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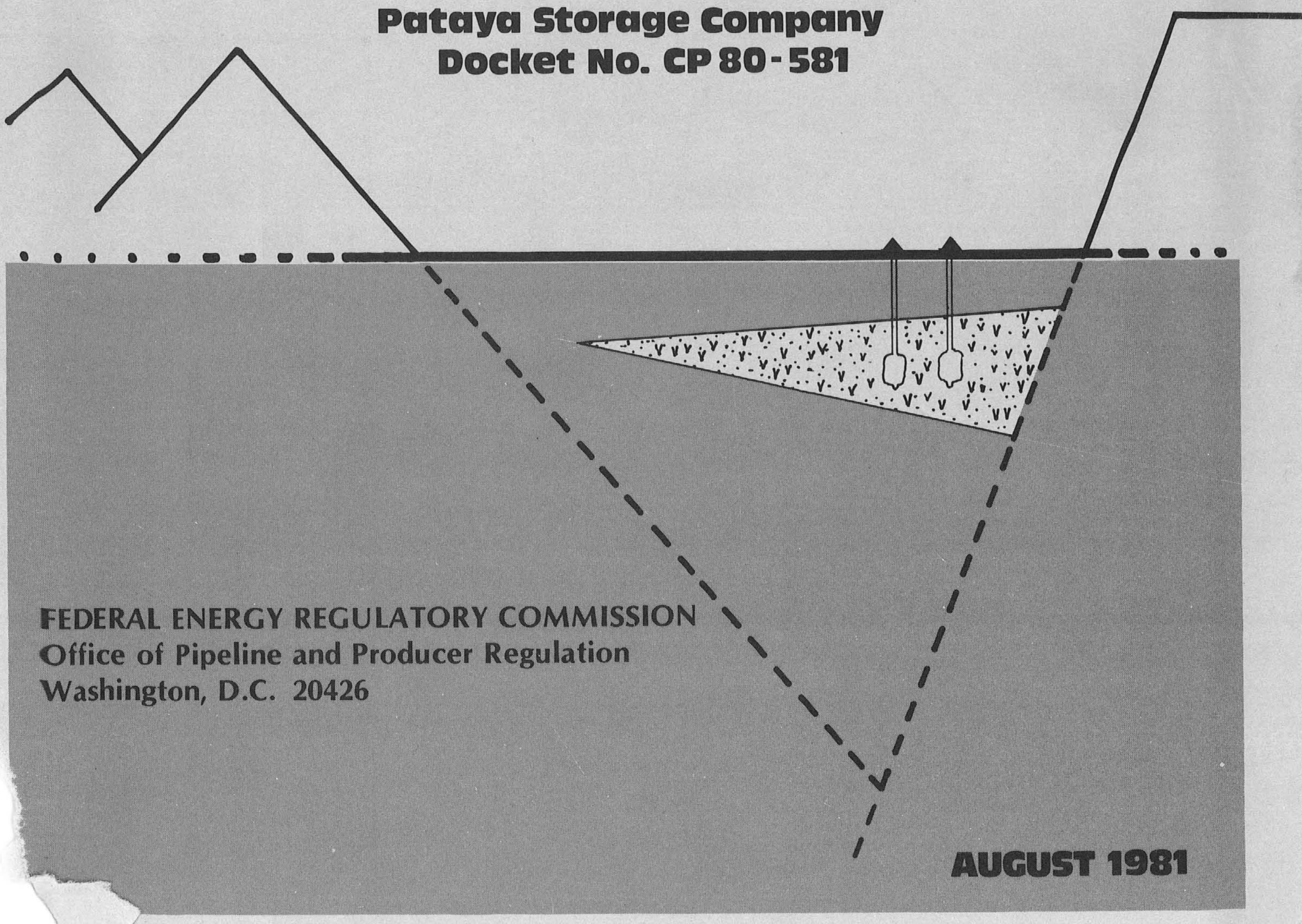
inquiries@azgs.az.gov

FERC/EIS-0028D

RED LAKE SALT CAVERN GAS STORAGE PROJECT

Draft Environmental Impact Statement

Pataya Storage Company
Docket No. CP 80-581



FEDERAL ENERGY REGULATORY COMMISSION
Office of Pipeline and Producer Regulation
Washington, D.C. 20426

AUGUST 1981

FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON 20426

IN REPLY REFER TO:

OPPR/DPC-EEB
Pataya Storage Company
Docket No. CP80-581

August 25, 1981

TO THE PARTY ADDRESSED:

Copies of the enclosed Draft Environmental Impact Statement (DEIS) for the Red Lake Salt Cavern Gas Storage Project are being transmitted pursuant to the requirements of the National Environmental Policy Act of 1969 and section 2.82(b) of Commission's Rules of Practice and Procedure (18 CFR 2.82). The final environmental impact statement (FEIS) will be one of the factors used by the Commission in determining whether the proposed project is in the public interest.

The DEIS analyzes the environmental effects of the proposed Red Lake Gas Storage System in Mohave County, Arizona, a gas storage field composed of two subsurface solution-mined salt cavities, 30 miles of 16-inch diameter gas pipeline, an onsite electric generator, 5,400 horsepower of compression, appurtenant site access roads, and brine evaporation ponds. The facility would be designed to store 3 billion cubic feet of usable natural gas and to transport that gas through the proposed and existing pipeline facilities to customers in Arizona and southern Nevada. The Department of the Interior, Bureau of Land Management, has permit authority over rights-of-way which cross Federal land and is a cooperating agency in preparing this DEIS.

The Commission staff requests public comment on the enclosed DEIS. These comments will be used in developing an FEIS and should be accompanied or clearly referenced with supporting data. Comments should be received no later than October 20, 1981. They should be mailed to the Secretary, Federal Energy Regulatory Commission, 825 North Capitol Street, N.E., Washington, D.C. 20426. All comments should reference Docket No. CP80-581.

Any person who desires to present evidence on environmental matters in this proceeding must file with the Commission a petition to intervene pursuant to section 1.8 of the Commission's Rules of Practice and Procedure (18 CFR 1.8).

Copies of the DEIS have been sent to the persons listed in the summary and all parties to the proceeding. The DEIS has also been placed in the public files of the Commission and is available for public inspection in the Commission's Office of Congressional and Public Affairs, located in Room 1000 of its Washington, D.C. offices, and at its regional office at 333 Market Street, 6th floor, San Francisco, California, 94105. Copies are available in limited quantities from the Commission's Office of Congressional and Public Affairs.

Very truly yours,

Kenneth F. Plumb

Secretary

Enclosure

August 1981

FERC/EIS-0028D

RED LAKE SALT CAVERN GAS STORAGE PROJECT

Draft Environmental Impact Statement

Pataya Storage Company
Docket No. CP80-581

This Draft Environmental Impact Statement (DEIS) analyzes the environmental effects of the proposed Red Lake Gas Storage System in Mohave County, Arizona, a gas storage field composed of two subsurface solution-mined salt cavities, 30 miles of 16-inch diameter gas pipeline, an onsite electric generator, 5,400 horsepower of compression, appurtenant site access roads, and brine evaporation ponds. The facility would be designed to store 3 billion cubic feet of usable natural gas and to transport that gas through the proposed and existing pipeline facilities to customers in Arizona and southern Nevada.

The Department of the Interior, Bureau of Land Management, has permit authority over rights-of-way which cross Federal land and is a cooperating agency in preparing this DEIS.

Comments on this DEIS must be received by **October 20, 1981**. Anyone desiring to file a petition to intervene with the Commission on the basis of this DEIS should do so in accordance with the requirements of the FERC's rules of Practice and Procedure, 18 CFR Part 1.8 and 1.10, by October 20, 1981.

For further information, contact:
Lonnie A. Lister, Project Manager
Federal Energy Regulatory Commission
825 North Capitol Street, N.E.
Washington, D.C. 20426
(202) 357-8870

Federal Energy Regulatory Commission
Office of Pipeline and Producer Regulation
Washington, D.C. 20426

FEDERAL POWER COMMISSION-ORDER 415-C
(Issued December 18, 1972)
STATEMENT OF GENERAL POLICY TO IMPLEMENT PROCEDURES FOR COMPLIANCE WITH THE NATIONAL ENVIRONMENTAL POLICY ACT OF 1969

§ 2.80 Detailed Environmental Statement.

(a) It shall be the general policy of the Federal Power Commission to adopt and to adhere to the objectives and aims of the National Environmental Policy Act of 1969 (Act) in its regulation under the Federal Power Act and the Natural Gas Act. The National Environmental Policy Act of 1969 requires, among other things, all Federal agencies to include a detailed environmental statement in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment.

(b) Therefore, in compliance with the National Environmental Policy Act of 1969 the Commission staff shall make a detailed environmental statement when the regulatory action taken by us under the Federal Power Act and Natural Gas Act will have a significant environmental impact. A "detailed statement" prepared in compliance with the requirements of §§ 2.81 through 2.82 of this Part shall fully develop the five factors listed hereinafter in the context of such considerations as the proposed activity's direct and indirect effect on the air and water environment of the project or natural gas pipeline facility; on the land, air, and water biota; on established park and recreational areas; and on sites of natural, historic, and scenic values and resources of the area. The statement shall discuss the extent of the conformity of the proposed activity with all applicable environmental standards. The statement shall also fully deal with alternative courses of action to the proposal and, to the maximum extent practicable, the environmental effects of each alternative. Further, it shall specifically discuss plans for future development related to the application under consideration.

The above factors are listed to merely illustrate the kinds of values that must be considered in the statement. In no respect is this listing to be construed as covering all relevant factors.

The five factors which must be specifically discussed in the detailed statement are:

(1) the environmental impact of the proposed action,

(2) any adverse environmental effects which cannot be avoided should the proposal be implemented;

(3) alternatives to the proposed action,

(4) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and

(5) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

(c) (i) To the maximum extent practicable no final administrative action is to be taken sooner than ninety days after a draft environmental statement has been circulated for comment or thirty days after the final text of an environmental statement has been made available to the Council on Environmental Quality and the public.

(c) (ii) Upon a finding that it is necessary and appropriate in the public interest, the Commission may dispense with any time period specified in §§ 2.80-2.82.

§ 2.81 Compliance with the National Environmental Policy Act of 1969 under Part I of the Federal Power Act

(a) All applications for major projects (those in excess of 2,000 horsepower) or for reservoirs only providing regulatory flows to downstream (major) hydroelectric projects under Part I of the Federal Power Act for license or relicense, shall be accompanied by Exhibit W, the applicant's detailed report of the environmental factors specified in § 2.80 and 4.41. All applications for surrender or amendment of a license proposing construction, or operating change of a project shall be accompanied by the applicant's detailed report of the environmental factors specified in § 2.80. Notice of all such applications shall continue to be made as prescribed by law.

(b) The staff shall make an initial review of the applicant's report and, if necessary, require applicant to correct deficiencies in the report. If the proposed action is determined to be a major Federal action significantly affecting the quality of the human environment, the staff shall conduct a detailed independent analysis of the action and prepare a draft environmental impact statement which shall be made available to the Council on Environmental Quality, the Environmental Protection Agency, other appropriate governmental bodies, and to the public, for comment. The statement shall also be served on all parties to the proceeding. The Secretary of the Federal Power Commission shall cause prompt publication in the Federal Register of notice of the availability of the staff's draft environmental statement. Written comments shall be made within 45 days of the date the notice of availability appears in the Federal Register. If any governmental entity, Federal, state, or local, or any member of the public, fails to comment within the time provided, it shall be assumed, absent a request for a specific extension of time, that such entity or person has no comment to make. Extensions of time shall be granted only for good cause shown. All entities filing comments with the Commission will submit ten copies of such comments to the Council on Environmental Quality. Upon expiration of the time for comment the staff shall consider all comments received and revise as necessary and finalize its environmental impact statement which, together with the comments received, shall accompany the proposal through the agency review and decision-making process and shall be made available to the parties to the proceeding, the Council on Environmental Quality, and the public. In the event the proposal is the subject of a hearing the staff's environmental statement will be placed in evidence at that hearing.

(c) Any person may file a petition to intervene on the basis of the staff draft environmental statement. All interveners taking a position on environmental matters shall file timely comments, in accordance with paragraph (b) of this section, on the draft statement with the Commission including, but not limited to, an analysis of their environmental position in the context of the factors enumerated in 2.80, and specifying any differences with staff's position upon which intervener wishes to be heard. Nothing herein shall preclude an intervener from filing a detailed environmental impact statement.

(d) In the case of each contested application, the applicant, staff, and all interveners taking a position on environmental matters shall offer evidence for the record in support of their environmental position. The applicant and all such interveners shall specify any differences with the staff's position, and shall include, among other relevant factors, a discussion of their position in the context of the factors enumerated in § 2.80.

(e) In the case of each contested application, the initial and reply briefs filed by the applicant, the staff and all interveners taking a position on environmental matters must specifically analyze and evaluate the evidence in the light of the environmental criteria enumerated in § 2.80. Furthermore, the Initial Decision of the Presiding Administrative Law Judge in such cases, and the final order of the Commission dealing with the application on the merits in all cases, shall include an evaluation of the environmental factors enumerated in § 2.80 and the views and comments expressed in conjunction therewith by the applicant and all those making formal comment pursuant to the provisions of this section.

§ 2.82 Compliance with the National Environmental Policy Act of 1969 Under the Natural Gas Act.

(a) All certificate applications filed under Section 7(c) of the Natural Gas Act (15 U.S.C. 717f(c)) for the construction of pipeline facilities, except abbreviated applications filed pursuant to Sections 157.7(b), (c) and (d) of Commission Regulations and producer applications for the sale of gas filed pursuant to Sections 157.23-29 of Commission Regulations, shall be accompanied by the applicant's detailed report of the environmental factors specified in § 2.80. Notice of all such applications shall continue to be made as prescribed by law.

(b) The staff shall make an initial review of the applicant's report and, if necessary, require applicant to correct deficiencies in the report. If the proposed action is determined to be a major Federal action significantly affecting the quality of the human environment, the staff shall conduct a detailed independent analysis of the action and prepare a draft environmental impact statement which shall be made available to the Council on Environmental Quality, the Environmental Protection Agency, other appropriate governmental bodies, and to the public, for comment. The statement shall also be served on all parties to the proceeding. The Secretary of the Federal Power Commission shall cause prompt publication in the Federal Register of notice of the availability of the staff's draft environmental statement. Written comments shall be made within 45 days of the date the notice of availability appears in the Federal Register. If any governmental entity, Federal, state, or local, or any member of the public, fails to comment within the time provided, it shall be assumed, absent a request for a specific extension of time, that such entity or person has no comment to make. Extensions of time shall be granted only for good cause shown. All entities filing comments with the Commission shall submit ten copies of such comments to the Council on Environmental Quality. Upon expiration of the time for comment the staff shall consider all comments received and revise as necessary and finalize its environmental impact statement which, together with the comments received, shall accompany the proposal through the agency review and decision-making process and shall be made available to the parties to the proceeding, the Council on Environmental Quality, and the public. In the event the proposal is the subject of a hearing, the staff's environmental statement will be placed in evidence at that hearing.

(c) Any person may file a petition to intervene on the basis of the staff draft environmental statement. All interveners taking a position on environmental matters shall file timely comments, in accordance with paragraph (b) of this section, on the draft statement with the Commission including, but not limited to, an analysis of their environmental position in the context of the factors enumerated in § 2.80, and specifying any differences with staff's position upon which intervener wishes to be heard. Nothing herein shall preclude an intervener from filing a detailed environmental impact statement.

(d) In the case of each contested application, the applicant, staff, and all interveners taking a position on environmental matters shall offer evidence for the record in support of their environmental position. The applicant and all such interveners shall specify any differences with the staff's position, and shall include, among other relevant factors, a discussion of their position in the context of the factors enumerated in §2.80.

(e) In the case of each contested application, the initial and reply briefs filed by the applicant, the staff, and all interveners taking a position on environmental matters must specifically analyze and evaluate the evidence in the light of the environmental criteria enumerated in § 2.80. Furthermore, the Initial Decision of the Presiding Administrative Law Judge in such cases, and the final order of the Commission dealing with the application on the merits in all cases, shall include an evaluation of the environmental factors enumerated in § 2.80 and the views and comments expressed in conjunction therewith by the applicant and all those making formal comment pursuant to the provisions of this section.

FEDERAL POWER COMMISSION

RULES OF PRACTICE AND PROCEDURE

18 CFR 1.8 Intervention

"(a) Initiation of intervention. Participation in a proceeding as an intervener may be initiated as follows:

(1) By the filing of a notice of intervention by a State Commission, including any regulatory body of the State or municipality having jurisdiction to regulate rates and charges for the sale of electric energy, or natural gas, as the case may be, to consumers within the intervening State or municipality.

(2) By order of the Commission upon petition to intervene.

(b) Who may petition. A petition to intervene may be filed by any person claiming a right to intervene or an interest of such nature that intervention is necessary or appropriate to the administration of the statute under which the proceeding is brought. Such right or interest may be:

(1) A right conferred by statute of the United States;

(2) An interest which may be directly affected and which is not adequately represented by existing parties and as to which petitioners may be bound by the Commission's action in the proceeding (the following may have such an interest; consumers served by the applicant, defendant, or respondent; holders of securities of the applicant, defendant, or respondent; and competitors of the applicant, defendant, or respondent).

(3) Any other interest of such nature that petitioner's participation may be in the public interest.

