) indicated that the concentrations of selenium at the outfall from the settling ponds were within the 0.05 mg/l standard for livestock usage and within the requirements of the NPDES permit. The WDEQ is reviewing NPDES discharges separately.

The USNRC's primary responsibility with respect to surface water discharges from the ISL facility is to ensure that 10 CFR Part 20 effluents to unrestricted areas limits are not exceeded. This is further discussed in Section 4.3.1.2.

3.6.4 Wastes

Liquid wastes generated by the project will include the 1 to 5 gpm bleed stream, excess resin wash and elution water, yellowcake wash water, sump fluids, and the water produced during aquifer restoration. Waste liquids with high total dissolved solids, such as the excess eluant, will be required by license condition to be routed to the solar evaporation ponds for evaporation and concentration.

In the event that the waste volume approaches pond capacity, the wastes shall be required by license condition to be disposed of in to a USNRC licensed disposal facility to restore pond capacity. SFC will be authorized by license condition to discharge bleed stream and liquids produced during aquifer restoration under the authorization and conditions of SFC's existing NPDES permit No. WY-0022411 through the settling tanks and on to the water treatment settling ponds. The wastes containing radium (in the barium chloride/sulfate sludges) from the in situ leaching operation accumulating in the water treatment settling tanks are byproduct material and will be required to be disposed of in a USNRC licensed facility.

The solid wastes generated by the program are expected to include rags, trash, packing material, and the solids remaining in the evaporation ponds after the waste liquids have evaporated. Nonradioactive wastes may be disposed of in the Bill Smith Mine's existing waste disposal facilities. The solids remaining in the evaporation ponds (including the synthetic liner) will be required to be disposed of at a USNRC licensed facility.

3.7 Ground-Water Restoration, Reclamation, and Decommissioning

3.7.1 Ground-Water Restoration

The goal of restoration is to return affected ground water to its baseline condition upon completion of leaching activities. Restoration is intended to reduce the concentration of contaminants remaining in the ground water from mining activities to acceptable levels.

SFC's restoration plan for the O-Sand will be required by license condition to be submitted at least 90 days prior to termination of lixiviant injection. Although SFC has not submitted a specific restoration plan for the O-Sand for approval, the primary restoration technique proposed by SFC in the O-Sand well field is a combination of ground-water sweep and clean water injection, the same technique used in restoration of the Q-Sand well field. Ground-water sweeping involves withdrawing water from selected injection and production wells which brings uncontaminated natural ground water into the leached area. Water withdrawn from the ore zone will first be processed through the ion exchange unit to recover any uranium pumped to the water treatment plant for barium chloride treatment and discharged as authorized by the NPDES permit.

A portion of the water recovered from the ore zone by the ground-water sweep will be processed through a reverse osmosis or electrodialysis reversal unit for purification and reintroduced to the contaminated aquifer to assist in the restoration process. The volume of water expected to be produced during restoration of the O-Sand well field is about 160 acre-feet (52.1 million gallons). This estimate is based on a 60-foot (18.3 m) thick ore zone, 25 percent porosity and replacement of six pore volumes during restoration.

The goal of the restoration program is to return the average concentrations of the parameters to baseline conditions. As further discussed in Section 4.2.3, baseline conditions for the O-Sand will be the mean values of the actual baseline water samples, plus or minus two standard deviations. The baseline values for the O-Sand are listed in Table 2.2.02 and the license will reference these values. If restoration to the baseline values cannot be achieved in a reasonable time using reasonable efforts, restoration criteria for those parameters not returned to baseline will be determined on a well-by-well and parameter-by-parameter basis, considering current and potential future uses of the ground water and any other pertinent factors. If restoration to baseline is not achieved, the licensee will be required to perform an evaluation of the impact of the remaining contamination on the ground water. The USNRC will then determine if that impact is acceptable and if further actions by the licensee will be required.

3.7.2 Reclamation and Decommissioning

At the completion of all leaching and restoration activities, SFC will be required by license condition to decommission the recovery facilities and reclaim all land affected.

SFC will also be required by license condition to decontaminate the drainage to which the discharges were directed to no more than 5 pCi/gram above baseline as discussed in Section 3.6.3.1. Baseline radium in the drainage is specified in Table 3.7.01.

At the termination of the operation, all structures such as tanks, buildings, and foundations will be removed and all remaining disturbed areas will be reclaimed. All wells will be plugged with cement and/or other approved material and the casing will be cut off 2 feet below the surface, in accordance with the State of Wyoming requirements. Sediments and radioactive solids remaining in the evaporation and settling ponds will be removed and disposed of at a licensed disposal site as discussed in Sections 3.6.2 and 3.6.3.

The evaporation and settling pond (Section 3.6.3.1) sites will be leveled and contoured to blend with the natural terrain, covered with topsoil, and revegetated. If it is decided to expand the project into a commercial scale operation, the reclamation would be deferred and completed as per the approved plan for the commercial scale operation. As required by license condition, a surety for the total amount of the estimated reclamation costs is required to be posted with the Wyoming Department of Environmental Quality (WDEQ), Land Quality Division (LQD), to ensure funds are available for the reclamation program.

4.0 EVALUATION OF ENVIRONMENTAL IMPACTS

4.1 Introduction

In situ leaching of uranium is a relatively new and developing technology. Primary human health and environmental concerns with this technique of mining are the potential impacts of mining on ground-water quality, the impacts of potential evaporation pond leakage, radiological impacts, and disposal of wastes.

4.2 Ground-Water Impacts

4.2.1 Excursions

Excursions of contaminated ground water in a well field can be due to improper balances between injection/production rates, undetected high permeability strata or geological structures,

improperly abandoned exploration drill holes, discontinuity and unsuitability of the confining strata to prevent movement of lixiviant out of the ore zone, cracked well casings and faulty well construction and hydrofracturing of the ore zone or surrounding units. There have been no excursions in the Q-Sand or O-Sand well fields during their operational history. The Q-Sand well field operated from October 1981 through May 1986, and the O-Sand well field has been operated since July 1984. Continued operation of the O-Sand well field, based upon historical operations, should result in no future excursion.

4.2.2 Evaporation Pond Seepage and Spills

Accidental uncontrolled leaks from the evaporation ponds could contaminate shallow aquifers and locally degrade ground-water quality. The construction quality control and the maintenance programs associated with the impermeable synthetic bottom liners and the maintenance and surveillance of the solar evaporation ponds should eliminate such uncontrolled seepage into the ground water. Furthermore, if a pond leak were to develop, the monitoring program described in Section 3.6.2 would allow for early detection and repair of the leak, thereby minimizing the impacts and the quantity of any leakage. Previous operational history indicates that no major pond leaks have occurred. However, on two occasions, minor leaks in the west cell have occurred. These leaks were detected by the leak detection system and were reported to USNRC on July 6, 1983, and December 26, 1984. The July 1983 leak was caused by ice movement of the previous winter and the December 1984 leak was also associated with ice. In both instances, only a small volume of water was involved and the water was pumped directly from the leak detection sump to the other pond with no loss of fluid. Therefore, based upon operational history and the effectiveness of the leak detection system, continued operation should not result in ground-water impacts from pond leakage.

Spills from the evaporation ponds resulting from dam failure could result in unacceptable contamination of surface and ground water. However, since pond water levels will be controlled with adequate freeboard requirements, the likelihood of a dam failure is very remote. Furthermore, the monitoring program discussed in Section 3.6.2 will provide early warning of embankment fatigue and potential dam failure situations.

4.2.3 Restoration of Ground Water

The Q-Sand restoration plan was approved by the USNRC and incorporated into SFC's license by Amendment No. 11, dated July 9,

1984. Restoration of the Q-Sand was initiated in November 1984 and continued for 18 months, at which time, in May 1986, the USNRC participated in a water quality sample-split with WDEQ and SFC to determine the water quality as a result of the ground-water restoration activities. In a September 30, 1986 letter to SFC, USNRC notified SFC that the first phase of restoration was complete and that the 12-month stability demonstration period had begun, retroactive to May 13, 1986.

At the end of the 12-month stability demonstration period, samples were split between WDEQ and SFC, on May 20, 1987. The results of the analysis from the 12-month stability demonstration period showed that the Q-Sand well field, as a whole, had been restored at or below the approved restoration values and on August 11, 1987, the USNRC amended SFC's license accordingly. Table 4.2.01 lists the summary of restoration criteria as well as the well field baseline information for the Q-Sand well field. In the review of the restoration of the Q-Sand well field, the USNRC staff indicated that a more appropriate restoration value for the Q-Sand well field should be specified in the renewed license. The recommended restoration criteria is the mean of the actual background water quality values, plus or minus two standard deviations.

The Q-Sand restoration criteria for a particular parameter was essentially the highest representative value of the background values plus 20 percent, or the EPA primary drinking water standard, whichever was higher. Although the restoration of the Q-Sand well field as a whole resulted in all parameters being stabilized at or below the restoration target values, the resultant concentrations were outside the mean plus two standard deviations (minus for pH) for 3 of the 19 parameters monitored (iron, uranium, and pH). It should be noted that only two parameters were outside of the range of baseline values, uranium and pH. Table 4.2.01 further illustrates the summary of the Q-Sand well field restoration. This table shows the stabilized well field average for each parameter as well as the background mean, range, and mean plus two standard deviations for each parameter. SFC's license will specify that the restoration criteria for the O-Sand R&D project will be the mean of the actual baseline, plus or minus two standard deviations, and also reference, in Table 2.2.02, the actual values. If restoration cannot be achieved to baseline, restoration criteria for those parameters not returned will be evaluated on a well-by-well and parameter-by-parameter basis. Also, if restoration cannot be achieved, SFC shall be required by license condition to submit a report describing the methodology actually implemented during their restoration, predicted results of any subsequent restoration efforts to further lower ground-water concentrations and an evaluation of the remaining ground-water contaminants.

4.3 Radiological Impacts

4.3.1 Offsite Impacts

4.3.1.1 Air Effluents

Since only liquids are brought to the surface during leaching and the product is packaged as a wet slurry, the release of radioactive particulates to the atmosphere from in situ operations is substantially less than would occur at a conventional uranium mining and milling operation, or at an in situ leach operation where the product is dried prior to packaging. Some radon will be released from the leach solutions and will be vented from the building to the atmosphere. Because these releases will be relatively small, and since the nearest permanent residence is approximately 4.5 miles from the site (Vollman Ranch), there should be no significant offsite radiological impacts. More specifically, based on comparison of this project (size, location of residents) with other in situ projects where air effluent exposures have been calculated (NUREG-0489), exposures should be well below allowable limits of 10 CFR 20 and 40 CFR 190. This is further discussed in the SER.

4.3.1.2 Water Effluents

The effluent waste stream from the elution process is directed to the solar evaporation ponds, which shall be designated as a restricted area due to the concentration of radionuclides (primarily radium). The first quarter 1987 concentration of radium and uranium in the evaporation pond water was 764 pCi/l and 240 mg/l, respectively. Due to the daily inspections of these ponds and the license requirement to dispose of radioactive material from the evaporation ponds in an USNRC licensed disposal facility, there should be no offsite impacts.

The effluent waste stream from the plant (bleed stream and restoration water) will be directed to a mixing cell, treated with barium chloride and discharged into the two settling tanks, allowed to settle out the barium sulfate sludge, then allowed to mix with the mine discharge and be sent to the water treatment settling ponds, where it is discharged under NPDES permit. The barium chloride removes the radium from the effluent and concentrates it in the settling tanks in the form of a sludge. Due to the requirement for monitoring (Section 5.1.2) and disposal of

the sludges in a USNRC licensed facility, there should be no offsite impacts.

4.3.1.3 Conclusions

SFC will continue the environmental monitoring program, which will evaluate the concentrations of radionuclides in the environment that could lead to offsite exposures. The staff considers that this environmental and effluent monitoring program (discussed in Section 5.1) will be sufficient to evaluate the radiological impact of the in situ leach operations.

4.3.2 In-plant Safety

SFC will continue to perform the in-plant radiation safety program. The staff, through license conditions, has required a program which contains the basic elements required for, and found to be effective at, other source material extraction operations to assure that exposures are kept as low as reasonably achievable (ALARA). The SER discusses SFC's ALARA program more specifically. The scope of the program has taken into account the small size of the proposed R&D project. In general, the program includes the following:

1) airborne and surface contamination sampling and monitoring;

2) personnel exposure monitoring;

3) qualified management of the safety program and training of personnel;

4) written radiation protection procedures, including an annual review; and

5) periodic audits and frequent site inspections by individuals meeting certain qualifications to assure the program is being conducted in a manner consistent with the ALARA philosophy.

The staff considers the program of in-plant safety, as required by license conditions, sufficient to protect in-plant personnel by keeping radiation doses as low as reasonably achievable.

4.3.3 Fluid Leakage

SFC will be required by license condition to notify the USNRC by telephone of any failure, break, rupture or leak of any component of the facility that results in an uncontrolled release of radioactive materials (including production fluid from the well field). Additionally, any unusual condition, which if not corrected, could lead to such failure shall also be required to be reported. Such oral notification shall be followed within seven days by a written report detailing the conditions leading to the failure, corrective actions taken and results achieved.

4.4 Waste Disposal

The USNRC has taken the position in its regulations on uranium milling in 10 CFR 40, Appendix A, Criterion 2, that the small volume of wastes generated at in situ operations should preferably be disposed of at existing tailings disposal sites or other licensed burial grounds to avoid proliferation of waste sites. The staff will require that the solid wastes generated at the SFC site, as described in Section 3.6, be disposed of at an existing USNRC licensed disposal site.

4.5 Surface Discharges

The bleed stream and restoration waters are authorized to be surface discharged under NPDES permit. This effluent must be processed through an IX unit for removal of uranium and treated with barium chloride for radium removal in the water treatment settling tanks described in SFC's September 17, 1987 submittal, prior to discharge. The discharge is permitted under Wyoming NPDES Permit WY #0022411. Sediment samples from the drainage system below the NPDES outfall (the water treatment settling ponds) have indicated exceedence of baseline radium-226 values by more than 5 pCi/gram on five occasions. In four of the cases, the high assay value was not supported by subsequent samples from the same location. However, a 1984 followup sample confirmed the high value and sediment from approximately 200 feet of the drainage channel directly below the discharge point were removed and placed on an existing low grade protore pile near the Bill Smith Mine.

5.0 MONITORING

5.1 Water Quality Monitoring

5.1.1 Well Field Water Quality

Figure 2.2.02 shows the locations of the injection, production and monitor wells at the O-Sand project. A ring of five

production zone monitor wells are located at approximately 250 feet from the well field area. Monitor wells are also completed in the overlying and underlying aquifers. All monitor wells will be required by license condition to be routinely sampled, analyzed for selected water quality parameters and water levels to provide early indications of excursions. If indications of leach solution appear in any of the monitor wells, overproduction (production over injection) rates should be increased accordingly to contain lixiviant solutions in the injection-production well field area. Excursions are further discussed in Section 5.1.3.

Monitor wells will be required by license condition to be sampled once every 2 weeks and analyzed for bicarbonate, sulfate, chloride and specific conductance (once a month for well OMO-1). All monitor wells will be required to have water level measurements taken once monthly prior to taking water quality samples Additionally, a set of samples from all monitor wells will be required by license condition to be analyzed for the full suite of water quality parameters listed in Table 5.1.01, prior to the cessation of lixiviant injection. This will be required so that prerestoration values can be determined.

The water quality analyses results will be included in the semiannual effluent and environmental monitoring report that is further discussed in Section 5.2.

5.1.2 Effluent Water Quality

The liquid wastes discussed in Section 3.6.3 shall be required to be characterized by license condition. Quarterly samples of the authorized discharge from the recovery facility will be analyzed for uranium, thorium, and radium prior to mixing with Bill Smith Mine water discharges. Semiannual samples from the evaporation ponds will be analyzed and the results reported in the semiannual report discussed in Section 5.2.

5.1.3 Upper Control Limits

The upper control limits (UCLs) for each monitor well were determined so that excursions could be identified on a well-by-well basis. Chloride, sulfate, bicarbonate and specific conductance were selected as excursion indicators. The UCLs were determined as follows:

1) chloride UCL were determined by adding 10 mg/l to the highest representative baseline value;

2) bicarbonate and sulfate UCLs was determined by adding 15 percent to the high representative baseline value; and

3) specific conductance UCL was determined by adding 10 percent to the highest representative baseline value.

As discussed in Section 5.1.1, the monitor wells are monitored biweekly for the excursion indicators.

As will be required by license condition, if any two excursion indicators exceed their UCLs or if one excursion parameter exceeds its UCL by 20 percent and is confirmed by verification samples taken within 48 hours after the results of the first analysis are received, an excursion will be declared and corrective action will be initiated by SFC. SFC will be required by license condition to notify the USNRC by telephone within 24 hours after the excursion has been verified. Also, a written report will be required to be submitted within 7 days detailing the excursion, corrective actions taken, and results of the corrective actions. An excursion status report will be submitted to the USNRC monthly until the monitor well(s) is released from excursion status. The sampling frequency for the affected well(s) will be increased to once per week for the four parameters listed above until the excursion parameter value(s) is below the UCL value(s). If corrective actions prove to be ineffective within 90 days from the date of verification analysis, well field injection shall be terminated until such time as the problem is mitigated and approval from the USNRC is received.

At least once prior to cessation of lixiviant addition in a well field (prior to commencement of restoration activities) a set of samples from all monitor wells will be analyzed for the suite of water quality parameters listed in Table 5.1.01. Results of these analyses will be reported in the semiannual report.