(c) Form and contents of petitions. Petitions to intervene shall set out clearly and concisely the facts from which the nature of the petitioner's alleged right-or interest can be determined, the grounds of the proposed intervention, and the position of the petitioner in the proceeding, so as fully and completely to advise the parties and the Commission as to the specific issues of fact or law to be raised or controverted, by admitting, denying or otherwise answering specifically and in detail, each material allegation of fact or law asserted in the proceeding, and citing by appropriate reference the statutory provisions or other authority relied on: Provided, that where the purpose of the proposed intervention is to obtain an allocation of natural gas for sale and distribution by a person or municipality engaged or legally authorized to engage in the local distribution of natural or artificial gas to the public, the petition shall comply with the requirements of Part 156 of this chapter (i.e., Regulations Under the Natural Gas Act). Such petitions shall in other respects comply with the requirements of §§1.15 to 1.17, inclusive.

(d) Filing and service of petitions. Petitions to intervene and notices of intervention may be filed at any time following the filing of a notice of rate or tariff change, or of an application, petition, complaint, or other document seeking Commission action, but in no event later than the date fixed for the filing of petitions to intervene in any order or notice with respect to the proceedings issued by the Commission or its Secretary, unless, in extraordinary circumstances for good cause shown, the Commission authorizes a late filing. Service shall be made as provided in §1.17. Where a person has been permitted to intervene notwithstanding his failure to file his petition within the time prescribed in this paragraph, the Commission or officer designated to preside may where the circumstances warrant, permit the waiver of the requirements of §1.26(c)(5) with respect to copies of exhibits for such intervener.

(e) Answers to petitions. Any party to the proceeding or staff counsel may file an answer to a petition to intervene, and in default thereof, may be deemed to have waived any objection to the granting of such petition. If made, answers shall be filed within 10 days after the date of service of the petition, but not later than 5 days prior to the date set for the commencement of the hearing, if any, unless for cause the Commission with or without motion shall perscribe a different time. They shall in all other respects conform to the requirements of §§1.15 to 1.17, inclusive.

(f) Notice and action on petitions

(1) Notice and service. Petitions to intervene, when tendered to the Commission for filing, shall show service thereof upon all participants to the proceeding in conformity with §1.17(b).

(2) Action on petitions. As soon as practicable after the expiration of the time for filing answers to such petitions or default thereof, as provided in paragraph (e) of this section, the Commission will grant or deny such petition in whole or in part or may, if found to be appropriate, authorize limited participation. No petitions to intervene may be filed or will be acted upon during a hearing unless permitted by the Commission after opportunity for all parties to object thereto. Only to avoid detriment to the public interest will any presiding officer tentatively permit participation in a hearing in advance of, and then only subject to, the granting by the Commission of a petition to intervene.

(g) Limitation in hearings. Where there are two or more interveners having substantially like interests and positions, the Commission or presiding officer may, in order to expedite the hearing, arrange appropriate limitations on the number of attorneys who will be permitted to cross-examine and make and argue motions and objections on behalf of such interveners."

SUMMARY

1. This draft environmental impact statement (DEIS), prepared by the staff of the Federal Energy Regulatory Commission, is related to an administrative action.

2. This administrative action arises from an application filed by Pataya Storage Company in Docket No. CP80-581 for a certificate of public convenience and necessity authorizing, pursuant to section 7(c) of the Natural Gas Act, the construction and operation of a natural gas storage plant near Red Lake in Mohave County, Arizona. Facilities would include two subsurface solution mined salt cavities, 30 miles of 16-inch diameter gas pipeline, an onsite electric generator, 5,400 horsepower of compression, appurtenant site access roads, and brine evaporation ponds.

3. The DEIS assesses the environmental impact of the proposed project, a recommended modification of the proposed design, and the feasibility of various other alternatives. The environmental staff has examined the potential effects on soils, geology, water, land use, recreation, aesthetic qualities, air quality, noise levels, vegetation, wildlife, cultural resources, and socioeconomic conditions.

4. The environmental staff concludes that: (1) further field investigation and soil testing is necessary to assess the feasibility of the evaporation pond scheme and to establish design constraints for pond construction; (2) the field investigation program should be presented to and discussed with the environmental staff before its implementation; (3) if evaporation ponds prove to be feasible, a single evaporation pond (as detailed in section 2B2) or a comparable alternative is preferable to the proposed system.

In general, the construction and operation of the proposed project would have limited adverse environmental impact. However, the feasibility of constructing the proposed evaporation pond system without posing an undue threat to the area's groundwater reserves has yet to be proven. Therefore, the environmental staff further concludes that it cannot complete its environmental analysis of this project until further investigations are conducted.

5. The staff recommends implementation of several mitigating measures as conditions to the certificate, should the Commission approve the project.

6. Before construction of the facilities can begin, the applicant must acquire permits from the U.S. Department of the Interior and the U.S. Environmental Protection Agency. State and local agencies must also issue permits before construction may take place in specific areas.

7. Comments on this DEIS are to be filed with the Secretary, Federal Energy Regulatory Commission, 825 North Capitol Street, N.E., Washington, D.C. 20426, no later than October 20, 1981. All comments should reference Docket No. CP80-581.

8. Copies of this DEIS are being made available to the public and to all parties in this proceeding, and to the following on or about August 25, 1981.

FEDERAL

Advisory Council on Historic Preservation
Council on Environmental Quality
Department of Agriculture
Department of Commerce
Department of Defense
Department of Energy
Department of Health and Human Services
Department of Housing and Urban Development
Department of the Interior
Department of Labor
Department of State
Department of Transportation
Environmental Protection Agency
Federal Trade Commission
Representative Robert Stump
Senator Barry Goldwater
Senator Dennis DeConcini

ARIZONA

Agriculture and Horticulture Department
Arizonans for Jobs and Energy
Atomic Energy Commission
Center for Public Affairs
Corporation Commission
Department of Health Services
Department of Transportation

Game and Fish Department
Labor Department
Land Department
Mineral Resources Department
Natural Heritage Program
Office of Economic Planning and Development
Office of the State Mine Inspector
Oil and Gas Conservation Commission
Power Authority
State Clearinghouse
State Museum
State Parks Board
Water Commission

NEVADA

Public Service Commission

LOCAL AGENCIES AND GROUPS

City of Kingman
District IV Council of Governments
Dolan Springs Chamber of Commerce
Kingman Fire Department
Mohave County Board of Supervisors
Mohave County Extension Service
Mohave County Planning and Zoning Commission
Mohave Livestock Association

SPECIAL INTEREST GROUPS

American Conservation Association, Inc.
American Gas Association
American Petroleum Institute
American Scenic and Historic Preservation Society
Arizona Geological Society
Conservation and Resource Foundation, Inc.
Conservation Foundation
Environmental Action
Environmental Defense Fund
Environmental Law Institute
Environmental Policy Center
Friends of the Earth
National Association of Conservation Districts
National Audubon Society
National Wildlife Federation
Natural Resources Council of America

Natural Resources Defense Council, Inc.
North American Landsailing Association
North American Wildlife Foundation
Sierra Club
The Nature Conservancy
The Wilderness Society

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ABBREVIATIONS AND ACRONYMS

BACT--best available control technology

Bcf--billion cubic feet

BLM--Bureau of Land Management

Btu--British thermal unit

cfd--cubic feet per day

cfs--cubic feet per second

CP National--CP National Corporation

CWC--Carson Water Company

dB(A)--decibels on the A-weighted scale

DOT--U.S. Department of Transportation

EIS--environmental impact statement

El Paso--El Paso Natural Gas Company

EPA--U.S. Environmental Protection Agency

ESD--emergency shutdown

FERC--Federal Energy Regulatory Commission

FWS--Fish and Wildlife Service

gpm--gallons per minute

GSL--Great Salt Lake Minerals and Chemicals Corporation

Kermac--Kerr-McGee Corporation

kV--kilovolts

L_{dn}--day-night sound level

L_{eq}--average sound level equivalent

LMA--labor market area

LNG--liquefied natural gas

LPG--liquefied petroleum gas

μg--microgram

$\mu g/m^3$--micrograms per cubic meter

mg/l--milligrams per liter

mg/m^3--milligrams per cubic meter

MP--milepost

NAAQS--National Ambient Air Quality Standards

NALSA--North American Landsailing Association

NO_2--nitrogen dioxide

Northwest--Northwest Pipeline Corporation

Pataya--Pataya Storage Company

ppm--parts per million

PSD--prevention of significant air quality deterioration

psia--pounds per square inch absolute

Sierra Pacific--Sierra Pacific Power Company

SO_2--sulfur dioxide

Southwest--Southwest Gas Corporation

Southwest Salt--Southwest Salt Company

Stauffer--Stauffer Chemical Company

TSP--total suspended particulates

USDA--U.S. Department of Agriculture

CHAPTER ONE
PURPOSE AND NEED FOR ACTION

The Pataya Storage Company (Pataya) a wholly owned subsidiary of Southwest Gas Corporation (Southwest) has filed an application before the Federal Energy Regulatory Commission (FERC) for a certificate of public convenience and necessity pursuant to section 7(c) of the Natural Gas Act. If approved, Pataya would construct and operate an underground natural gas storage facility in the vicinity of Red Lake, Mohave County, Arizona. Figure 1 shows the location of the proposed facility. The total estimated cost of the proposal would be $43 million.

The U.S. Department of the Interior, Bureau of Land Management (BLM), which has permit authority over rights-of-way that cross Federal lands, is a cooperating agency in this project. (Affected Federal lands are shown in figure 24.) BLM is currently preparing an independent impact assessment of the proposed pipeline route; relevant portions will be incorporated in the final environmental impact statement (EIS).

Using two solution-mined subsurface caverns within a previously identified halite (salt) deposit beneath Hualapai Valley, Pataya would store natural gas under pressure during periods of low demand and deliver it to customers during periods of high demand. In addition, Pataya requests authorization to provide Southwest with up to 100 million cubic feet per day (cfd) of natural natural gas and a total of 3 billion cubic feet (Bcf) annually. Southwest purchases, transmits, and distributes natural gas in Nevada, Arizona, and California. Its service area includes most of the populated areas of Nevada, sections of southern, central, and northwestern Arizona, and portions of California, including Lake Tahoe and the high desert and mountain areas in San Bernardino County.

In northern Nevada and northern California, Southwest provides gas directly to 36,000 customers and offers wholesale gas service to the Sierra Pacific Power Company (Sierra Pacific), which distributes natural gas in Reno and Sparks and the surrounding area, and to CP National Corporation (CP National), which distributes natural gas in portions of Eldorado County, California, at the southern end of Lake Tahoe. Sierra Pacific and CP National provide service to 62,000 customers in Nevada and California. Southwest distributes gas directly to 82,000 customers in Las Vegas and surrounding communities and wholesales gas to CP National to serve an additional 45,000 customers in Henderson, Nevada. In southern California, Southwest distributes gas to approximately 40,000 customers.

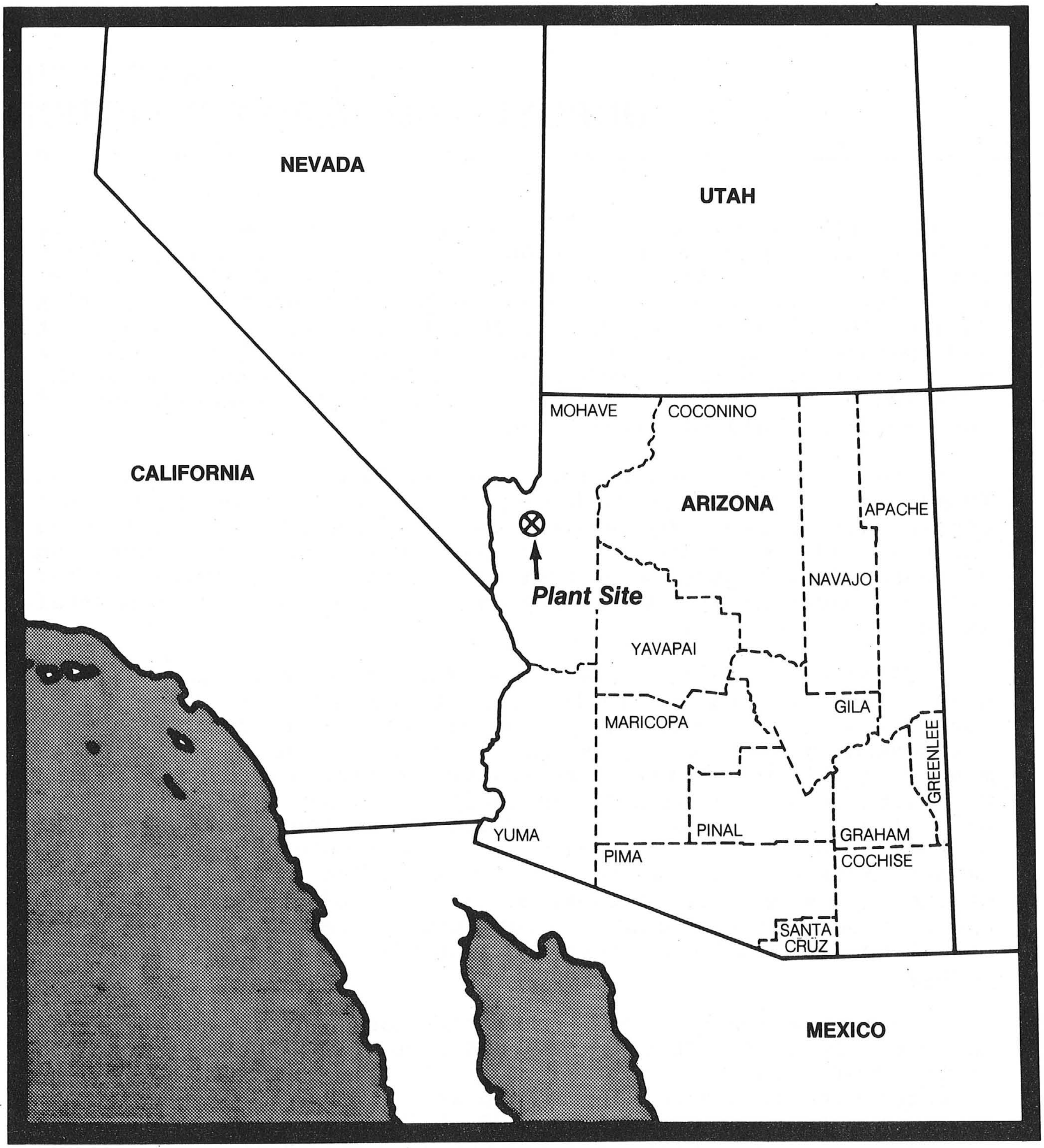

Figure 1
Location of Proposed Project

Southwest previously supplied natural gas to 23,000 customers in Gila, Pinal, Greenlee, and Mohave Counties in Arizona. On April 1, 1979, Southwest acquired all of the gas utility assets of the Tucson Electric Power Company and expanded its service areas in Arizona to include Tucson, South Tucson, and certain unincorporated areas in Pima and Pinal Counties. Southwest presently distributes gas to 167,000 customers in Arizona.

Southwest currently purchases its base supply for its Arizona and southern Nevada systems from El Paso Natural Gas Company (El Paso). Southwest's southern California gas requirements are purchased from the Pacific Gas and Electric Company, and gas for the company's northern Nevada and California systems is purchased from the Northwest Pipeline Corporation (Northwest).

Since 1973, Southwest has been forced to curtail gas deliveries to its low priority industrial and powerplant customers which receive their base supply from El Paso because insufficient gas is available from El Paso during certain periods of high demand. El Paso's long-range gas supply forecasts indicate continued and increasing curtailments of Southwest's industrial and powerplant customers. These forecasts also project curtailment of Southwest's high priority residential and commercial customers as early as 1987.

Since 1975, Southwest has been developing supplemental sources of gas supply for its service areas in Arizona and southern Nevada to maintain high levels of service to its industrial and powerplant customers and to protect the continued growth of its residential and commercial customers. Southwest can purchase supplemental natural gas for Arizona and southern Nevada at the wellhead, from independent producers in Utah, Colorado, and New Mexico, from intrastate suppliers, from Canadian gas supplied by Northwest, and through specific seasonal contract purchases. In addition, Southwest may purchase gas from its Northern Nevada Division, which is currently constructing a liquefied natural gas (LNG) peak-shaving facility near Lovelock, Nevada. This facility was authorized by the Commission in Docket No. CP78-221.

The proposed storage facilities would help provide a dependable, year-round natural gas supply for Southwest's customers in Arizona and southern Nevada. The storage facility could also supply gas to Southwest's northern system by transporting gas through El Paso's pipeline to a connection with Northwest's system at Ignacio, Colorado. The volumes of gas contracted to Southwest exceed the requirements of its customer demands during low demand periods of the year. The excess volumes are presently sold so that Southwest can maintain a high load-factor. Southwest now proposes to store these volumes in the Pataya facility for use during high demand periods. The proposed storage facilities would therefore be used to eliminate possible gas curtailments of high priority customers during high demand or gas shortage. Additionally, when Southwest is able to supply all the needs of its high priority customers, the proposed storage volumes would be used to supply the lower priority (industrial and powerplant requirements of its customers.

As with other major projects, the need for the proposed facilities, market for the gas supply, gas supply issues, and other matters related to the public convenience and necessity are being fully examined by other technical staff of the FERC and may be the subject of formal FERC evidentiary hearings. Under section 7(c) of the Natural Gas Act and its implementing regulations, the FERC has sole responsibility for determining that interstate gas facilities are in the public interest. If the FERC determines that there is or will be a need for a proposed service, it will issue a certificate of public convenience and necessity that authorizes the Red Lake Gas Storage Project. Until the FERC makes a decision based on a fully developed record, which includes consideration of the environmental impact of the proposal, as required by the National Environmental Policy Act of 1969, the need for the proposed project has not been established.

CHAPTER TWO
PROPOSED ACTION AND ALTERNATIVES

A. PROPOSED FACILITIES

The proposed plant would be approximately 30 miles north of Kingman, Arizona, on the relatively flat surface of Hualapai Valley, an intermontane alluvial basin bounded by the Cerbat Mountains to the west and the Grand Wash Cliffs of the Colorado Plateau to the east. The facilities, shown in figure 2, would include two storage caverns, brine evaporation ponds, 30 miles of 16-inch diameter pipeline, a 5,400-horsepower compressor station, and an electric power generator of unspecified output. 1/ The storage system is designed for an injection rate of 50 million cfd and withdrawal of 100 million cfd. The cavern site and compressor station, shown in figure 3, would occupy approximately 20 acres. However, with the proposed evaporation ponds, soil, borrow areas, and pipeline right-of-way, approximately 2,220 acres would be affected.

1. Construction

a) Subsurface Cavern System

Pataya proposes to construct two caverns with diameters of approximately 150 feet and usable heights of 1,000 feet by leaching--circulating fresh water through a well bore, thereby dissolving a chamber in the salt. The total combined active cavern volume would equal 23 million cubic feet.

The presently proposed cavern design is based on calculations using a two-dimensional model for solution mining simulation. This

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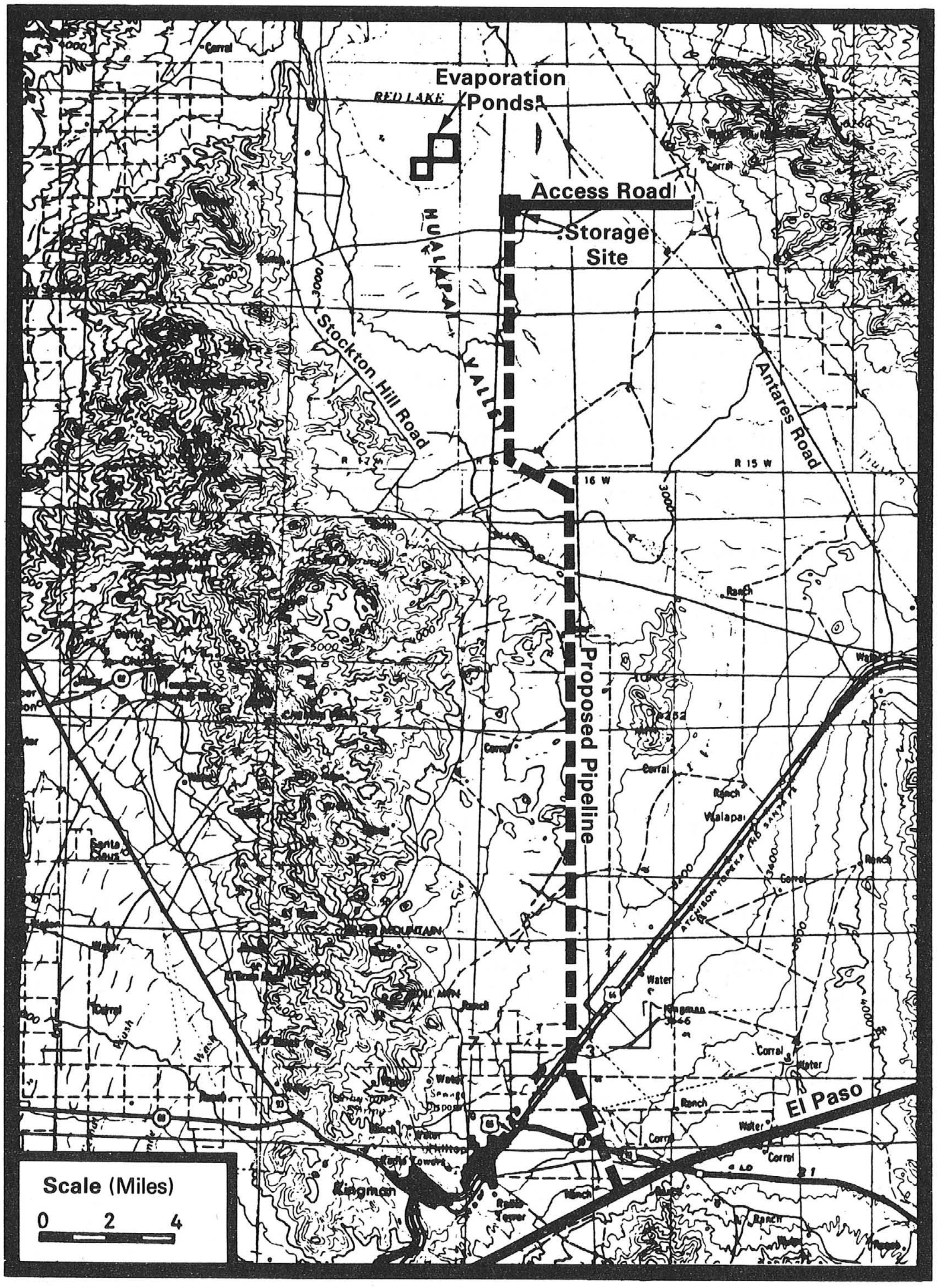
1/ Originally, a 26-mile long electric transmission line was proposed. Although the application has not been amended, it is the staff's understanding that onsite power generation would now be used. The staff's assumptions on the sizing of the onsite generator and potential air quality impact are discussed in section 4A of this EIS.



Adapted from U.S. Geological Survey Topographic Maps, Kingman and Williams Sheets. Scale 1:250,000.

Figure 2
Proposed Facilities

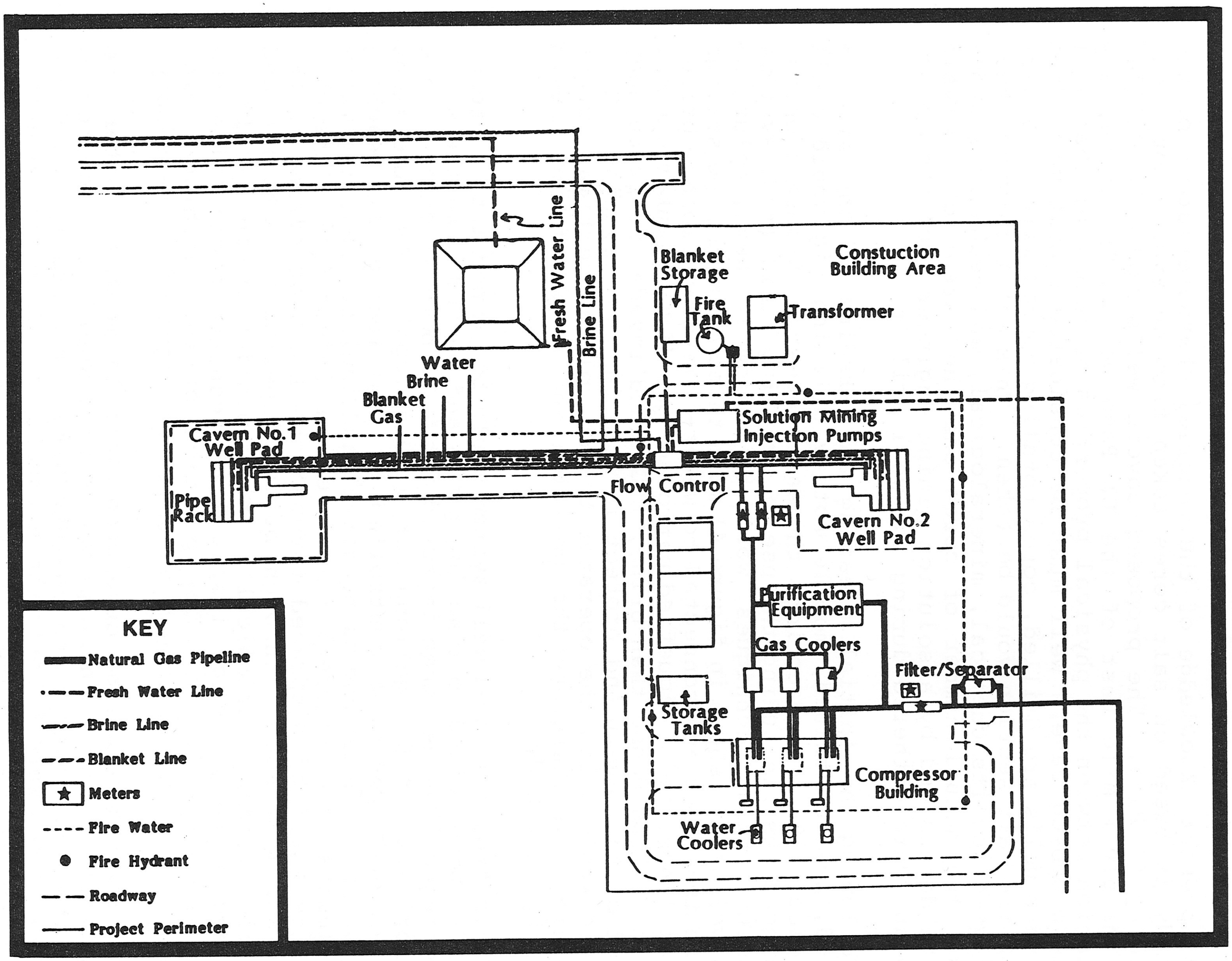


Figure 3

Plot Plan of Proposed Cavern Site

model was developed in 1976 by the Solution Mining Research Institute of Woodstock, Illinois, and has been successfully used in other cavern projects. However, the final design of the storage caverns and leaching methods to be used would depend on the structural, mechanical, and chemical characteristics of the salt.

At present, knowledge of the material characteristics of the salt body is based on salt cores taken from an exploratory well drilled by El Paso. The proposed cavern wells would be drilled approximately 1 mile west of the El Paso well. Therefore, any correlation between the physical properties of salt from that well and the proposed cavern well must be considered tentative. When the cavern wells are drilled, cores totaling approximately 10 percent of the salt section would be taken. This material would then be analyzed for its chemical, mineralogical, and mechanical properties. The actual number of cores and the extent of analysis would be determined by a solution mining engineer from the information and data gathered during the well drilling.

Following the initial clearing and grading of the site, a standard, self-contained, mobile rotary drilling rig would drill bore holes 5,300 feet deep into the salt deposit. Standard operating procedures, including the use of drilling fluid (mud) systems and casing setting techniques, would be followed. Next, solution-mining wellheads (shown in figure 4) with three coaxial pipe strings would be installed and connected to water-injection piping, brine-disposal lines, and a liquefied petroleum gas (LPG) blanket system. Since it is less dense than brine, LPG would invade the space near the roof of the cavern and protect it from further leaching. This procedure would allow the operator to control the vertical extent of leaching and therefore the position and shape of the cavern within the salt body.

Water from the local well system would be pumped into a fresh-water feed pond, piped to leaching pumps and pumped down the solution-mining wellheads, then injected into the bore space at a rate of approximately 1,500 gallons per minute (gpm). The dimensions of the caverns would be controlled by positioning the leaching tubing and LPG blanket and using direct and indirect leaching methods, illustrated in figure 5. As water was injected into the cavern, brine would be displaced through the leaching string to the surface and transported through buried pipeline to settling and evaporation ponds. Periodically, the solution mining would be halted and a sonar device inserted to accurately determine the dimensions of the cavern. The position of the leaching tubing and direction of water injection would be adjusted as necessary.

The caverns would be developed over 14 months. After the final phase of development, a pressure test would be conducted to confirm that the caverns and casings were structurally sound before the caverns were filled with natural gas. Then the solution-mining wellhead would be modified to allow for gas injection. (See figure 4 for an illustration of the storage wellhead.)