5.1.4 Evaporation Pond Leak Detection Systems

The standpipes at the evaporation pond will be required to be checked daily for fluid. If 3 inches or more of fluid is found in the standpipes, a sample will be collected and analyzed for chloride, specific conductance, and sulfate. Should these analyses indicate that the pond is leaking, the USNRC will be required to be notified within 48 hours and mitigative actions will be initiated immediately. A written report will be submitted to the USNRC within 30 days detailing the cause of the leak and corrective actions taken.

5.2 Environmental Monitoring

Operational radiological and environmental monitoring programs will be consistent with the approved programs developed and approved for the previous operations at the project.

5.2.1 Radiological Monitoring

The SFC radiological monitoring programs include inplant alpha, gamma and air sampling. These surveys will be performed as specified in the SER. The operational radiological monitoring program locations are presented in Table 5.2.01 and more fully discussed in the SER.

5.2.2 Other Monitoring

Monitoring (primarily water-related) is discussed in other sections of this EA. SFC will be required by license condition that the results of monitoring, as well as meetings, calibrations, sampling, analyses and surveys required by the license as well as any subsequent reviews, and corrective actions, shall be documented and shall be maintained at the project site for a period of at least 5 years.

SFC will also be required by license condition to submit a semiannual report that summarizes the status of the R&D test program with supporting analytical data and evaluations. The report will be required to include the results of all non-ALARA effluent and environmental monitoring required by the license and shall be reported in accordance with 10 CFR 40, Section 40.65, "Effluent Monitoring Reporting Requirements."

Additionally, in order to keep the USNRC informed of activities with the State of Wyoming, SFC will be required by license condition to submit to USNRC, copies of any correspondence sent to the WDEQ regarding operation of the R&D facility, including NPDES discharges.

6.0 ALTERNATIVES

It is the staff's conclusion that the impacts associated with renewal of Source Material License No. SUA-1387 are within the realm of impacts anticipated in the FEA. Recognizing these impacts, the

staff has available two alternatives with respect to the requested license renewal:

1) Renew the license with such conditions as are considered necessary or appropriate to protect public health and safety and the environment; or

2) Deny renewal of the license.

In the SER prepared for this action, the staff has reviewed the licensee's proposed action with respect to the criteria for license issuance specified in 10 CFR 40, Section 40.32, and has no basis for denial of the license. Moreover, the environmental impacts described in this document do not warrant denial of the application. For these reasons, license denial is considered an unacceptable alternative, and the staff has determined that no significant impacts will be associated with the license renewal.

7.0 FINDING OF NO SIGNIFICANT IMPACT

Based on this environmental assessment the staff finds that the renewal of Source Material License SUA-1387 for research and development operation of the SFC site will not have a significant impact on human health or the environment. The specific reasons for drawing this conclusion are:

- The control and monitoring of the ground water at the SFC facility is sufficient to monitor operations and will provide a warning system that will minimize any impact on ground water. Furthermore, aquifer testing and the operational history of the project indicates that the production zone is adequately confined, thereby assuring hydrologic control of the mining solutions;

- The solar evaporation ponds are lined to eliminate seepage of waste solutions; a monitoring system below the liner should detect any leakage which may occur, and license conditions require that corrective action in response to a leak is promptly taken;

- Radiological releases from the well field and processing plant will be very small (exposures which are small fractions of radiological exposure standards will result) and the environmental monitoring program is comprehensive and will detect any radiological releases resulting from the operation;

- Radioactive wastes, including those from the solar evaporation and water treatment tanks, will be minimal and will be disposed of at an USNRC licensed site, in accordance with applicable federal and state regulations;

- The Q-Sand well field was restored at or below the restoration criteria and the Q-Sand well field restoration criteria will be the actual baseline mean values, plus or minus two standard deviations.

The licensee's submittals for renewal did not address all of the operational and environmental concerns for the site, as discussed in this EA and accompanying SER. Therefore, to assure that the impacts listed above are truly representative of renewal R&D operation at the SFC site, the staff recommends that the following license conditions be incorporated into the license renewal:

1. Authorized Place of Use: The licensee's research and development uranium in situ leaching facility located in Converse County, Wyoming.

2. Authorized Use: For uranium recovery from pregnant lixiviant in accordance with statements, representations and conditions contained in (1) the licensee's renewal application dated May 27, 1986; and (2) additions to the renewal application dated June 15, 1987, September 17, 1987, and December 14, 1987. Notwithstanding the above, the following conditions shall override any conflicting statements contained in the licensee's application and supplements. Wherever the word "will" is used in the above referenced sections, it shall denote a require

3. Pressures at the well heads of all injection wells shall not exceed the pressures maintained during the well integrity testing program as specified in Table 2-3, "Well Casing Integrity Test Results," of Appendix XI of the licensee's June 15, 1987 submittal. Integrity tests shall be performed at anytime a production well is converted to an injection well and after each incidence of well work-over or any other operation involving insertion of drill rods or related equipment into a well cased with PVC or fiberglass. The wells shall be tested at a pressure of 100 psi, which simulates the maximum anticipated operating pressure of the well. If no more than a 5 percent decrease in pressure occurs after at least ten (10) minutes of testing, the well casing will be determined to be mechanically sound. In the event a well fails the casing integrity test and cannot be repaired, it shall not be used for injection.

4. Flow rates on each injection and production well, and injection well head pressures shall be measured at least once per day and recorded on a daily operating log.

5. The licensee is authorized to use a sodium bicarbonate lixiviant with hydrogen peroxide and/or oxygen added, as discussed on page 11 of the licensee's June 15, 1987 submittal. A change in lixiviant

will require USNRC review and approval in the form of a license amendment.

6. The uranium recovery plant shall be operated at a maximum average flow rate of two hundred and fifty (250) gallons per minute (gpm).

7. Any major changes in the process circuit, as shown in Figure 1-1 of Appendix XI of the licensee's June 15, 1987 submittal, shall require the approval of the RSO and shall be submitted to the USNRC, Uranium Recovery Field Office, for prior approval in the form of a license amendment.

8. The Licensee shall comply with the following requirements regarding the two solar evaporation ponds:

   A. Maintain at least 3 feet of freeboard in each of the evaporation ponds to allow for pumping the contents of one pond into the other in the event of a leak.

   B. Maintain a fence around the evaporation ponds that prevents the intrusion of game animals into the evaporation pond area.

   C. Perform a daily visual inspection of all pond embankments by an individual trained in proper inspection procedures and record the results on a daily log sheet.

   D. Perform a daily visual inspection for leaks at the evaporation ponds. If more than 3 inches of fluid is detected in the standpipes of the pond leak detection system, the fluid shall be analyzed for chloride, bicarbonate, sulfate and specific conductance. Should analyses indicate that the pond is leaking, the USNRC, Uranium Recovery Field Office, shall be notified by telephone within fourty-eight (48) hours of verification and the pond level lowered by transferring its contents into the other cell so that repairs can be made. Water quality samples taken at the standpipe shall be analyzed for at least chloride and specific conductance at least once every seven (7) days during the leak period and for at least two weeks following repairs.

   A written report shall be filed with the USNRC, Uranium Recovery Field Office, within thirty (30) days of first notifying the USNRC that a leak exists and subsequently every 30 days until the leak is repaired. This report shall include all available analytical data and shall describe the action taken to stop the leak and the results of the action(s).

9. All liquid discharges from the processing facility shall be to the solar evaporation ponds, with the exception of bleed and the restoration stream which shall first be processed through the ion exchange unit and then treated for radium removal in the treatment tanks, and discharged in accordance with NPDES Permit No. WY-0022411.

10. The licensee shall dispose of the following at a USNRC approved disposal site:

    A. Any radioactive solids or residues from the facility or evaporation ponds.

    B. All sediments and residues from the water treatment settling tanks associated with pretreatment of surface discharges from the in situ leaching operations under the NPDES permit No. WY-0022411.

11. The licensee shall submit to the USNRC, Uranium Recovery Field Office, within 60 days of issuance of the renewed license, a report in the form of a license amendment, detailing the sludges in the three water treatment settling ponds. The report shall detail the results of the sampling and provide measurements and calculations of the volume, weight, and activity of the sludges.

12. The licensee shall conduct a confirmatory survey of sediments in the drainage to which surface discharges have been directed under authority of NPDES PERMIT No. WY-0022411, to confirm that radium values are less than 5 pCi/gram above background and submit the results to the USNRC, Uranium Recovery Field Office as an amendment to their license. Background values are 2.45, 6.5, and 1.58 pCi/gram for the outfall, Ross Road, and 1½ miles downstream, respectively.