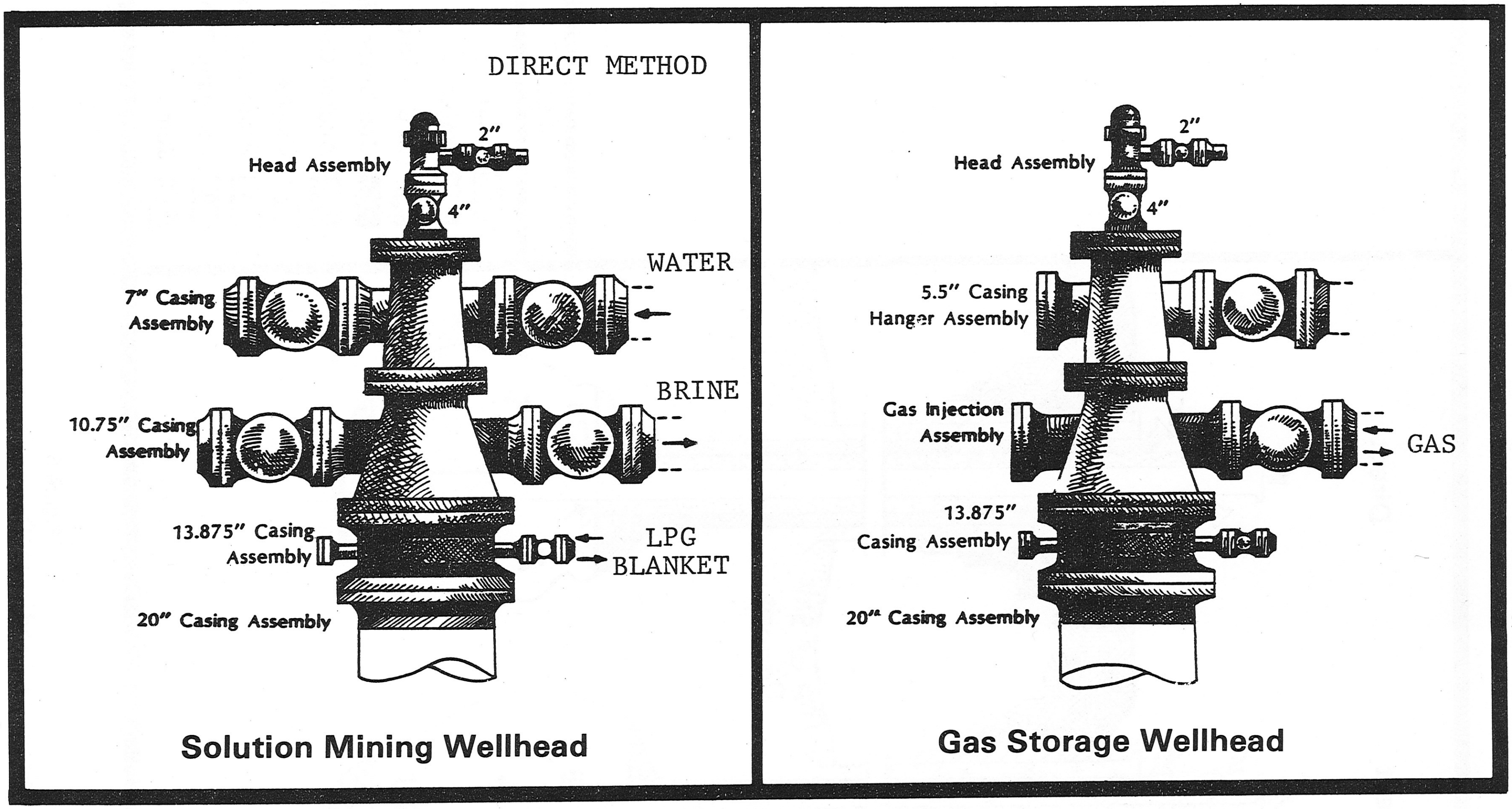


Figure 4

Wellheads to Construct and Operate Natural Gas Storage Facilities

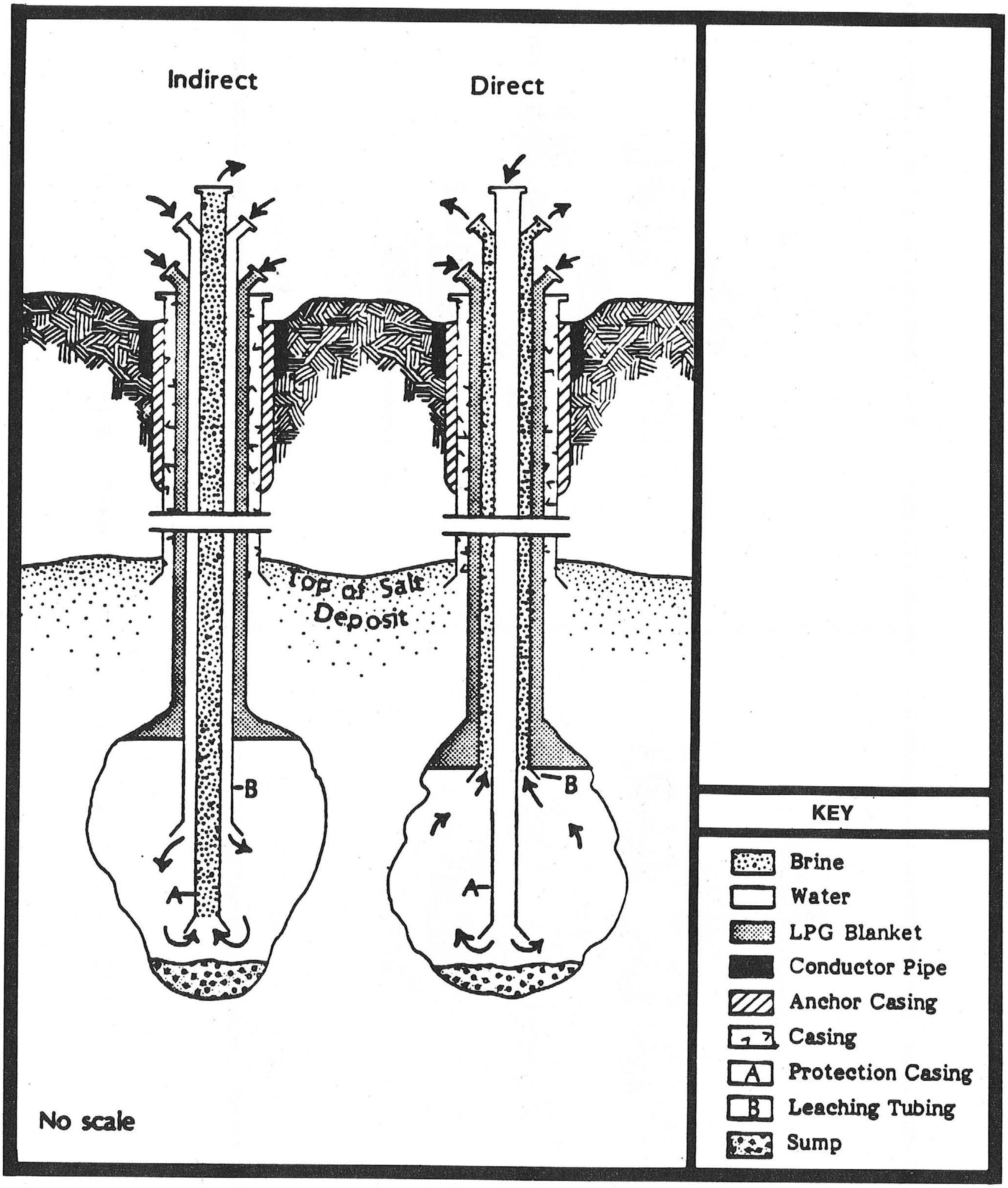


Figure 5
Direct and Indirect Cavern Leaching Methods

b) Brine Evaporation Ponds

Continuous injection of freshwater into the cavern (approximately 5,000 acre feet or 1.6 billion gallons during solution mining) would displace an approximately equivalent volume of brine to the surface through the leaching tubing. After passing through the flow-control equipment, the brine solution would be directed through underground piping to the settling and evaporation ponds, shown in figure 6. Located approximately 4 miles from the actual gas storage facilities, the proposed pond system would be situated on the surface of Red Lake, a seasonally dry, hydrologic depression. Evaporation would reduce the large quantities of brine produced by the solution mining of the caverns, yielding 1.56 million tons of salt.

The surface of the Red Lake playa consists of low permeability silty clay material. Approximately 150,000 cubic yards of this natural material would be used to construct the 6-foot high perimeter and interior dikes surrounding the evaporation ponds. A thin layer of surface clay would be scraped from the playa and used as the primary construction material. Following compaction of the dikes and basin surfaces, rip-rap would be placed along the interior face of the dikes to protect them from wave erosion. An unspecified floodwater diversion would be constructed just south of the proposed pond sites to divert flows from Truxton Wash to the north of the ponds.

The brine solution would first be transferred to the settling ponds to allow a large percentage of suspended solids to settle out by gravity. The remaining volume would then flow through "V" weirs into the evaporation ponds. Evaporation by solar insolation, ambient low humidity, and local winds would reduce the solution. A variety of inorganic compounds, primarily sodium chloride, would precipitate out on the pond floors.

Following evaporation, and assuming equal distribution of the brine over the ponds, approximately 12 to 18 inches of residue would remain on the pond surfaces. When the brine had completely evaporated, the salt layers would be harvested down to an unsaleable salt-clay mixture (approximately 6 inches thick). The remaining salt would be covered with a 3- to 6-inch thick overlay of silty clay from the dikes. Roughly 200,000 to 335,000 cubic yards of additional material would be removed from other areas of the lakebed to cover the salt. (Figure 7 identifies these areas.) Pataya states that no more than a 2.25-inch layer of borrow material would be excavated from any location.

R17W R16W

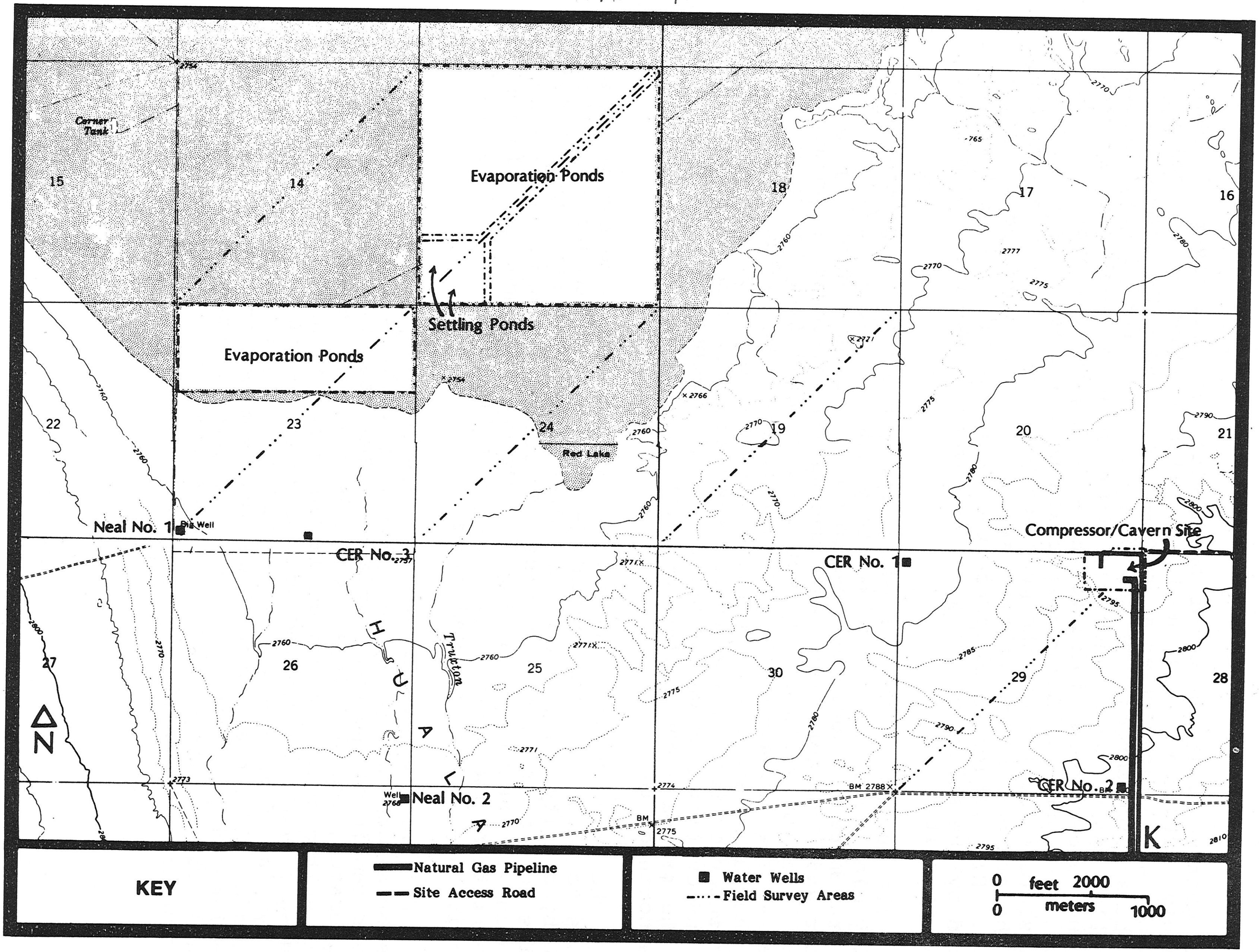


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Figure 6
Proposed Settling and Evaporation Ponds

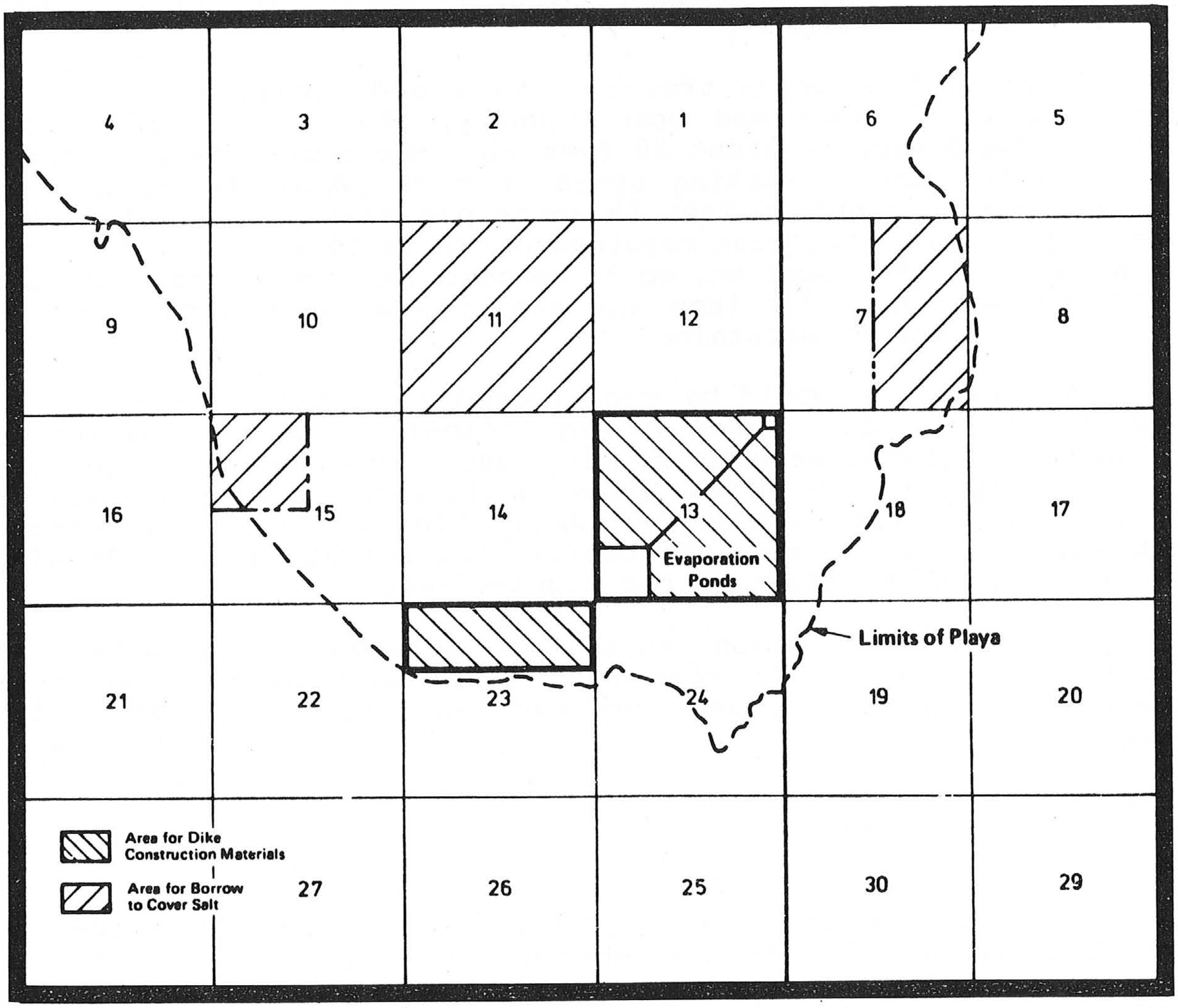

Figure 7

Proposed Borrow Areas

c) Natural Gas Pipeline

Concurrent with the solution mining of the storage caverns, approximately 30 miles of 16-inch diameter steel pipeline would be constructed to connect with three 34-inch diameter parallel pipelines, operated by El Paso. This connection would be constructed at the site of an existing pipeline monitoring station about 6 miles east of Kingman.

The pipeline would traverse rural and semirural areas. In less populated areas and open country, the construction right-of-way would average about 50 feet wide and require approximately 6 acres per mile. Working space in more populated areas would be limited to about 40 feet (5 acres per mile). Typical natural gas pipeline construction requirements of 36 to 48 inches of cover, depending of the location, would be observed. When crossing other structures (e.g., pipelines and cables), a minimum clearance of 24 inches would be maintained.

The pipeline would be constructed in a single spread. The construction would proceed in the following order: clearing and grading the right-of-way, hauling and stringing the pipe sections, preparing the ditch, bending the pipe, laying and welding the pipe, applying its protective coating or wrapping, lowering it and tying it in, testing, backfilling the ditch, and cleaning, restoring, and maintaining the right-of-way.

Special construction crews would be required to install and alter fences, bore under road and railway beds, make any necessary watercourse crossings, and construct intermediate valve control stations.

d) Access Road

A 5-mile long road, improved and maintained, would accommodate construction traffic to the storage facility site. Connecting Antares Road and the project site to the west, the 25-foot wide graded and treated surface would occupy a 100-foot wide right-of-way.

After surveying and staking, the access right-of-way would be graded and compacted as necessary. The roadbed would consist of native soil and gravel and would be maintained with a spray-applied treatment of a commercial soil stabilizer, magnesium chloride, which would be reapplied at least once a year for dust control.

Construction traffic would vary considerably from day to day. In addition to a wide variety of heavy and light construction equipment moving about the construction sites, tractor trailers and light-duty trucks would use Antares Road and Stockton Hill Road to deliver these construction vehicles, other equipment, and parts to the plant site. Construction worker traffic would be significant during the first 2 years of construction. Salt harvesting would also create substantial vehicular traffic. Although the actual number of trips has not been estimated, a nearly continuous daytime flow of traffic would occur during the 2-year construction phase of the project.

If necessary during construction, traffic control signs would be installed at the intersection of the access road and Antares Road. As an alternative, flagmen would be available to ensure the safe flow of traffic along Antares Road.

Following site construction and leaching operations, vehicular traffic would be limited to one or two cars or trucks per day.

e) Permits and Authorizations

Table 1 lists the permits and authorizations needed to complete the proposed project. The BLM, a cooperating agency in preparing this EIS, has permit authority over rights-of-way which would cross Federal lands.

In addition, right-of-way agreements, leases, or purchases would have to be negotiated with any private landowners whose property would be crossed or otherwise used for project facilities.

While the applicant does not currently have title to the land under the larger of the two proposed evaporation ponds (section 13, T.26N, R.17W), if a certificate is issued by the Commmission, the Natural Gas Act allows the certificate holder to exercise the right of eminent domain. If purchase, exchange, or lease cannot be negotiated with the present landowners, a hearing before the district court of the United States for the district in which the property is located or in a state court is necessary to obtain such authority. Following this process, the land can be condemned.

2. Operation and Maintenance

After the subsurface connection between the proposed 16-inch diameter pipeline and the 34-inch diameter El Paso pipelines was completed and the storage caverns were ready, gas transported through the El Paso pipeline would flow through a valve assembly north to the Pataya facility. The first fill (estimated to take 90 days) would displace the final cavern volume of brine and prepare the storage system for normal operations.

TABLE 1

PERMITS AND AUTHORIZATIONS REQUIRED TO IMPLEMENT PROPOSED PROJECT

Agency		Authority
Federal	FERC	Issues certificate to construct and operate facility.
	Bureau of Land Management	Issues right-of-way grant for facilities on Federal land.
	U.S. Environmental Protection Agency	Issues prevention of significant deterioration permit, if required.
State of Arizona	Department of Health Services	Issues permit for both construction and permanent equipment; makes recommendations on figutive dust control.
	Department of Water Resources 1/	Issues water well and potable water permits.
	Land Department	Issues rights-of-way for facilities on state lands.
	Mining Board	Issues certificate for safety training of mining personnel.
	Oil and Gas Commission	Authorizes storage cavity design and construction.
	Water Quality Board	Issues permit for ponds and solution wells.
Mohave County	Board of Supervisors	Issues conditional use permit; rezones property.
	Fire Department	Issues permit for fire protection
	Health Department	Issues septic tank permit.
	Planning and Zoning Commission	Issues building permits.
	Road Department	Issues road construction permit.

1/ Division of Dam Safety would review evaporation pond design if water level were above 6 feet.

At the storage facility, the gas would be metered before entering the compressor building. Three 1,800-horsepower, natural gas-fueled reciprocating engines would compress the gas received from El Paso at approximately 720 to 810 pounds per square inch actual (psia) to 1,000 to 3,000 psia. Following compression, the gas would be cooled and injected into the caverns. Because of fluctuations in ambient cavern volumes, one, two, or three compressor units would be operated simultaneously. It is estimated that the compressors would operate for 2,160 hours per year.

Gas would be withdrawn from the storage cavern by reversing the valve at the wellhead. The pressurized gas would be removed from the caverns and piped to the dehydrator, which would use a glycol-based system to remove water from the gas. About 1,700 cubic feet per hour of natural gas would be required to fuel the dehydrator.

Any entrained hydrocarbon liquids would be removed in the filter separator and stored on the plant site for subsequent sale or disposal. The gas would then be metered, depressurized, treated to pipeline requirements, and injected into the proposed 16-inch diameter pipeline. Pipeline flow would be reversed, allowing the gas removed from storage to be transported south to the El Paso interconnection. El Paso would transport the gas for use by Southwest customers.

Additional structures and equipment used during the operation of the proposed facility would include site fencing and security lighting, monitoring equipment, storage tanks for liquid hydrocarbons filtered from the natural gas, and an auxiliary building for small tool storage, operating personnel, an emergency power generator, and the communications system.

Normal gas withdrawal and injection operations would be controlled by a telecommunications system from Las Vegas; only one or two employees would be stationed at the facility. A microwave link to be installed between the cavern site and the Las Vegas office of Southwest would include one relay station at Red Mountain, near Boulder City, Nevada (an existing site operated by Southwest) and another on Mount Tipton in the Cerbat Mountains to the west of the site. Receivers and transmitters would be required at each end point and relay point. Remote control would monitor the recording instruments at the storage site, control valves to allow flow of gas into and out of the caverns, and start and stop the gas compressor engines.

Routine maintenance would include clearing and maintaining pipeline right-of-way segments; inspecting and servicing of the cathodic (corrosion) protection system, and inspecting pipeline crossings of other pipelines, roads, utilities, and other construction. Periodic reconnaissance of the entire pipeline would be made either by air or by vehicle.

3. Future Plans and Abandonment

The proposed project calls for two caverns capable of storing 3 Bcf of working gas. Since the initial siting and feasibility work, done before 1978, was predicated upon a need for a 10-Bcf storage capacity, there is a significant potential for expansion of the facility by solution mining additional caverns. Future caverns could probably be constructed at a lower cost than the ones presently proposed because all the necessary leaching and related equipment would remain at the site, though some piping rearrangements, additional site grading, and perhaps more compressor horsepower would be necessary.

Of course, construction of additional solution-mined caverns would require additional groundwater withdrawals, and if a similar evaporation pond system were used, more disposal or storage space for the produced salt would also be needed. Furthermore, continued cavern construction implies a continued need for construction personnel and construction traffic, with associated impact.

Since the applicant has repeatedly alluded to plans for expansion of the proposed facility over an extended period of time, this EIS attempts to address the impacts of expansion which would be significantly more severe than those of the present proposal. Any expansion of the facility would require additional FERC certification.

It is conceivable that caverns in other areas of this unique salt deposit could be developed for other uses such as hazardous waste disposal. However, such development is not directly related to this project. Although successful completion of the Pataya project might encourage accelerated industrial development in the area, the type and extent of development and the potential environmental impact of that possibility not reasonably predictable.

It is also possible that continued operation of the proposed gas storage system could become physically or economically impractical. In this event, the entire final volume of stored gas could be withdrawn from the caverns. The pipeline facilities would probably be emptied and filled with inert gas or corrosion inhibitors. All storage tanks at the project site would be drained and isolated. Connections would be removed and sealed by bolted flanges or plugs. Electrical circuits, as well as compressor and dehydrator units, would be disconnected. All piping would be cut and sealed below ground level. If the area occupied by structures and equipment were designated for other uses, belowground equipment other than the storage caverns would be dismantled and removed from the site.

Salvaging the gas pipe would require construction similar to the installation of the pipeline system. Additional backfill might be required, although sections beneath roadways and railways would probably remain in place.

The proposed evaporating ponds would be abandoned using the procedures discussed in section 1b.

B. ALTERNATIVES

The general objective of the proposed project is to develop more reliable delivery to Southwest's natural gas customers during periods of high demand. To meet this objective in an economically and environmentally acceptable manner, siting and engineering criteria were established by Pataya. The requirements included: (1) sufficient storage capacity for 10 Bcf by 1985, with 2.5 to 3 Bcf available by the early 1980's; (2) deliverability of 100 million cfd; (3) proximity to a major natural gas transmission pipeline with sufficient capacity and flexibility to transport gas from storage; and (4) proximity to Southwest's market area. The environmental staff's analysis is based on the assumption that any feasible alternative must meet these specifications.

1. No Action

The actions that are available are to grant the certificate that is sought, to deny it, or to postpone action pending further study. If action were postponed, one of the other two actions would ultimately follow. The FERC is solely responsible for determining whether the Red Lake Storage Project is in the public interest; it will therefore determine the need for the project

Denial of the project could result in no construction of the proposed system, construction of an equivalent alternative system, or increased use of alternative energy sources. If the proposal is denied and no alternative system is recommended, the conclusion would be that the proposed service is not needed or required by the public convenience and necessity. Construction of an equivalent alternative system could result in more or less environmental impact than the proposed project, depending on the nature and location of the required facilities.

The applicant states that since 1973, it has curtailed gas deliveries to its industrial and powerplant customers throughout its service areas which receive their base gas supply from El Paso. These curtailments are the result of El Paso's gas shortages during periods of high demand. Long-range gas supply forecasts prepared by El Paso indicate continued and increasing curtailments of gas deliveries to Southwest's industrial and powerplant customers.

Should curtailments occur without the benefit of nearby gas storage or increased deliverability, those low priority customers with alternate fuel capability would have to burn other fuels. Less tractable economic impact could result if customers without alternate fuel sources were curtailed. The use of the facility for supplying lower priority users is an issue in these proceedings.

Curtailments are also projected for Southwest's residential and commercial customers as early as 1987. While these customers are, by definition, high priority, the projected curtailments are pertinent to future residential community growth. Pataya states that, under the various assumptions used in the gas supply forecast study, if the Red Lake Storage Project or some appropriate alternative is not implemented, future curtailment will be inevitable. However, the need for the proposed project has not yet been established by the Commission. The No Project Alternative is therefore a possibility.

2. Brine Disposal Alternatives

a) Impermeable Liners

Using impermeable membrane liners instead of the proposed compacted playa materials would temporarily prevent the brine (and subsequent salt leachate) from seeping through the playa deposits, but the long-term effectiveness of this technique is uncertain. Further, costs associated with lining the proposed evaporation ponds could significantly increase the cost of the overall project--from $8.75 million to over $22 million, depending upon the liner material chosen, its thickness, and installation costs. 1/

The relative impermeability of the underlying playa material suggests that steady state seepage (i.e., no major cracks, fissures, or other anisotropies exist) would probably not be a major problem. A more appropriate use of membrane lining might be as an impermeable cover over the residual salt layer. Field inspection and evaluations by the environmental staff suggest that Pataya's proposed abandonment scheme--i.e., spreading 3 to 6 inches of playa material atop the residual salt layer to form a 900-acre plateau on the otherwise flat lakebed surface--would

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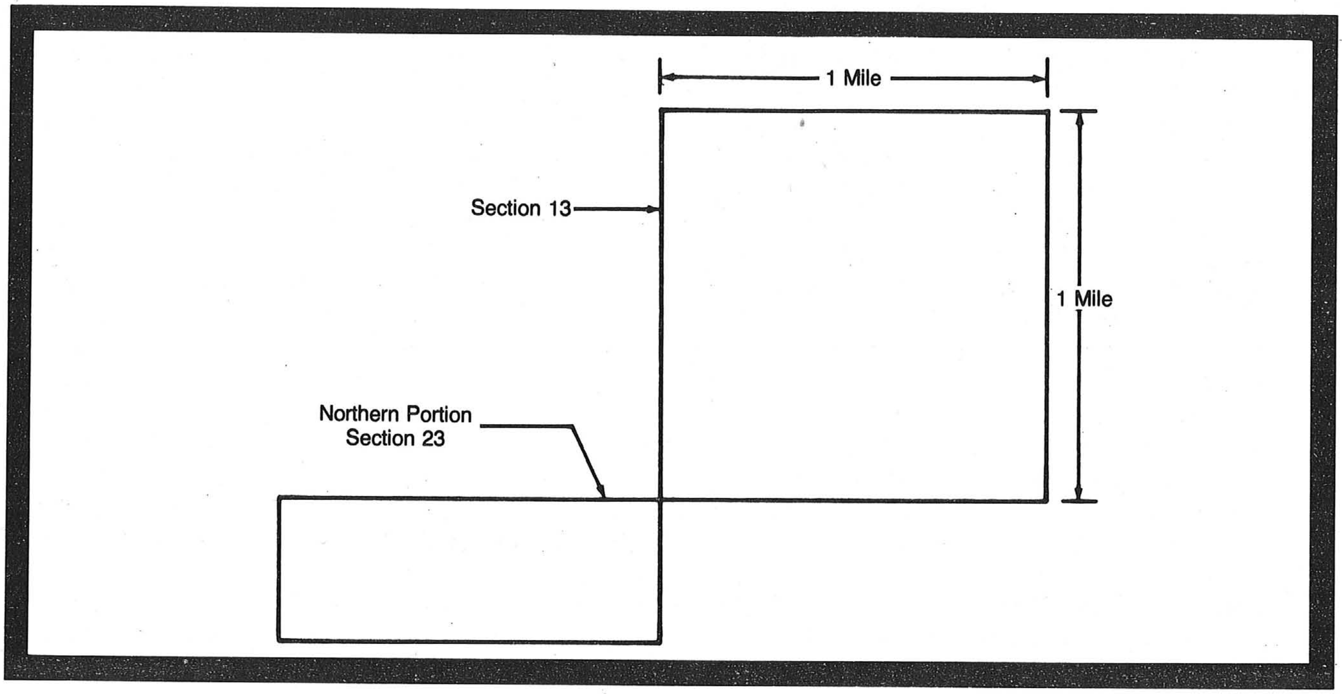
1/ These figures assume a lined area of 872 acres. Low values were calculated for a 10-mil (0.01 inch) unreinforced polyvinyl chloride liner covered by 1 foot of playa material. (Covering would be necessary to protect the liner from ultraviolet degradation.) High values were calculated for a 36-mil polyester reinforced chlorosulfonated polyethylene ("Hypalon") liner. Hypalon liners are not subject to ultraviolet degradation.

be ineffective in preventing migration of the salt from its original disposal location. Not only would the elevated area be subject to wind and wave erosion during flood stages, but the high shrink-swell property of the playa material would result in the formation of dessication cracks that would allow direct contact between the waste salt and rain and floodwaters, dispersing salt over a larger area. (Characteristics of the playa material proposed to cover the residual salt are discussed in section 3C2.) An impermeable liner covering the residual salt layer could control dissolution of the salt for the forseeable future. While such a measure would be somewhat less costly than lining the evaporation ponds, covering the large surface area of the pond system would still add significantly to the overall project costs. Since the staff's analysis shows that an alternative pond design (one which currently does not include liners) would be environmentally preferable to the proposed design, impermeable liners were not given further consideration. However, if further recommended investigations of the pond site conclude that the natural geologic conditions are unsuitable for the proposed use, impermeable liners might be an appropriate modification.

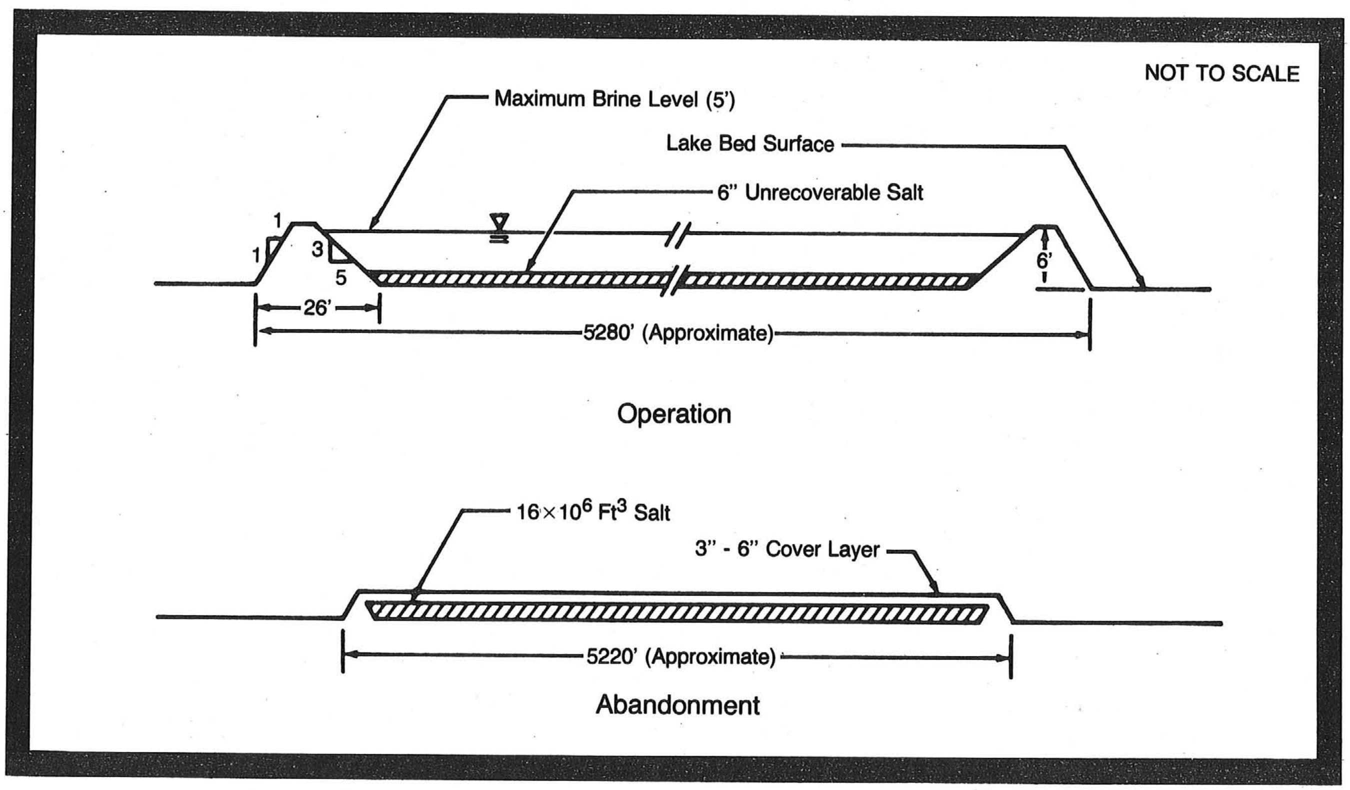
b) Alternative Evaporation Pond Design

As discussed in section 2A1, the applicant proposes to dispose of brine generated during the solution mining process by pumping it into evaporation ponds constructed on the surface of the Red Lake playa. (Figure 8 illustrates the proposed design.) Evaporation would then reduce the brine to solid salt which would be mined for sale. When solution mining concluded and the last of the recoverable salt had been harvested, a residual layer of salt approximately 6 inches thick would remain on the lakebed surface. Dikes constructed to contain the brine during evaporation would then be regraded over the residual salt. An additional 200,000 to 335,000 cubic yards of soil would be scraped from neighboring sections of the playa to build up the proposed 3- to 6-inch thick cover layer. This disposal plan would therefore create a surficial salt lens with a thin soil overlay covering an area on the lakebed roughly equivalent to the size of the evaporation ponds and approximately 6 to 12 inches above the current base level of the playa.

The major shortcoming associated with Pataya's proposed evaporation pond plan is that it would fail to securely isolate the residual salt following abandonment. In view of the shrink-swell nature of the playa material, it is highly probable that the thin layer of overburden proposed to cover the salt would dry and crack, allowing relatively unrestricted contact between surface waters and the salt. Furthermore, field investigations conducted by the environmental staff suggest there is an active shrink-swell layer which extends to a depth of approximately 22 inches. (See section 3C2 for information on the field investigation.) Unless the residual salt layer is buried below the active soil, long-term isolation of the salt could not be assured.



PLAN VIEW



CROSS SECTIONS

Figure 8
Proposed Evaporation Pond Design

Increasing the thickness of the soil cover could mitigate the problem of shrinking and swelling. However, a substantial thickness would be required, and the active soil layer would have to be thoroughly compacted over an area somewhat larger than the proposed ponds to prevent lateral seepage. Furthermore, erosion of the soil cover would necessitate continued maintenance.

As an alternative to the proposed design, a smaller, single pond with its compacted bottom approximately 3 feet below the lakebed could be constructed on section 13. Figure 9 shows the alternative design. Assuming a 6-inch thick layer of residual salt and a 22-inch thick active soil layer, there would be approximately 6 inches of inactive compacted material between the top of the salt and the bottom of the active soil layer upon abandonment. A 6-inch high crown of soil could be compacted over the fill to allow for subsidence, should water ever reach the abandoned salt. By constructing the perimeter dikes to an elevation of 10 feet above the lakebed surface, the pond's design storage volume (178 million cubic feet) could be obtained in approximately 3,900 feet square. 1/ Because such an excavation would generate significantly more material than would be required for dike construction, excess material could be stockpiled by grading it into broad gentle slopes surrounding the outside of the perimeter dikes (shown by shading in the crossectional view in figure 8). The feasibility of this alternative is contingent upon satisfactory results from additional site investigations and soil tests. Pataya's design is subject to similar constraints.