13. A. At least 90 days prior to termination of O-Sand lixiviant injection, the licensee shall submit to the USNRC, Uranium Recovery Field Office, a specific plan for O-Sand ground-water quality restoration. This plan will include a description of restoration steps, projected schedule of activity, and plans for restoration and post-restoration monitoring. Specific restoration methods and specific plans for restoration and post-restoration monitoring shall require USNRC approval. The licensee shall initiate ground-water restoration within sixty (60) days after leaching operations have terminated and shall provide written notification to the USNRC, Uranium Recovery Field Office, that restoration activities have been initiated.

B. The restoration criteria for the O-Sand well field will be based on the well field as a whole, on a parameter-by-parameter basis. All parameters are to be returned to as close to baseline as is reasonably achievable. Baseline shall be defined as the mean of the preoperational background values, plus or minus two standard deviations. Baseline is specified in Attachment No. to this license, "O-Sand Well field Baseline Data and Restoration Criteria". Additionally, failure to restore ground-water quality to baseline concentrations shall require the licensee to submit a report describing the methodology actually implemented during the restoration activity, predicted results of any subsequent restoration activity and efforts to obtain baseline levels and an evaluation of the impacts of the remaining ground-water concentrations.

14. The licensee shall properly plug all wells and reclaim and decommission the process facility site as discussed on page 14 of the licensee's June 15, 1987 submittal.

15. The licensee shall maintain an USNRC-approved financial surety arrangement, consistent with 10 CFR 40, Appendix A, Criterion 9, adequate to cover the estimated costs, if accomplished by a third party, for completion of the USNRC-approved site closure plan including; above ground decommissioning and decontamination, the cost of offsite disposal of radioactive solid process or evaporation pond residues, and ground-water restoration as warranted. Within three (3) months of USNRC approval of a revised closure plan and cost estimate, the licensee shall submit, for USNRC review and approval, a proposed revision to the financial surety arrangement if estimated costs in the newly approved site closure plan exceed the amount covered in the existing financial surety. The revised surety shall then be in effect within three (3) months of written USNRC approval. Annual updates to the surety amount, required by 10 CFR 40, Appendix A, Criterion 9, shall be provided to the USNRC at least three (3) months prior to the anniversary of the effective date of the existing surety instrument. If the USNRC has not approved a proposed revision 30 days prior to the expiration date of the existing surety arrangement, the licensee shall extend the existing arrangement, prior to expiration, for one year.

Along with each proposed revision or annual update, the licensee shall submit supporting documentation showing a breakdown of the costs and the basis for the cost estimates with adjustments for inflation, maintenance of a minimum 15% contingency, changes in engineering plans, activities performed and any other conditions affecting estimated costs for site closure. The licensee shall also provide the USNRC with copies of surety related correspondence

submitted to the State, a copy of the State's surety review and the final approved surety arrangement. The licensee must also ensure that the surety, where authorized to be held by the State, expressly identifies the USNRC related portion of the surety and covers the above ground decommissioning and decontamination, the cost of offsite disposal, soil and water sample analyses and ground-water restoration associated with the site. The basis for the cost estimate is the USNRC approved site closure plan or the USNRC approved revisions to the plan.

Sequoyah Fuel's currently approved surety instrument, two surety bonds in the amount of $109,000 [redacted] and $157,000 [redacted] issued by SAFECO Insurance Company of America in favor of the State of Wyoming, shall be continuously maintained for the purpose of complying with 10 CFR 40, Appendix A, Criterion 9, until a replacement is authorized by both the State and the USNRC. Attachment 1 to this license outlines the minimum considerations used by the USNRC in the review of site closure estimates. Reclamation/decommissioning plans and annual updates should follow this outline.

16. The licensee shall, within forty-eight (48) hours, notify the USNRC, Uranium Recovery Field Office, by telephone of any failure of any solution pond, any break or rupture of any pipeline, or any similar failure of any other fluid or material conduit or storage facility which results in an uncontrolled release of radioactive materials, or of any unusual conditions which, if not corrected, could lead to such failure. Such notification shall be followed, within seven (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.

17. A semiannual report shall be submitted to the USNRC, Uranium Recovery Field Office, that summarizes the status of the R&D program, with supporting analytical data and evaluations including lixiviant migration control measures, waste generation volumes, volumes of injected lixiviant, pregnant solution produced, volumes of discharges to the evaporation ponds and all environmental monitoring and ground-water data, as well as all monitoring data and reports required under NPDES Permit No. WY-0022411. The semiannual report shall include the non-ALARA results of all effluent and environmental monitoring required by this license and shall be reported in accordance with 10 CFR 40, Section 40.65. Monitoring data shall be reported in the format shown in Attachment No. __ to this license, "Sample Format for Reporting Monitoring Data."

18. The licensee shall have a waste sampling and analysis program that requires:

    A. During solution mining activities of the O-Sand well field, the monitor wells shown on Figure 3 of the licensee's May 27, 1986 submittal and identified as OM-1 through OM-5, OMM-1, OMW-1, and OMS-1, shall be sampled and analyzed for bicarbonate, chloride, sulfate, and specific conductance once every two (2) weeks. Well OMO-1 shall be sampled monthly and analyzed for bicarbonate, chloride, sulfate and specific conductance.

    B. Water levels in monitoring wells OM-1 through OM-5, OMM-1, OMS-1 and OMO-1 shall be measured monthly prior to water quality sampling.

    C. Prior to mixing with other sources, the NPDES discharges from the recovery facility will be sampled and analyzed for uranium, radium-226 and thorium-230 on a quarterly basis.

    D. Semiannual samples of evaporation pond water will be analyzed for calcium, chloride, sulfate, TDS, bicarbonate, sodium, uranium, thorium-230 and radium-226.

    E. Prior to cessation of lixiviant addition in the O-Sand, a set of samples from all monitor wells shall be analyzed for the full suite of water quality parameters listed in Table 1.5 of the licensee's June 15, 1987 submittal. Analytical results shall be reported in the semiannual report.

19. Excursion parameters and upper control limits (UCL) for O-Sand monitor wells shall be as follows:

Well No.	Chloride (mg/l)	Bicarbonate (mg/l)	Sulfate (mg/l)	Conductivity (umhos/cm)
OM-1	17	283	345	1018
OM-2	18	304	345	1032
OM-3	17	287	334	1020
OM-4	20	275	334	952
OM-5	19	306	328	1012
OMS-1	22	359	276	1007
OMW-1	16	238	55	418
OMM-1	16	224	104	534

    A. If any two UCL values are exceeded in a well, or if one UCL value is exceeded by 20 percent or more, the licensee shall collect another water sample within fourty-eight (48) hours and analyze it for at least the constituents listed above. An

excursion is confirmed if the analysis of the second sample indicates that two or more UCL values are exceeded or one UCL value is exceeded by 20 percent or more. Corrective action shall be initiated by the licensee when an excursion is confirmed, and the USNRC, Uranium Recovery Field Office, shall be notified within fourty-eight (48) hours by telephone and within seven (7) days in writing.

B. Sampling and analysis for the UCL constituents listed above shall be conducted at least once every seven (7) days for all wells on confirmed excursion status.

C. A written report shall be provided to the USNRC, Uranium Recovery Field Office, within thirty (30) days of confirming the excursion. The report shall describe the condition, the corrective action taken, and the results obtained as well as pre-excursion and post-excursion data obtained from the analysis of at least two separate water quality samples taken before and after the excursion. If wells are still on excursion at the time the report is filed, monthly written progress reports concerning the excursion shall be sent to the USNRC, Uranium Recovery Field Office, monthly until the monitor wells are no longer on excursion status.

D. If corrective actions have not been effective in controlling the excursion within ninety (90) days of excursion verification, injection of lixiviant shall be terminated until the licensee can demonstrate the excursion has been mitigated and injection of any lixiviant shall not resume until written approval is received from the USNRC, Uranium Recovery Field Office.

20. The results of sampling, analyses, surveys and monitoring, the results of calibration of equipment, safety meetings and training courses requested by this license, as well as reports on audits and inspections, any subsequent reviews, investigations, and corrective actions, shall be documented. Unless otherwise specified in the USNRC regulations, all such documentation shall be maintained on site for a period of at least five (5) years.

21. The licensee shall submit to the USNRC, Uranium Recovery Field Office, copies of any correspondence sent to the Wyoming Department of Environmental Quality (WDEQ), regarding the ISL pilot plant or NPDES discharges.

Table 2.2.01: Description of Hydrogeologic Units In the Vicinity of the Project.