This alternative presents a number of distinct advantages over the proposal:

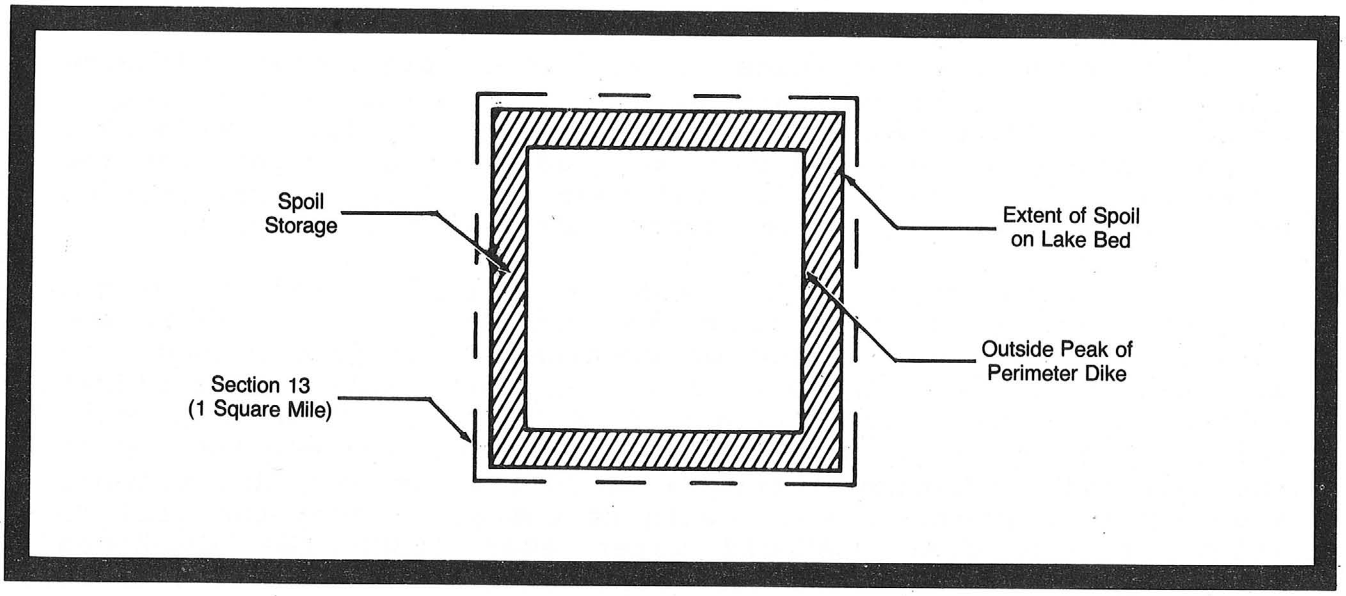
> A single pond sited on section 13 would disturb less of the lakebed surface.

> The use of section 13 might also avoid the potential problem of constructing on the large dessication cracks which are clearly visible in section 23.

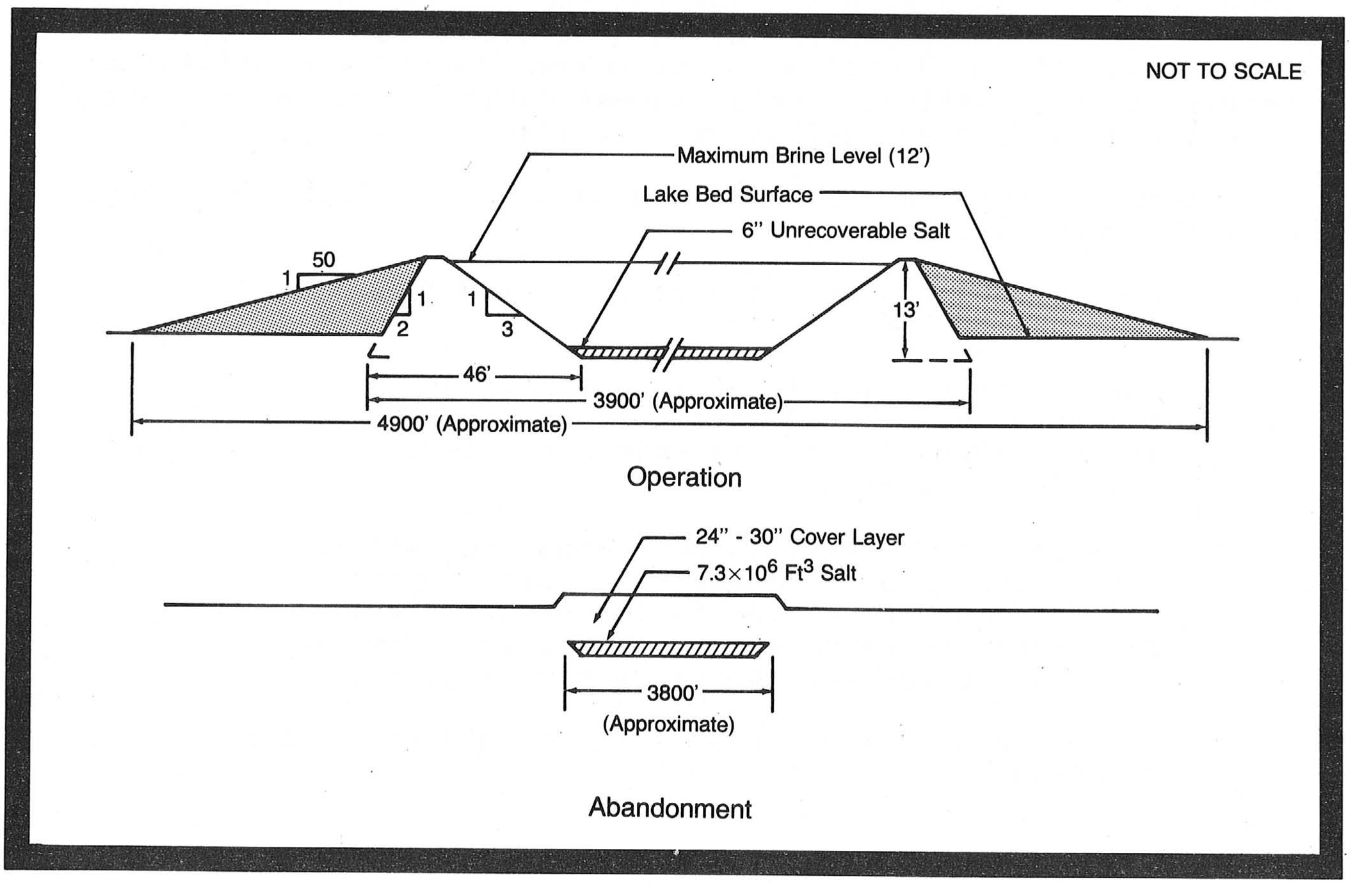
> Because the evaporation pond would be smaller, more salt could be harvested. Calculations suggest that as much as 83 percent of the total salt could be harvested, compared to Pataya's proposal to recover approximately 24 percent.

> A smaller pond would reduce the length of diking required.

1/ This dimension assumes a maximum brine depth of 12 feet in a single square pond which could be located entirely within section 13.



PLAN VIEW



CROSS SECTIONS

Figure 9
Alternative Evaporation Pond Design

> The excavation would ensure that the residual salt layer could be isolated securely below the active shrink-swell zone.

> Construction of a drainage diversion system to protect the evaporation ponds from floodwaters through Truxton Wash could be avoided by grading the excess soil into a gentle slope behind the perimeter dikes. (These higher, broader dikes would be more stable in the event of catastrophic flash flooding.)

> Larger, oversized dikes would be less susceptible to degradation or failure resulting from drying, shrinking, and cracking. While unprotected surfaces of the dikes would dry and crack, over-sizing would allow the core to remain at or near the proper moisture content.

> Compaction of the evaporation pond floor and dike construction would be facilitated by the excavation because the deeper playa material has a higher moisture content and would require less water to achieve the design level of compaction.

> Upon termination of evaporation pond operations, it would not be necessary to disrupt the proposed borrow areas on neighboring sections to obtain additional material for covering the residual salt because adequate cover material would be stockpiled on the outer slope of the perimeter dikes.

The alternative pond design would require significantly more excavation than that proposed by Pataya. Costs associated with this excavation would be offset by eliminating the need for a drainage diversion and hauling borrow material from neighboring sections and by reducing the amount of water applied during construction. Other disadvantages include the longer time that might be required to construct the higher perimeter dikes and the longer time required to evaporate the brine. Ten-foot high perimeter dikes might also require review by the Arizona Division of Dam Safety. Because of its benefits, this alternative has been retained for further impact analysis in the EIS.

c) Deep Well Injection

In view of the large volume of brine which would be generated during the proposed solution mining and the potential environmental concerns associated with shallow burial of a relatively large volume of salt, the environmental staff considered deep well injection as an alternative means of brine disposal. Given the appropriate geologic and hydrogeologic conditions, brine can be injected into deep brackish or saline aquifers.

Since no deep well disposal has been done in the project vicinity, it is not known whether a suitable injection zone is present. To ascertain the feasibility of this disposal option, at least one exploratory well would be required. Once a possible injection zone was identified, aquifer tests would have to be performed to determine the various aquifer parameters (lithology, porosity, permeability, thickness, etc.) and to assess the capability of the injection zone to accept the brine at the anticipated rate of flow (3,000 gpm, a relatively high rate). A comprehensive feasibility evaluation and development of a disposal well could cost several million dollars, depending upon the extent of current subsurface knowledge and the depth(s) at which suitable disposal zones were found. Costs associated with drilling, testing, and completion of a deep well alone could exceed a million dollars.

Because the brine generated during solution mining would be composed primarily of sodium chloride (i.e., table salt), introducing it into a stratum already saturated with saline water would present certain environmental advantages over the currently proposed disposal method. The composition of the byproduct brine also suggests that chemical compatability with a saline groundwater would not be a problem. Further, recent seismic surveys (figure 17) in the Red Lake area indicate that a number of sedimentary strata underlie the valley between the base of the salt deposit and the Precambrian basement bedrock. Therefore, a suitable injection zone might be present. In the absence of specific knowledge to the contrary, such factors may be interpreted optimistically. Nevertheless, only a deep exploratory drilling and aquifer testing program would provide the data necessary to evaluate this alternative. Since the environmental staff believes that the alternative pond design would be feasible and preferable to the proposed ponds, it does not appear that the expense of drilling the necessary exploratory well would be justified. Therefore, further analysis of this alternative is not practical. However, if both the proposed and alternative pond sites and designs prove to be infeasible, the deep injection alternative would remain an option warranting further study.

d) Induced Salt Evaporation

Salt can be produced from brine by boiling off the water. The vacuum-pan multiple-effect system is the most common method of producing salt from brine solutions. The first multiple-effect salt evaporation plant was constructed in 1899. Since then, numerous process support changes have improved the overall plant operation. The construction and operation of a vacuum-pan multiple-effect salt recovery plant at the Red Lake site would eliminate the need for the proposed evaporation ponds. The process feed would be the brine solution resulting from solution mining.

The plant would consist of four evaporators or "effects." Other equipment would include a process stream boiler, brine slurry storage tanks, separation equipment, product dryers, scaling equipment, and packaging equipment. About 50 acres of land would be required for such a plant and support facilities.

The major operational expense of the plant would be fuel. Natural gas or coal could be used to fuel the process boiler. However, the Fuel Use Act of 1979 restricts the use of natural gas to new facilities that have a heat input of less than or equal to 10 million British thermal units (Btu's) per hour. Since this plant would require a heat input of roughly 40 million Btu's per hour, it would be required to burn coal.

The estimated base price of constructing an "off the shelf" plant would be about $30,780,000. If coal were used to generate stream, the fuel costs for 14 months would be $4,580,000 (not including transportation). If natural gas were used, the fuel cost would be $10,330,000. Salt production for 14 months from this plant would total 262,695 tons (assuming a typical 3.4-percent solute concentration). Vacuum pan-produced salt is currently sold for $76.44 per ton. 1/ At this price, the salt harvested would produce a total income of only $20,080,405, which would not be enough to recover the capital investment in the plant, even if the salt were sold at its maximum market value.

Therefore, this alternative would not be feasible. In addition, obtaining the total volume of salt produced from the caverns within the 14 months of solution mining would require specially designed evaporators and process equipment, further limiting the feasibility of this alternative.

e) Solar Pond

The energy from the sun falling on the surface of the earth in 1 month is about equal to the entire fossil fuel reserves of the world. Until recently, the silicon solar cell has been the most efficient way of generating electricity directly from sunshine. However, this type of electrical generation is very

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1/ D. S. Kostick, U.S. Department of the Interior, Bureau of Mines, telephone conversation with J. Korzeniowski, FERC staff, July 16, 1980.

costly and requires large land areas for numerous solar collectors. Another disadvantage is that the solar collectors are actually degraded by sunlight, requiring constant maintenance and repair.

A solar pond, which has a yearly collection efficiency of 25 percent, is a static body of water that collects solar energy and stores it as thermal energy. This thermal energy can be used for a variety of purposes, including electrical power generation and industrial process heating. The basic principle of solar ponds is to prevent the flow of heat from the bottom of the pond to the top. In a normal body of water, the sun heats the water during the day, the heat is lost to the surrounding environment at night. A salt gradient prevents the hot, denser water of the lower region from rising.

Wind and localized surface heating creates a homogeneous layer of saltwater in the top 12 inches of a solar pond. Immediately below this layer, a salt gradient forms whose concentration increases with depth. The lower layer, or storage zone, has a relatively constant salt concentration, typically from 15 to 20 weight percent sodium chloride. Other salts may be used, but sodium chloride is the least expensive.

Convection (heat loss) occcurs only in the top and bottom layers. The salt gradient prevents normal convection from carrying the hot water from the bottom to the surface. Solar radiation heats the water at the bottom to a much higher temperature than the surface. The average water temperature at the bottom of these ponds can range from 194°F to 210°F. The stored heat, removed by a heat exchanger, can be routed to a powerplant to generate electricity.

However, solar ponds are still experimental. Two types of engineering problems remain to be solved. First, how much heat can be collected, and how can this heat be extracted from the bottom of the pond? Second, can stability be maintained to prevent mixing of the layers? In addition, there are numerous technical problems, such as how to construct the pond container, how to establish and maintain the salt gradient, how to keep the pond clean and transparent, and what to do with the heat generated.

A solar pond developed from the alternative evaporation pond design discussed in section b would require 2,779 million gallons of water to maintain a constant depth of 10 feet. About 1,528 tons of salt would be required to establish an initial salt gradient. This amount of salt would still be available after all of the recoverable salt had been harvested. The solar pond could be used to power an electrical generating plant rated at 11,080 kilowatt hours. Development of this alternative would defer abandonment of the evaporation pond and add to the experimental data base of a new technology. Since implementation of this option would not significantly alter the environmental impact of the proposed storage project and there are concerns about its technology and reliability, it was not given further consideration.

f) Salt Marsh Pond

The Arizona Game and Fish Department has suggested that the evaporation ponds could be managed to provide habitat for migrating waterfowl. The management plan would include introducing salt-tolerant vegetation, algae, brine shrimp, and brine fly larvae to the ponds and maintaining adequate water levels by pumping the alkaline groundwater under the surface facilities. The environmental staff believes that the potential benefits of such a management program would not justify the necessary expense. The high evaporation rate would necessitate that approximately 350 to 800 million gallons of water per year be pumped to replenish the pond. The extent of alkaline groundwater is currently unknown. Furthermore, as discussed in section 4E1, the high salt concentrations in the ponds could adversely affect waterfowl.

3. <u>Alternative Sites</u>

a) Alternative Storage Sites

CER Corporation, consultant to Pataya, investigated the possibility of solution mining a storage cavern in the Luke salt body near Phoenix. The Luke salt body is the only other possible salt cavern storage site near the Southwest system known to the staff. The possible site, near a major El Paso pipeline, would require only about 2 miles of pipeline to connect to the storage facility, instead of the 30 miles required by the proposed project. There is little doubt that the salt body would be able to contain the caverns; in fact, LPG is stored in a number of leached out caverns in that area.

However, it is not certain that sufficient volumes of water could be obtained for the leaching process. The Luke site is near the Phoenix metropolitan area, and groundwater needs there already far exceed the annual recharge into the groundwater system. Availability of sufficient acreage for evaporating ponds is also in question, since subdivision development in the Glendale area is encroaching on the potential facility location. Furthermore, there are no suitable low permeability soils in the area, so evaporation ponds would have to be lined--a substantial additional expense. In view of these disadvantages of the Luke site, the cost of constructing the required facility in this location would probably be far higher than a similar sized facility at Red Lake and was therefore not given further consideration as an alternative.

b) Alternative Rights-of-Way

The proposed pipeline route would traverse Hualapai Valley in a north-south direction. The terrain slopes gently toward the Red Lake area; no unusual construction conditions are anticipated and no critically sensitive wildlife habitat would be crossed. While minor deviations from the route indicated in figure 2 might occur, perhaps to avoid impact to archaeological sites, there are no significantly superior alternatives.

The initial proposal included approximately 26 miles of 69-kV powerline that would parallel the proposed pipeline. This portion of the project has since been modified. Current planning is to install onsite power generating equipment. There are two existing electric powerlines in the vicinity of the proposed plant site. However, both are major transmission lines (i.e., greater than 340 kV) and do not supply power to individual customers. Supply to the site from a 20.8-kV line which presently terminates in the Dolan Springs area northwest of the site was considered, but that line would be too small for the proposed power requirements.