Geologic Age	Hydro-geologic Unit	Approximate Thickness (feet)	Lithologic Characteristics	Hydrologic Characteristics
Eocene	Wasatch Formation	0-500	Fine- to coarse-grained lenticular arkosic sandstone, and interbedded claystone and siltstone	Ground-water production generally good, but lenticular Nature restricts aquifer use locally; yields of as much as 140 gpm have been produced
Paleocene	Fort Union Formation	3000	Fine- to coarse-grained, lenticular sandstone, and interbedded carbonaceous shale and coal	Ground-water production good beneath site; yields of 550 gpm have been produced over prolonged periods
Cretaceous	Lance Formation	3000	Fine- to coarse-grained sandstone, and interbedded sand, shale and claystone	Ground-water production largely unknown in vicinity of site; probably would not yield over 20 gpm
Cretaceous	Fox Hills	500-700	Fine- to coarse-grained sandstone and interbedded thin sandy shale	Ground-water production largely unknown in vicinity of site; probably would not yield over 100 gpm

Sources: Hodson et al., 1973; Hodson, 1971; Harshbarger and Associates, 1974.

Table 2.2.02

O-Sand Well Field Baseline Data and Restoration Targets

Parameter	Baseline Range	Baseline Mean	Restoration Criteria*
Aluminum (Al)	.1-.2	1	.14
Arsenic (As)	.001-.016	.004	.011
Boron (B)	.01-.3	.13	.26
Barium (Ba)	.1-.2	.104	.14
Calcium (Ca)	83-122	106	124
Cadmium (Cd)	.002-.02	.004	.012
Cobalt (Co)	.01-.05	.01	.03
Chromium (Cr)	.01-.05	.02	.06
Copper (Cu)	.01-.04	.012	.02
Iron (Fe)	.01-.32	.065	.21
Mercury (Hg)	.0002-.0005	.0002	.0003
Potassium (K)	6-25	14	26
Magnesium (Mg)	21-32	26	30
Manganese (Mn)	.01-.31	.03	.12
Molybdenum (Mo)	.001-.1	.06	.17
Sodium (Na)	24-32	27	31
Nickel (Ni)	.02-.18	.03	.08
Lead (Pb)	.01-.20	.05	.10
Selenium (Se)	.001-.046	.005	.023
Uranium (U)	.003-1.68	.273	1.02
Vanadium (V)	.01-.1	.1	.14
Zinc (Zn)	.005-1.11	.202	.67
Chloride (Cl)	2-8	4	8
Bicarbonate (HCO_3)	146-234	202	240
Carbonate (CO_3)	ND	ND	ND
Fluoride (F)	.2-.74	.46	.69
Nitrate (as N)	.01-.21	.044	.11
pH Units	7.31-8.16	7.72	8.1
E.C. (umhos/c)	636-978	778	901
Sulfate	244-310	268	300
T.D.S	522-656	582	644
Thorium-230 (Th), pCi	.0-5.6	1.0	3.3
Radium-226 (Ra), pCi/	61-680	276	561

All values are mg/l except Radium and Thorium (pCi/l), Conductivity (umho/cm), and pH (standard units).

* Baseline mean, plus (minus for pH) two standard deviations.

Table 3.3.01

Well Casing Integrity Test Results
O-Sand In Situ Leach Project

Well No.	Test Date	Initial Pressure PSI	Pressure at 10 min. PSI	Change %
OI-1	10/26/82	110	110	-
OI-2	10/21/83	230	230	-
OI-3	7/12/83	160	160	-
OI-4	7/20/83	170	170	-
OI-5	10/22/82	103	100	-
OI-6	10/22/83	220	220	-
OI-7	11/02/83	325	325	-
OI-8	10/29/82	125	125	-
OI-9	10/25/83	270	270	-
OI-10	10/20/83	170	170	-
OI-11	10/26/83	300	300	-

(From Table 2-3 of SFC's June 15, 1987 submittal.)

Table 3.6.01

SFC Q-Sand/O-Sand
First Quarter 1987
Effluent Water Quality Values

(Values in mg/l; radium and thorium in pCi/l)

	Bleed Stream	Evap. Ponds
Bicarbonate	1098	-
Carbonate	0	-
Chloride	131	59,000
Selenium	1	-
Sodium	207	37,000
Sulfate	580	3,655
Uranium	1.7	240
TDS	2110	110,000
Radium	1267	764
Thorium	56	-
Arsenic	-	0.08
Alkalinity	-	21

Table 3.7.01

Baseline Radium-226 Values for Soils/Sediments
Downstream from WY-0022411 NPDES Discharge Location
(values in pCi/gram)

Sampling Location	Baseline	Action Level (Baseline +5 pCi/grams)
Outfall from final treatment	2.45	7.45
Ross Road	6.5	11.5
1½ miles below Discharge Point	1.58	6.58

Table 4.2.01

Q-Sand Restoration Stability Demonstration
Summary Data

	Background Mean	Background Range	Wyoming Std.	Target Value	SDA*	M+2SD*
Arsenic	.004	.001-.013	.05	.05	.009	.011
Boron	.17	.002-.7	-	.54	.163	.47
Iron	.014	.01-.27	.3	.3	.15	.12
Manganese	.03	.01-.077	.05	.09	.046	.06
Radium-226	334	6-1132	5.0	923	406	986
Selenium	.005	.001-.024	.01	.029	.008	.014
Thorium-230	.77	.027-4.68	-	5.62	3.8	5.1
Uranium	.432	.001-.95	5.0	3.7	1.48	1.44
Bicarbonate	195	129-245	-	294	235	265
Calcium	67	24-245	-	120	76	127
Carbonate	11	nd-13	-	16	nd	12
Chloride	14	4-65	250	250	15	52
Magnesium	16	3-22	-	26	14	24
Potassium	12	7-34	-	23	8	57
Sodium	24	.015-.05	-	41	41	167
Sulfate	117	100-200	250	250	135	164
E.C.	590	518-689	-	827	653	669
TDS	365	155-673	500	571	443	568
pH	8.0	7.5-9.4	-	6.5-8.6	6.9	7.6

*SDA: Stability Demonstration Average
M+2SD: Background Mean plus two standard deviations

Table 5.1.01

List of Chemical Parameters to be Sampled

A. Trace and Minor Elements

Arsenic
Boron
Iron
Manganese
Molybdenum
Radium-226
Selenium
Thorium-230
Uranium

B. Common Constituents

Bicarbonate
Calcium
Carbonate
Chloride
Magnesium
Potassium
Sodium
Sulfate

C. Physical Parameters

Specific Conductivity[1]
Temperature[2]
pH[1]
Total Dissolved Solids[3]
Appearance, color, odor[2]

[1]Field and laboratory determination.
[2]Field only.
[3]Laboratory only.

(From Table 15 (also see Table 5.1.1.01) of SFC's June 15, 1987 submittal.)

Table 5.2.01 - Operational Surface Radiological Environmental Monitoring Program

Type of Sample	Number	Location	Method	Frequency	Type of Analysis
Radon	3[3]	Upwind at site boundary*[3] Downwind at site boundary Pregnant leach tank*[3]	Continuous or Grab[1]	Monthly or Quarterly	Rn-222 (pCi/l)
Direct Gamma	4	At same locations used for air sampling and at	Survey meter or dosimeter	Quarterly	Gamma exposure rate (μR/hr)
Sediment/Soil	3	Outfall from final treatment unit 2 locations in drainageway between Outfall and Sage Creek	Grab sample	Quarterly	Ra-226 (pCi/g - dry weight)
Water	2	Outfall of final treatment unit*[4] Prior to mixture with dilutent water or receiving stream*[5]	Grab sample	Quarterly	Total Ra-226 and Total Th-230 (pCi/ml)

[1]A grab sample shall consist of at least four (4) separate forty-eight (48) hour samples using the "Tedlar Bag Method" during a period of one month.
[2]Although a monthly sampling frequency is recommended, a quarterly sampling frequency is acceptable where a continuous passive radon detector is used.
*[3]Radon monitoring at upwind and leach tank locations deleted by License Amendment No. 14 (November 21, 1985).
[4]Final treatment will be considered the treatment tanks, rather than the mine water treatment settling ponds.
[5]Sample will be prior to mixing with water from Bill Smith Mine or discharge into the water treatment settling ponds.

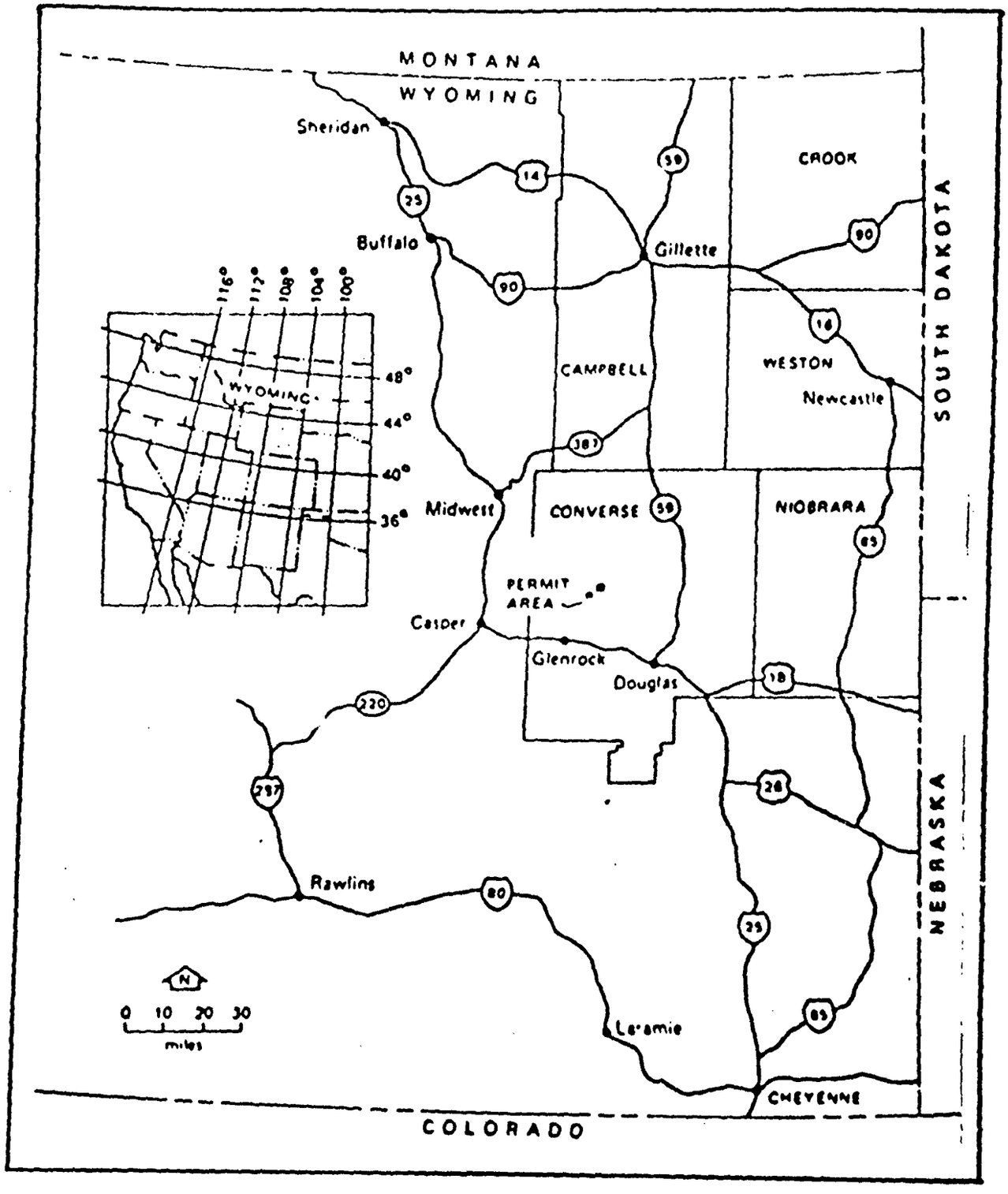

Figure 2.1.01 - Regional Location

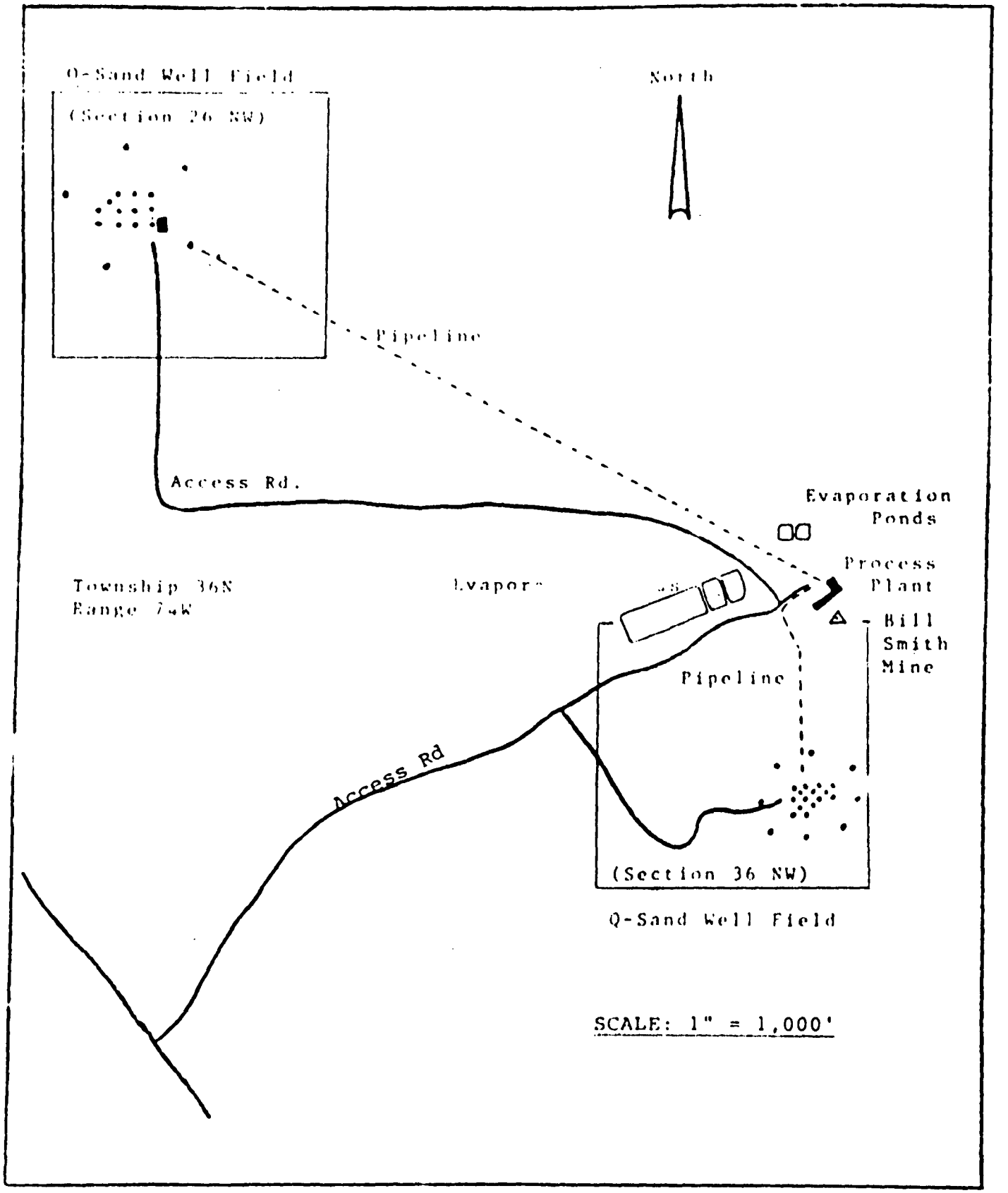

Figure 2.1.02 - Q-Sand/O-Sand Well Fields and Plant Locations.