Onsite power generation would eliminate the impact of constructing 26 miles of powerline, but it would also increase air emissions because of the fossil fuel-driven generator engines. Since neither the construction nor the air emissions would create a major environmental impact, Pataya's final choice will be based on other factors. The environmental staff will recommend appropriate mitigating measures to lessen any significant impact from either option.

Two well-developed roads traverse Hualapai Valley. Both are unpaved, hard surface roads maintained by Mohave County. Stockton Hill Road runs from Kingman along the west side of the valley, northward past the Red Lake area. Antares Road traverses the east side of the valley. (Both roads are shown on figure 2.) Either road could provide access to the site if 5 to 6 miles of additional roadway were constructed.

Use of Stockton Hill Road for access to the proposed plant site would require crossing the floodplain of Truxton Wash. Since flooding does occur, though infrequently, an access road connecting to Stockton Hill Road might be unusable at times. Though access via Stockton Hill Road was originally proposed, the permanent access road is currently planned to approach the site from Antares Road to the east. This route would cross high ground and would not enter the floodplain. The access route from Stockton Hill Road would be graded as a construction road and would be subject to periodic inundation. Therefore, Stockton Hill Road would not be as suitable as Antares Road for permanent site access.

4. Project Alternatives

It is conceivable that the applicant's gas requirements can be met without constructing the proposed salt caverns. Four alternative approaches are: construction of an LNG plant, development of a conventional underground storage or pore space reservoir, use of storage space at existing or readily expandable gas storage fields, or firm delivery of an increased volume of wellhead or field gas. Any of these alternative projects would preclude the need to construct the proposed storage caverns if a system that meets the siting and engineering criteria for the Red Lake Storage Project could be designed.

In the first alternative, natural gas could be liquefied by removing heat, thereby reducing its volume to approximately one six-hundredth of that at standard temperature and pressure. The resulting LNG maintained at a temperature of approximately -260°F, is usually stored in heavily insulated aboveground cryogenic storage tanks (commonly 9-percent nickel steel). Applying this process to meet the proposed project's basic objectives would require construction of liquefaction and vaporization systems and perhaps two or three LNG storage tanks.

In general, the facilities required for storing LNG equivalent to 3 Bcf of natural gas would probably require an investment of construction and operating funds significantly greater than that of the proposed cavern storage system. The additional seismic risk studies and other analyses required by U.S. Department of Transportation regulations, the detailed planning and other engineering studies, and the lead time necessary to fabricate the cryogenic hardware would probably add considerable cost and delay to the project. There is no environmental, economic, or safety advantage to LNG; therefore, this alternative was not considered in detail.

In the second alternative--conventional underground storage--the gas would be stored in interconnected pore spaces between grains or within the fractured or otherwise porous and permeable sedimentary rock formations. This would require adequate structural or stratigraphic closure and, in some cases, a large number of wells or a relatively large volume of "cushion" gas to maintain sufficient delivery pressure.

CER Corporation has evaluated a number of potential pore space storage reservoirs in southern Nevada, Utah, and New Mexico: the McElmo Mesa Oil Field (southeastern Utah), the Lime Ridge Raplee Anticline (southeastern Utah), the Arden Dome (Clark County, Nevada), and the Torrivio Anticline (McKinley County, New Mexico). 1/

1/ "Review of Various Potential Gas Storage Systems," Las Vegas, February 1980.

Of the four primary pore space prospects, two--the Lime Ridge Raplee Anticline and the Arden Dome--proved to be of only marginal interest, primarily because of the lack of geological and reservoir engineering data. Additional mapping and exploratory drilling and testing would be necessary to determine the feasibility of these sites. The two remaining prospects--the McElmo Mesa and Torrivio Anticline--have development potential; however, the McElmo Mesa is considered too small (2.8 Bcf maximum working gas) and the Torrivio Anticline too expensive (approximately 80 Bcf of cushion gas required).

The third alternative would use storage space at existing or readily expandable gas storage fields. Whether such an alternative could be designed depends on the availability of storage space, proximity of the field to a transportation pipeline with suitable capacity and interconnections, additional facilities required, and costs of the service.

The Commission staff has considered the use of storage space at existing storage fields such as the Clay Basin field (Daggett County, Utah), Washington Ranch field (Eddy County, New Mexico, and Culberson County, Texas), Barker Dome (San Juan County, New Mexico, and La Plata County, Colorado), Rhodes field (Lea County, New Mexico), and Bammel field (Harris County, Texas). Subject to verification of specific information that Pataya has agreed to provide for the record, all of these were eliminated from further consideration. Pataya states that the Clay Basin storage field could provide firm storage service to Pataya; however, construction of substantial transmission looping would make this alternative prohibitively expensive. Washington Ranch, which is being developed according to an established development schedule, is currently fully utilized for high priority uses. Barker Dome is also fully utilized. Rhodes field is fully used, and expansion is currently impossible because of leakage problems. The Bammel field is an intrastate facility and could only provide "best efforts" service.

Firm delivery of wellhead gas is the fourth alternative to the Red Lake project. El Paso currently has the mainline transportation capacity, but Southwest does not have the necessary production capability.

Because of the information developed by the Commission staff, the preliminary determination of the EIS is that there is no feasible project alternative which would meet the criteria identified and offer the service provided by the proposed project. Extensive analyses of gas supply, projected market requirements, and costs are necessary for a comprehensive evaluation of these alternatives. As noted in chapter 1 and "No Action," results of these analyses will be an integral part of the complete record upon which the Commission will base its decision on the need for the proposed project. If the proposed project is denied and an alternative is recommended, the alternative project would be subject to further environmental review when Pataya applied to the Commission for authorization of that project. These analyses are beyond the scope of this draft EIS; if required, they would be the subject of future environmental studies.

CHAPTER THREE
AFFECTED ENVIRONMENT

A. CLIMATE

Monthly precipitation at Kingman, Arizona, is shown on figure 10. 1/ Almost half of the yearly precipitation comes from Pacific storms that enter the continent along southern California from December through March. A brief peak of rainfall occurs in August, the result of warm, moist air from the Gulf of Mexico rising over mountain peaks, cooling and forming thunderstorms. Because the ground is extremely dry in August and the intensity of rainfall is high, rainfall runs off, eroding streambeds and flooding playas. (As much as a half-inch of rain can fall in less than 15 minutes.) The Red Lake playa is most likely to flood during this period, but flooding can also occur in the winter. Floodwaters are rarely deeper than 6 inches. Precipitation averages 10.63 inches yearly, but it can vary widely from year to year. The greatest difference year-to-year occurred in 1941 and 1942, which had 16.5 and 5 inches of precipitation, respectively. The highest yearly precipitation on record is 20 inches (1919); the lowest is 3.5 inches (1947).

The nearest weather station that records wind data is north of Las Vegas at the Nellis Air Force Base, approximately 70 miles northwest of Red Lake. Because there are several mountains and valleys between Las Vegas and Red Lake, wind at the two locations is somewhat different. A recent study of the project area estimates the following facts about the wind in Hualapai Valley. 2/

> Spring winds are strongest; dust storms are common (no prevailing direction estimated).

1/ Kingman, located 28 miles south of Red Lake, is the nearest weather station to the site. Lying about 600 feet higher than Red Lake and saddled between two mountains, Kingman probably receives a little more precipitation and is a little cooler than Red Lake.

2/ BLM, Proposed Livestock Grazing Program: Cerbat/Black Mountain Planning Unit; Final Environmental Impact Statement (Phoenix, 1978), p. II-4.

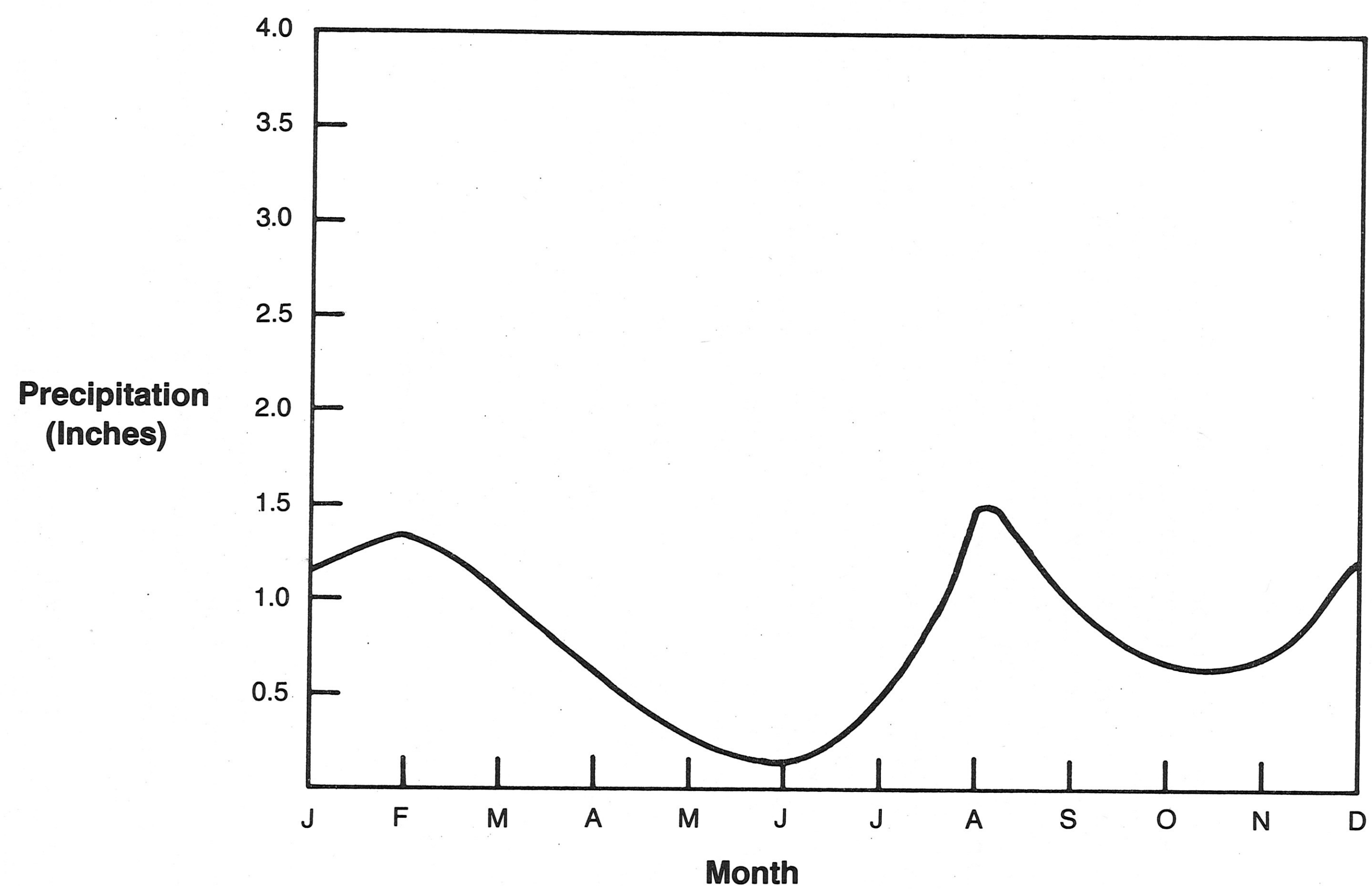


Figure 10
Mean Monthly Precipitation: Kingman, Arizona

> Summer winds are southerly, 8-12 miles per hour.

> Winter winds are northerly, 12-24 miles per hour.

> Night winds are very light; morning winds are moderate and oriented north and south; afternoon winds are stronger with changeable directions.

> Winds blow about 70 percent of the time; the most extended periods of calm occur during winter.

Thermal inversions probably occur at Red Lake, but because of the lack of data, the frequency, intensity, duration, and altitude of these inversions is not well known. However, it is possible to estimate some of the chracteristics of these inversions based on the climate and terrain. One climatic factor is the 25° to 30° difference between the night and day surface air temperature, shown in figure 11. As the surface air temperature drops at night, it becomes cooler than the air above, forming a thermal inversion. This wide temperature variation occurs throughout the year, and inversions probably occur 3 days out of 4. Another factor is that Red Lake lies at the bottom of a basin. Cool night air drains onto the lake, bolstering the inversion layer, which may extend 300 to 1,000 feet above the surface. The night winds are normally too light to mix the thermal layers; thus, inversions persist until either the morning sun warms the surface enough to cause the air to rise or until afternoon winds dissipate it. Inversions therefore last 12 to 15 hours, but they may last several days during the winter when periods of calm are frequent. The average annual freshwater lake evaporation rate at Red Lake is estimated to be about 74 inches per year.

B. AIR QUALITY

In assessing the significance of the potential air quality impact on the proposed project, the baseline air quality levels must be compared to the national ambient air quality standards (NAAQS) which govern the United States as an outgrowth of the Clean Air Act Amendments of 1970. The national primary and secondary standards for air pollutants are presented in table 2. The primary standards are the levels necessary to protect public health; secondary standards, generally more stringent than primary standards, are designed to protect public welfare from any known or anticipate effect of all criteria pollutants. The ambient air quality standards for Arizona are also included in table 2.

The proposed plant would be in the Yuma Interstate Air Quality Control Region, which includes Mohave and Yuma Counties, Arizona. The ambient air quality in the vicinity of the project site is quite good, largely typical of the sparsely populated nonindustrial areas of the Southwest.

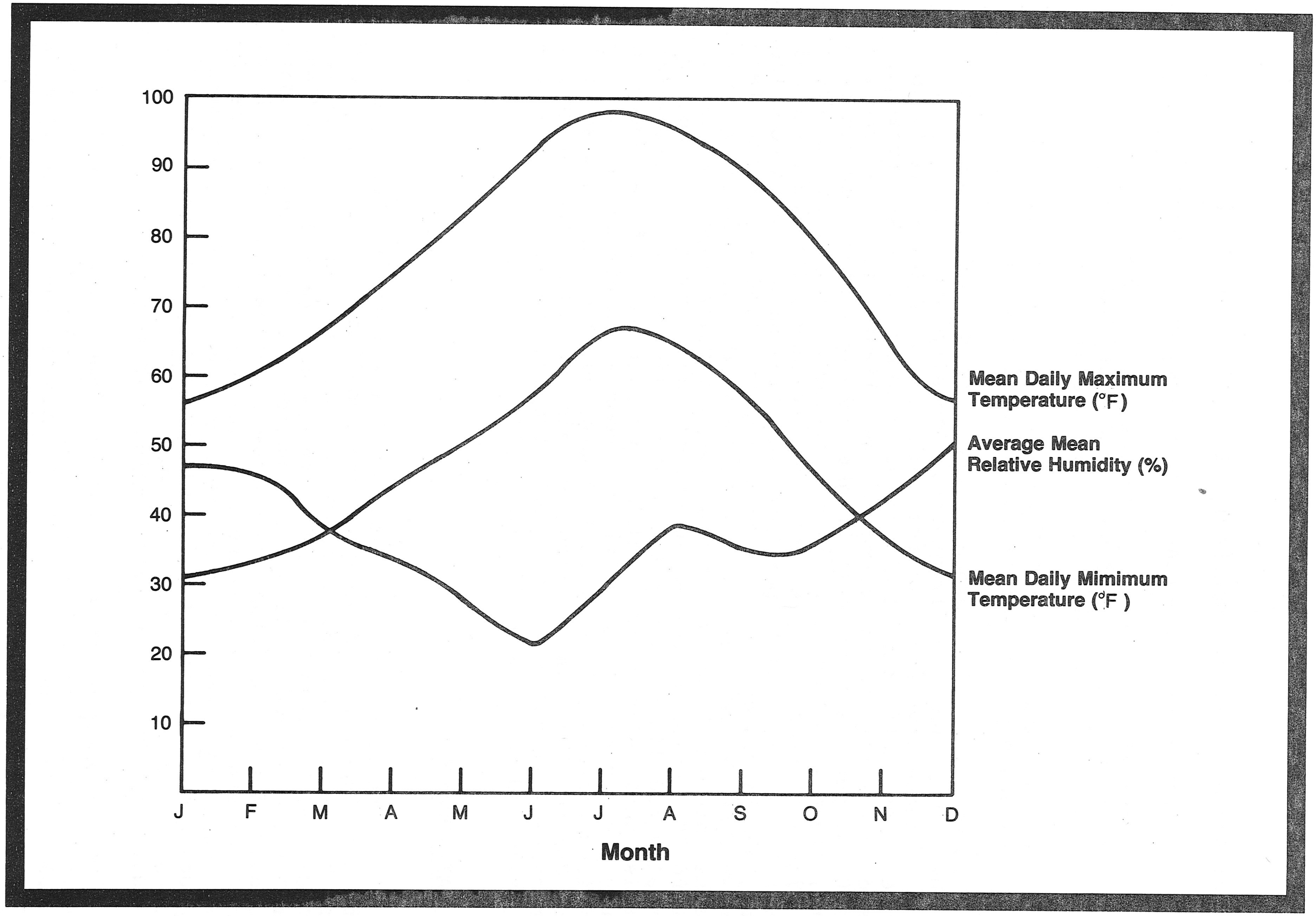


Figure 11
Temperature and Humidity: Kingman, Arizona

TABLE 2

NATIONAL AND ARIZONA AIR QUALITY STANDARDS

Pollutant	Averaging Time	Primary National Standard	Secondary National Standard	Arizona Standards[b/]
Total Suspended Particulates	Annual (Geometric Mean)	75 μg/m^3 [c/]	60 μg/m^3	75 μg/m^3
	24-Hours	260 μg/m^3	150 μg/m^3	150 μg/m^3
Sulfur Dioxide	Annual (Arithmetic Mean)	80 μg/m^3	d/	80 μg/m^3
	24-Hours	365 μg/m^3	d/	365 μg/m^3
	3 Hours	d/	1,300 μg/m^3	1,300 μg/m^3
Nitrogen Dioxide	Annual (Arithmetic Mean)	100 μg/m^3	100 μg/m^3	100 μg/m^3
Carbon Monoxide	8 Hours	10 mg/m^3 [e/]	10 mg/m^3	10 mg/m^3
	1 Hour	40 mg/m^3	40 mg/m^3	40 mg/m^3
Nonmethane Hydrocarbons	3 Hours (6-9 a.m.)	160 μg/m^3	160 μg/m^3	160 μg/m^3
Photochemical Oxidants	1 Hour	235 μg/m^3	235 μg/m^3	160 μg/m^3
Particulate Lead	Calendar Quarter Average	1.5 μg/m^3	1.5 μg/m^3	1.5 μg/m^3

a/ All national standards except those based on annual or geometric means are not to be exceeded more than once a year.

b/ Source: Arizona Department of Health Services, 1979.

c/ μg/m^3--micrograms per cubic meter.

d/ No standard exists.

e/ mg/m^3--milligrams per cubic meter or μg/m^3 x 1,000 = mg/m^3.