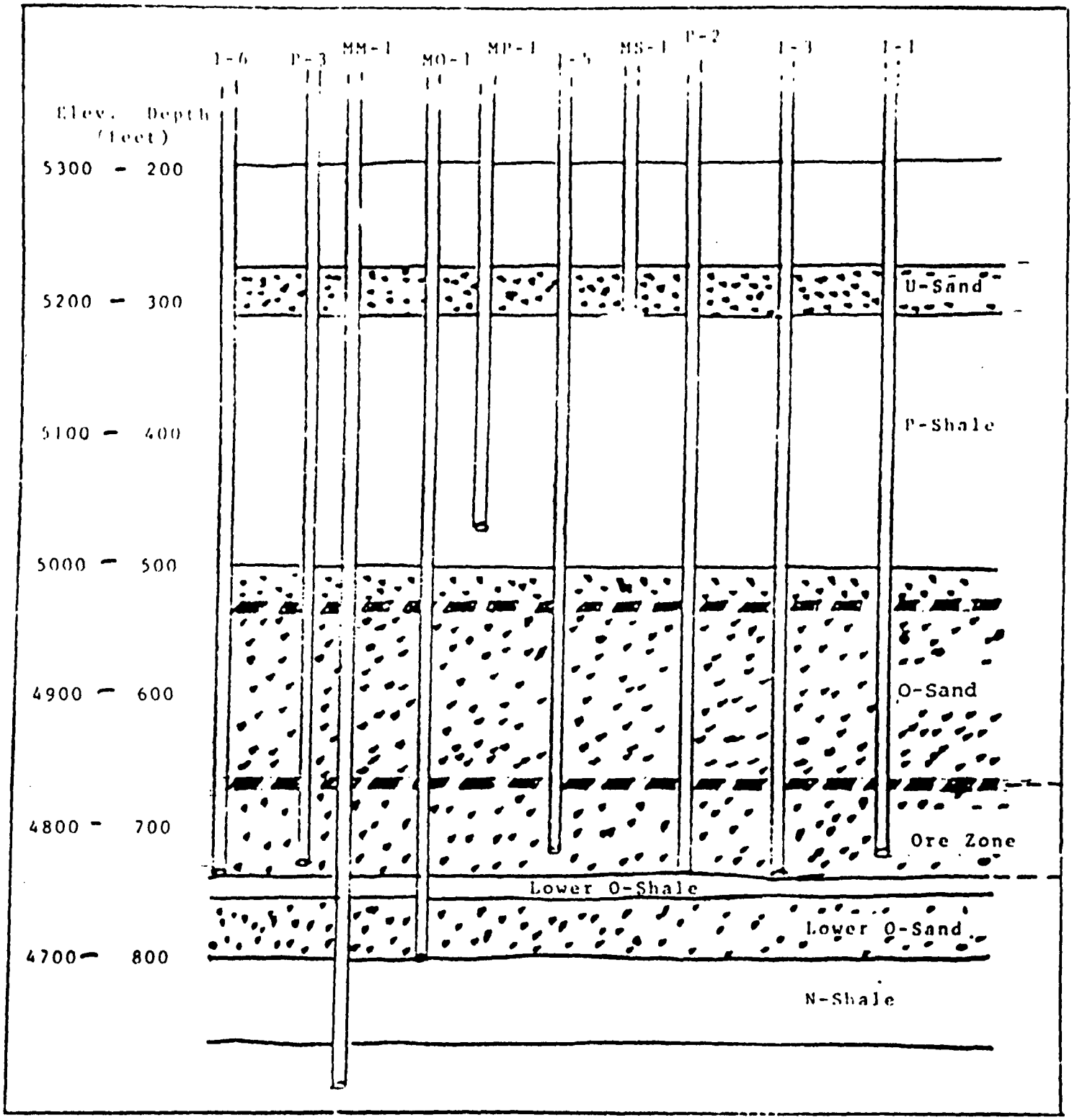

Figure 2.2.01 - Statigraphic Section of O-Sand Well Field Area.

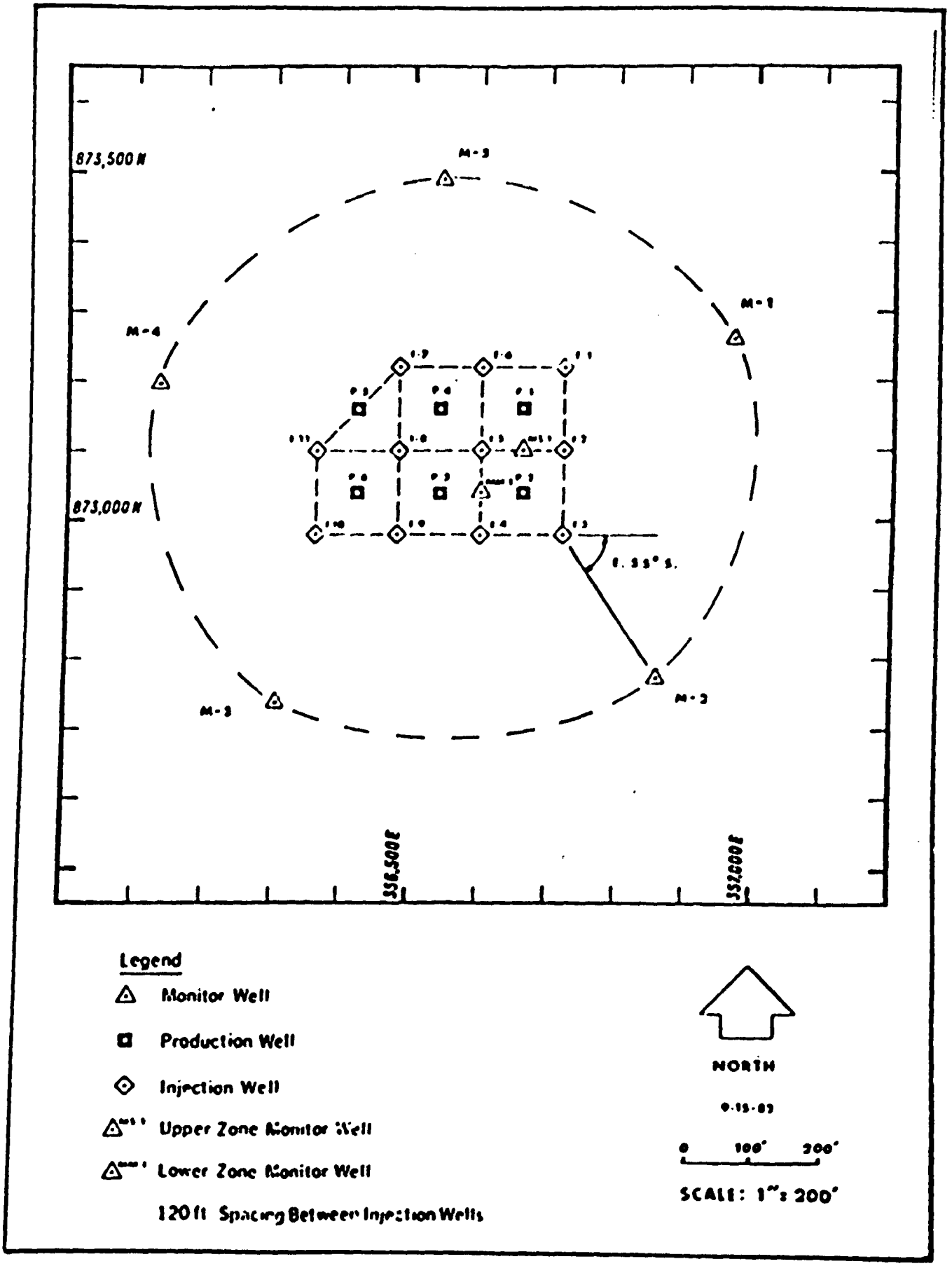

Figure 2.2.02 - O-Sand Well Field

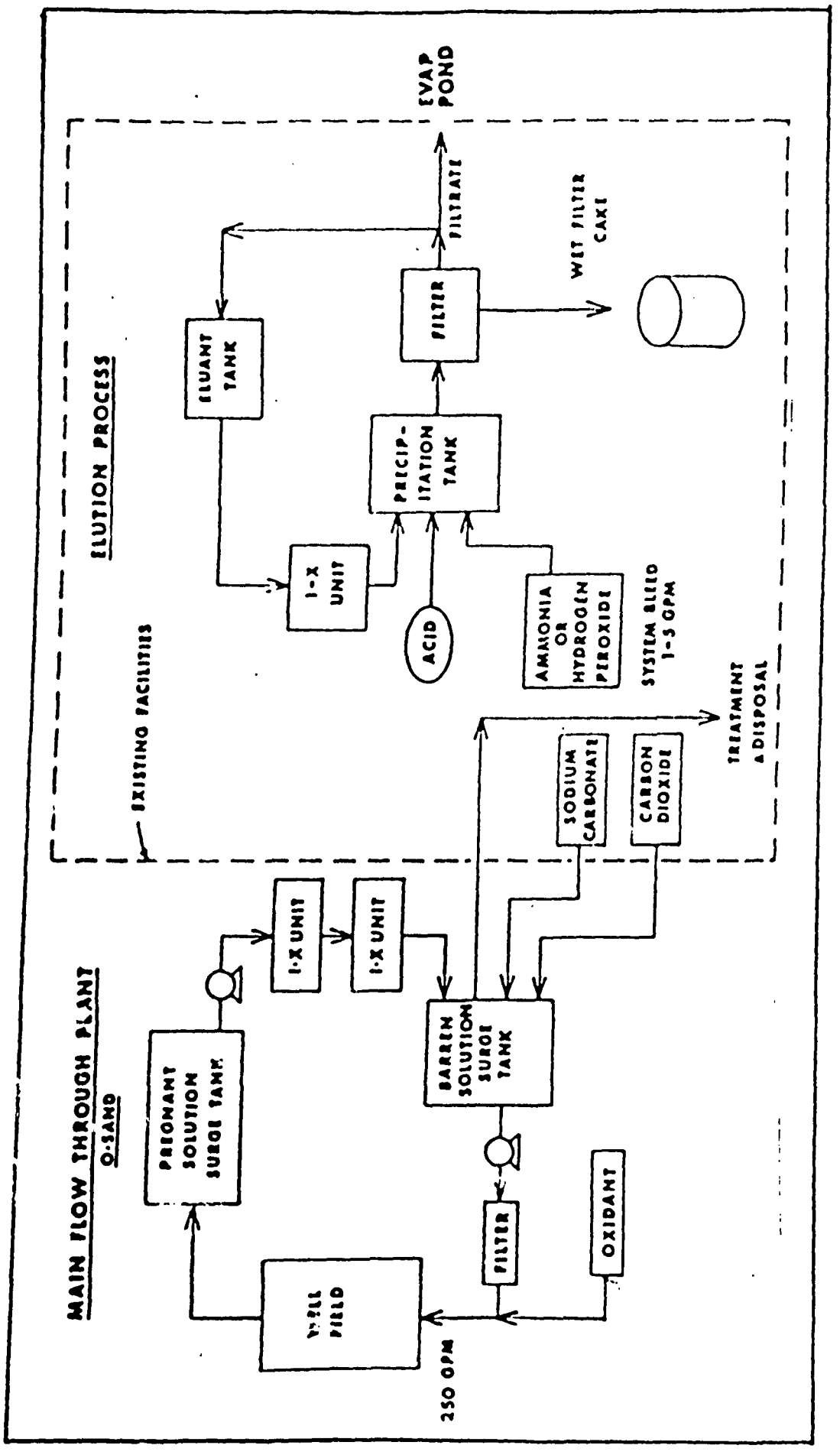

Figure 3.5.01 - Schematic Flow Diagram of Process Plant

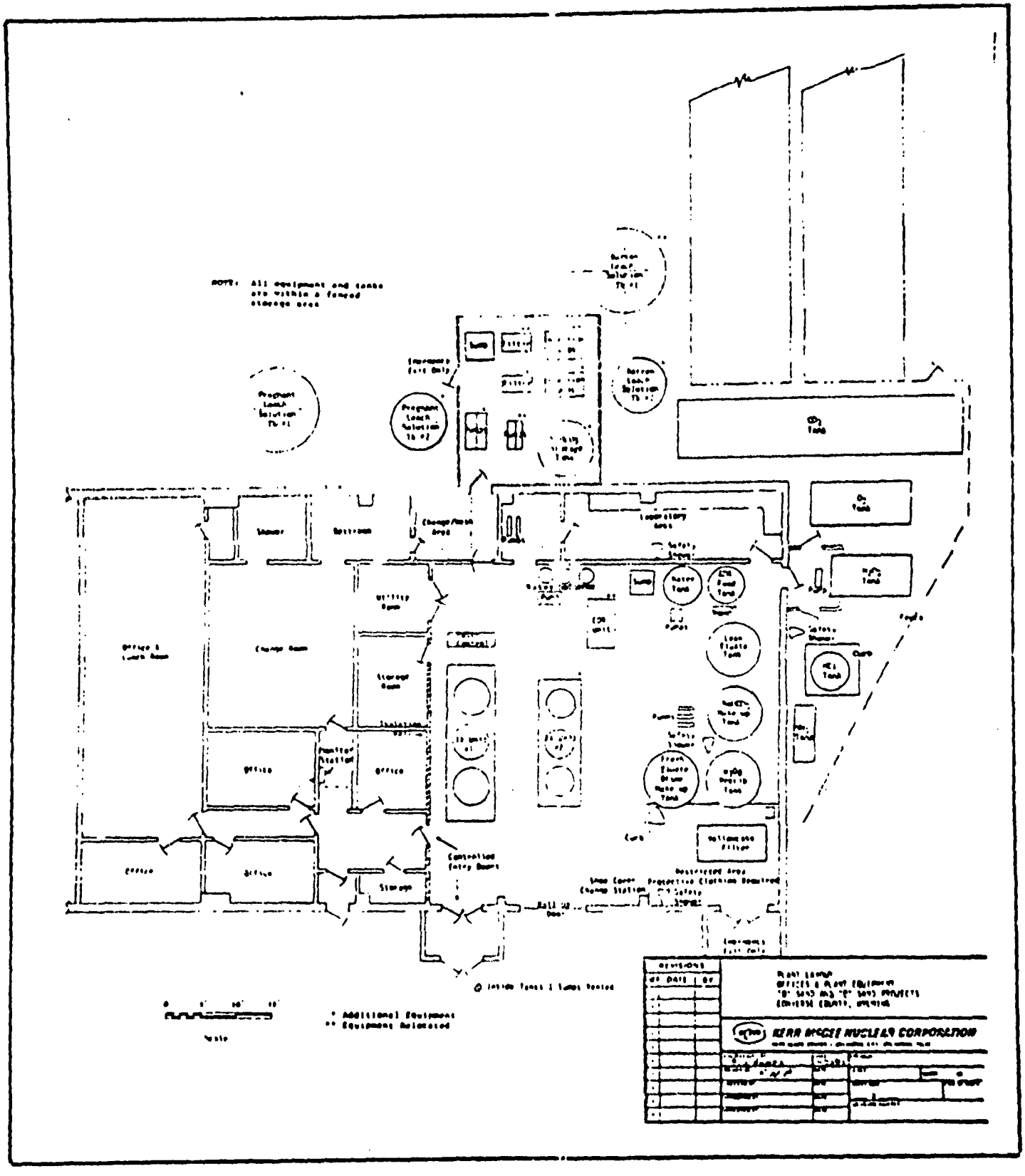

Figure 3.6.01 - Process Plant Plan

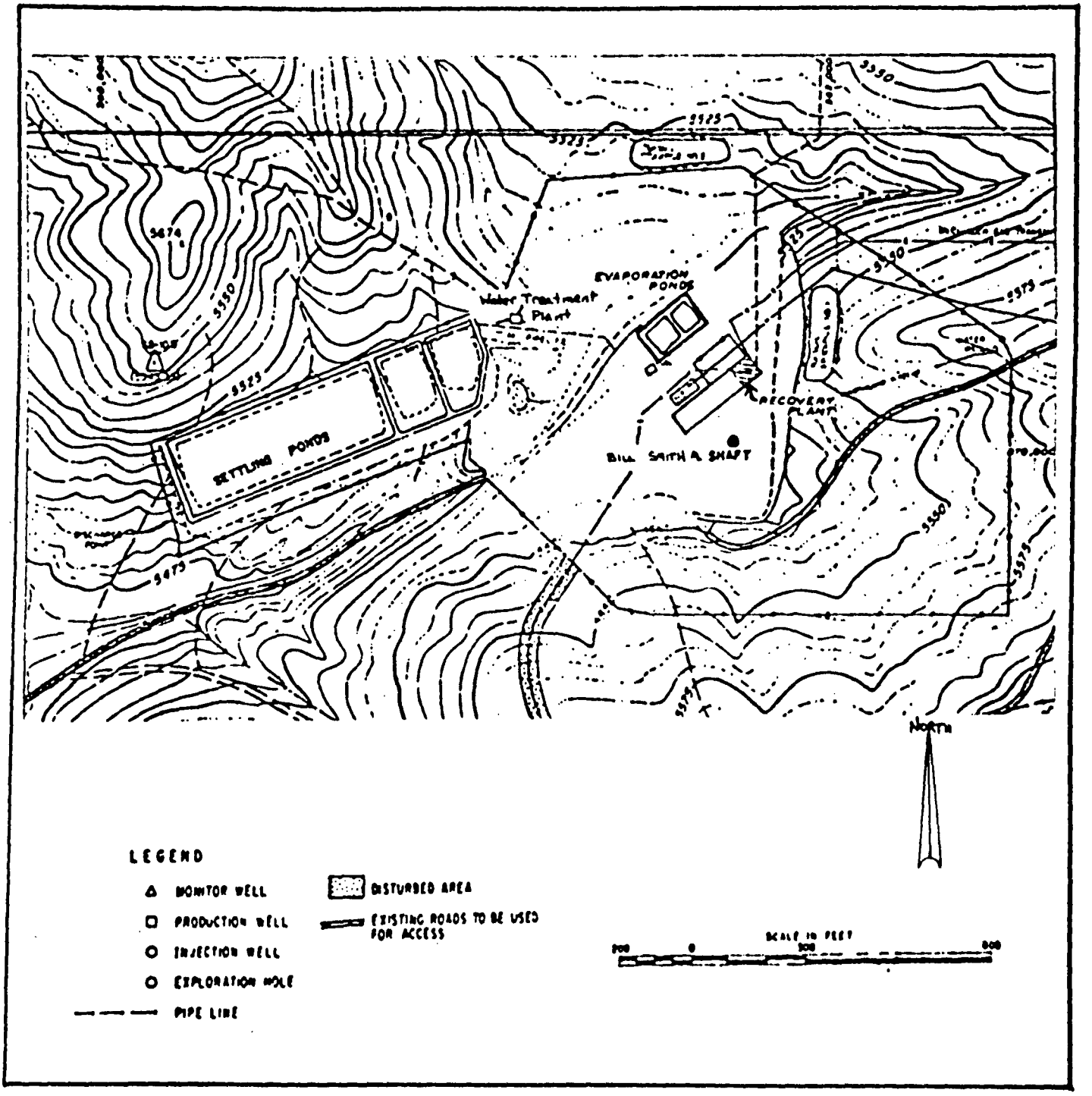

Figure 3.6.02 - Locations of Settling and Evaporation Ponds.