According to the U.S. Environmental Protection Agency (EPA), Mohave County is in attainment for all criteria pollutants. The nearest nonattainment area is a portion of Clark County, Nevada, south of Las Vegas that exceeds the primary standard for total suspended particulates (TSP). Periodic high particulate levels are the primary air quality problem in the vicinity of the project area, rather than high levels of other criteria pollutants such as sulfur dioxide (SO_2) and nitrogen dioxide (NO_2) generated from point sources. Ambient air quality data for particulates, SO_2, and NO_2 can be found in tables 3, 4, and 5.

Existing sources of particulate emissions in northwestern Arizona are, in order of decreasing importance, desert dust, dirt roads, mining, power generating stations, and livestock corrals. Blowing dust on desert valley floors is quite common in dry summer months and in windy spring months. Dust particulate concentrations in the project area are generally greatest in late spring and early summer, when the ground has simultaneously lost moisture from the winter rains and is exposed to high spring winds.

Background dust particulate levels-naturally produced levels of particulates (suspended desert dust)-are a moot point because a substantial portion of the blowing dust is the result of widespread overgrazing by cattle in areas of thin soil and sparse vegetation. The topsoil gradually blows away so that the richer natural vegetation cannot grow. Cattle hoofs break the hard surface of the exposed clayey soils, allowing desert winds and updrafts to blow the fine particulates. Cattle grazing and artificially generated particulate dust is probably responsible for half the dust levels in rural northwest Arizona.

A similar source of blowing dust/particulates in ranching areas is the network of unpaved roads, which eventually develop hard, windproof surfaces covered with pebbles and large sand grains. Blowing dust then occurs only when vehicles pass over the road and break the road surface, exposing the fresh fine dust to the wind. The average daily traffic on the ranch roads in northwestern Arizona is very low--around 10 vehicles per day--but this level of disruption is enough to keep the clay dust continually exposed. Traffic on the unpaved ranch roads in Mohave County results in suspended particulate emissions of about 100,000 tons per year.

Other artificial particulate sources are the mining, construction, and mineral industries. The largest stationary sources of particulate emissions in the project area are the Duval Corporation mine at Chloride, emitting 87 tons of particulates per year, and the Lake Havasu Materials Industry, emitting 36 tons of particulates per year. These emissions do not cause regional problems because they represent less than 1 percent of the total Mohave County emission inventory of particulates. Finally, the small corrals scattered throughout the ranching areas of Mohave County contribute small, localized dust during roundups.

TABLE 3

1979 PARTICULATE SUMMARY FOR MOHAVE COUNTY, ARIZONA

Nearest Town	Monitoring Site	Number of Samples	Annual Geometric Mean ($\mu g/m^3$)	Maximum 24-hour Concentration ($\mu g/m3$)		Violations of of 24-hour Standards	
				Maximum	2nd Highest	Primary	Secondary
Bullhead City	224 Main Street	55	46	289	0.54	1	2
Davis Dam	DRI Mountain	51	23	92	63	0	0
Grand Canyon Village	Grand Canyon	25	20[a/]	119	118	0	0
Hopi Point	Grand Canyon	22	22[a/]	24	23	0	0
Katherine Landing	Davis Dam	58	25	95	86	0	0
Kingman	305 Beale Street	34	56[b/]	456	287	2	6
Lake Havasu City	Community Hospital	54	7[b/]	69	68	0	0
Nelson	Peach Springs	27	12	100	64	0	1
Riveria	Camera Site	60	35	178	122	0	1
Riveria	Hancock	57	46	289	144	1	1
Riveria	Fort Mohave	55	41	191	113	0	1

Source: Arizona Department of Health Services, 1979 Air Quality Data for Arizona.

a/ Annual value; samples were limited by relocation or later installation of the monitoring site.

b/ Annual value based on a limited number of values.

TABLE 4

1979 SULFUR DIOXIDE SUMMARY FOR MOHAVE COUNTY, ARIZONA

Nearest Town	Monitoring Site	Number of Samples		Annual Arithmetic Mean ($\mu g/m^3$)	Maximum Average Concentrations ($\mu g/m^3$)		Violations of Standards	
		3-Hour	24-Hour		3-Hour	24-Hour	3-Hour	24-Hour
Bullhead City	Bullhead City	7,195	--	23	173	103	0	0
Davis Dam	DRI Mountain	7,426	--	28	124	33	0	0
Grand Canyon Village	Grand Canyon	--	20	5[a/]	--	14	0	0
Hopi Point	Grand Canyon	--	18	5[b/]	--	18	0	0
Katherine's Landing	Davis Dam	7,337	--	28	171	46	0	0
Riveria	Fort Mohave	7,304	--	28	126	38	0	0

Source: Arizona Department of Health Services, 1979 Air Quality Data for Arizona.

-- No data available.

a/ Annual value; samples limited by termination of the monitoring site.

b/ Annual value; samples limited by relocation or later installation of the monitoring site.

TABLE 5

1979 NITROGEN DIOXIDE SUMMARY FOR MOHAVE COUNTY, ARIZONA

Nearest Town	Monitoring Site	Number of Samples		Annual Arithmetic Mean ($\mu g/m^3$)	Maximum Average Concentrations ($\mu g/m^3$)	
		1-Hour	24-Hour		1-Hour	24-Hour
Bullhead City	224 N. Main St.	5,534	--	27 a/	193	59
Davis Dam	DRI Mountain	6,994	--	22	97	32
Grand Canyon Village	Grand Canyon	--	17	19 b/	--	42
Hopi Point	Grand Canyon	--	17	9 b/	--	21
Katherine's Landing	Davis Dam	5,246	--	24 a/	116	38
Riveria	Fort Mohave	3,437	--	22 a/	97	26

Source: Arizona Department of Health Services, 1979 Air Quality Data for Arizona.

-- No data available.

a/ Annual values based on a limited number of samples.

b/ Annual value; samples limited by relocation or later installation of the monitoring site.

Violations of the NAAQS have occurred because of extremely high particulate levels during dust storms. One particularly severe dust storm on June 17, 1975, produced particulate concentrations from 200 micrograms (μg) per cubic meter to 1,800 μg per cubic meter south of the project area in Mohave County. Storms such as this require dust storm warnings from the Arizona Highway Patrol. Because of the high dust levels, only mountain areas near the proposed project consistently meet Federal and state standards for particulates. The Arizona Department of Health Services has instituted procedures to prevent particulate concentrations which would cause significant harm to the health of individuals. These procedures include public notification (air pollution alerts), increased departmental monitoring, and forecast responsibilities.

Sulfur oxides, nitrogen oxides, carbon monoxide, and hydrocabons are not emitted in significant amounts in Mohave County. The two major sources of sulfur dioxide in the vicinity of the project area are the Duval Mine, emitting 1,323 tons of SO_2 per year, and the Mohave Generating Station west of Bullhead City. The only other source of SO_2 in the project area is Lake Havasu Materials Industry, which emits 1 ton per year; this industry is also the only source of NO_2 emissions (3 tons per year). Among the other criteria pollutants, hydrocarbons (12 tons per year) are emitted at the Duval Mine. Carbon Monoxide is not emitted in significant amounts by any point source.

Carbon monoxide, hydrocarbons, and nitrogen oxides, all products of combustion, are concentrated near major roads and highways, especially around urban areas of Mohave County. Nitrogen oxide concentrations are very low in comparison to the Federal and Arizona state annnual standard of 100 μg per cubic meter. The highest recording of nitrogen oxides occurred at the Davis Dam and Bullhead City, reflecting the concentrations of both recreational vehicles and tourist traffic that enter these areas in the summer. Nevertheless, no violations of the NAAQS for SO_2 and NO_2 were recorded in Mohave County in 1979.

According to EPA definition, Class I areas, where existing air quality cannot be degraded by new development, include:

> International parks.

> National wilderness areas which exceed 5,000 acres.

> National memorial parks which exceed 5,000 acres.

> National parks exceeding 6,000 acres which were in existence on August 7, 1977.

These areas are given more protection under the Clean Air Act (i.e., the incremental emission allowances are more restrictive for new sources). The Class I area closest to the Red Lake Site is the Grand Canyon National Park, about 40 miles to the northeast.

C. SOILS

The most detailed soil map of the project area is a 1974 general soil survey of Mohave County, which is not detailed enough for site-specific analysis. The soil in Red Lake, which encompasses approximately 20 square miles, is distinct from the soil of the surrounding valley floor and is not identified in the general survey. Much of the information used in this analysis was obtained by the environmental staff during its inspection of the project site.

1. Storage Site

The gas storage facility would be approximately 2 miles east of the south end of Red Lake and about 40 feet higher in elevation. The valley soils developed primarily from water-transported sand, silt, and clay; some of the sandier soils were reshaped by wind into long, dune-like deposits.

The topsoil in the valley is primarily a sand or sandy loam. Water infiltrates rapidly and, when dry, the soil blows easily. These soils have poor to fair compaction characteristics and are generally unsuitable for constructing water-containment structures. They are highly corrosive to uncoated steel.

2. Evaporation Ponds

The proposed evaporation ponds would be constructed on the surface of Red Lake, a flat, 20 square mile ephemerally wet lakebed. During wetter climatic periods, the lakebed might have been much larger than the current lake borders. The lakebed sediments, which are salty at least in the upper 5 feet, are known to be at least 628 feet thick near the center of the lake. They are composed primarily of clay and silty clay, although more permeable zones of sand, gravel, or other materials are present.

Large polygonal cracks, shown in figure 12, exist on the playa and surrounding valley. These cracks are believed to have formed when the groundwater level declined enough to allow drying and subsequent shrinkage of the clayey lake deposits. Most easily seen from the air, they are typically 1,000 to 2,000 feet long, several feet wide, and possibly 100 feet or more deep. Because the strong valley winds blow the surrounding sandy soil, the cracks fill with sand soon after they form. These sand fills are less saline and/or less alkaline than the surrounding soils and tend to channel surface runoff, allowing vegetation to thrive. These cracks might also represent an avenue for rapid downward seepage of brine or salt leachate. Although most of

Source: Pataya

Figure 12
Large Dessication Cracks Near Project Site

the cracks appear to be old, it is currently thought that most have formed in this century. The smaller evaporation pond would be located over several of these cracks; aerial photographs indicate there may be dessication cracks at the large pond site, although these are not clearly defined. Paleocracks--those formed during an earlier time, by similar processes, but since covered over with younger sediments--might also be present.

Figure 13 shows a vertical profile of the soil at the larger evaporation pond site (section 13). From the surface to a depth of 22 inches, the soil has a platy structure; below 22 inches, it has no apparent structure. Soil scientists such as Dr. Del Fanning at the University of Maryland suspect that platy structure is caused by swelling and shrinking as soil becomes alternately wet and dry. This theory could explain the appearance of platy structure in this soil, since dry lake (playa) clays frequently have a high shrink-swell. Additionally, a graph of the moisture profile of the playa soil in April 1981 (figure 14) shows that while the moisture content increases dramatically from the surface down to approximately 20 inches, it becomes more uniform below 20 inches. This evidence supports the shrink-swell theory.

According to this theory, the lower limit of the platy structure represents the most frequent depth at which significant change in the soil moisture occurs. This would mean that, given an estimated water-holding capacity of 0.15 inch of water per inch of soil, the most frequent flood level or depth of heavy rain at Red Lake would be at least 3.3 inches. Deeper flooding could wet the soil below 22 inches, but below this depth, the soil does not dry out often. Thus, platy structure does not form there.

Soil samples obtained by the applicant were tested to assess the permeability of the soil to saturated brine, the soil texture, the optimum moisture content for maximum mechanical compaction, and the susceptibility of the soil to dispersion in brine. (The laboratory report is presented in appendix A.) Briefly, the test results indicate the following.

> The permeability of undisturbed samples of the soil to brine, from a soil depth of 1 or 2 feet (a 12-inch vertical column beginning 1 foot below the surface), averages 0.057 inch per hour. The permeability to brine following maximum compaction of the soil is less than 0.000002 inch per hour. The permeability of the undisturbed samples should be considered only an approximate value because sampling techniques disturb the soil somewhat, affecting the permeability.

> The soil texture from the surface down to 1 foot ranges from clay to silty clay.

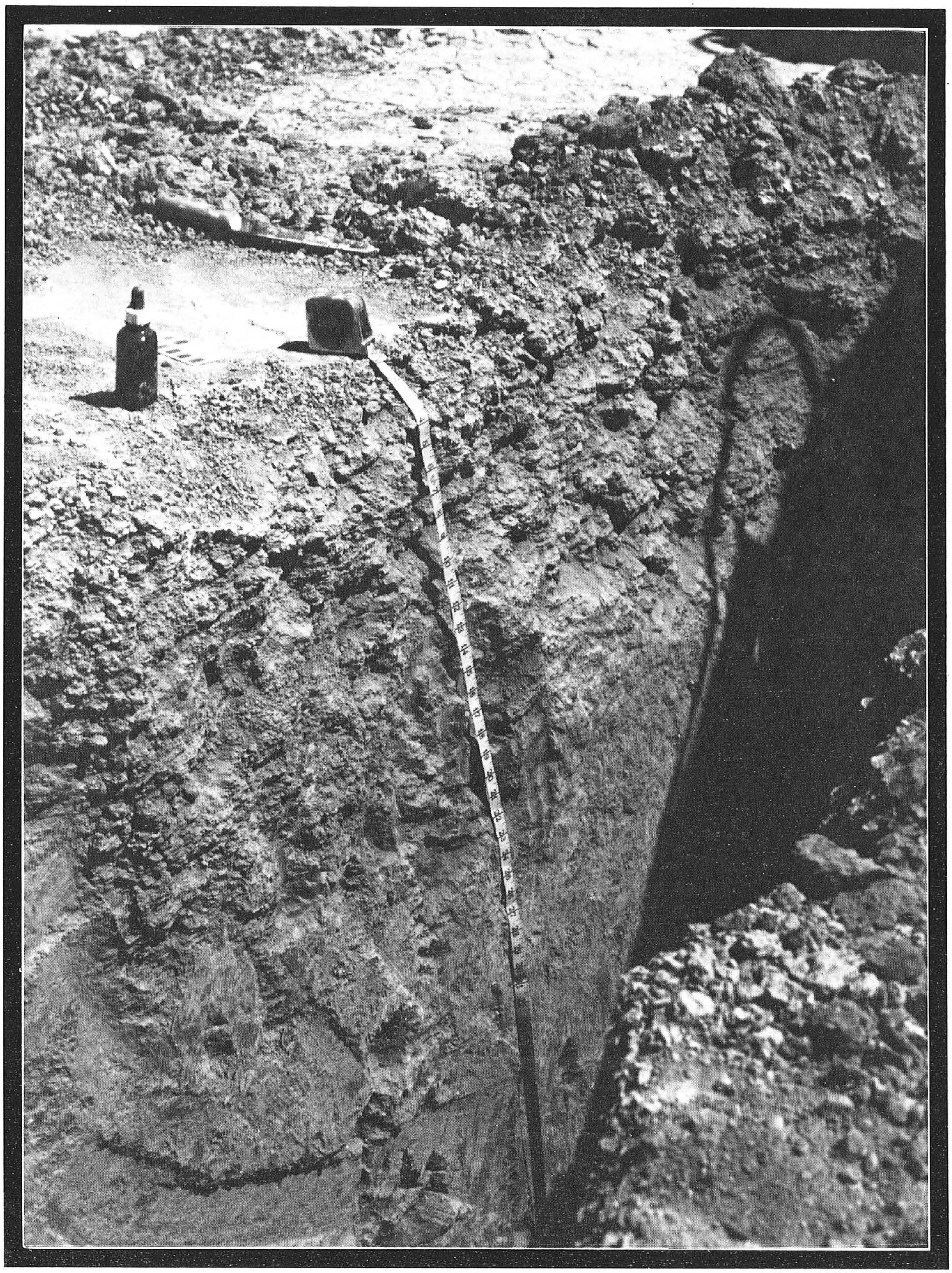


Figure 13
Soil Profile of Main Evaporation Pond Site

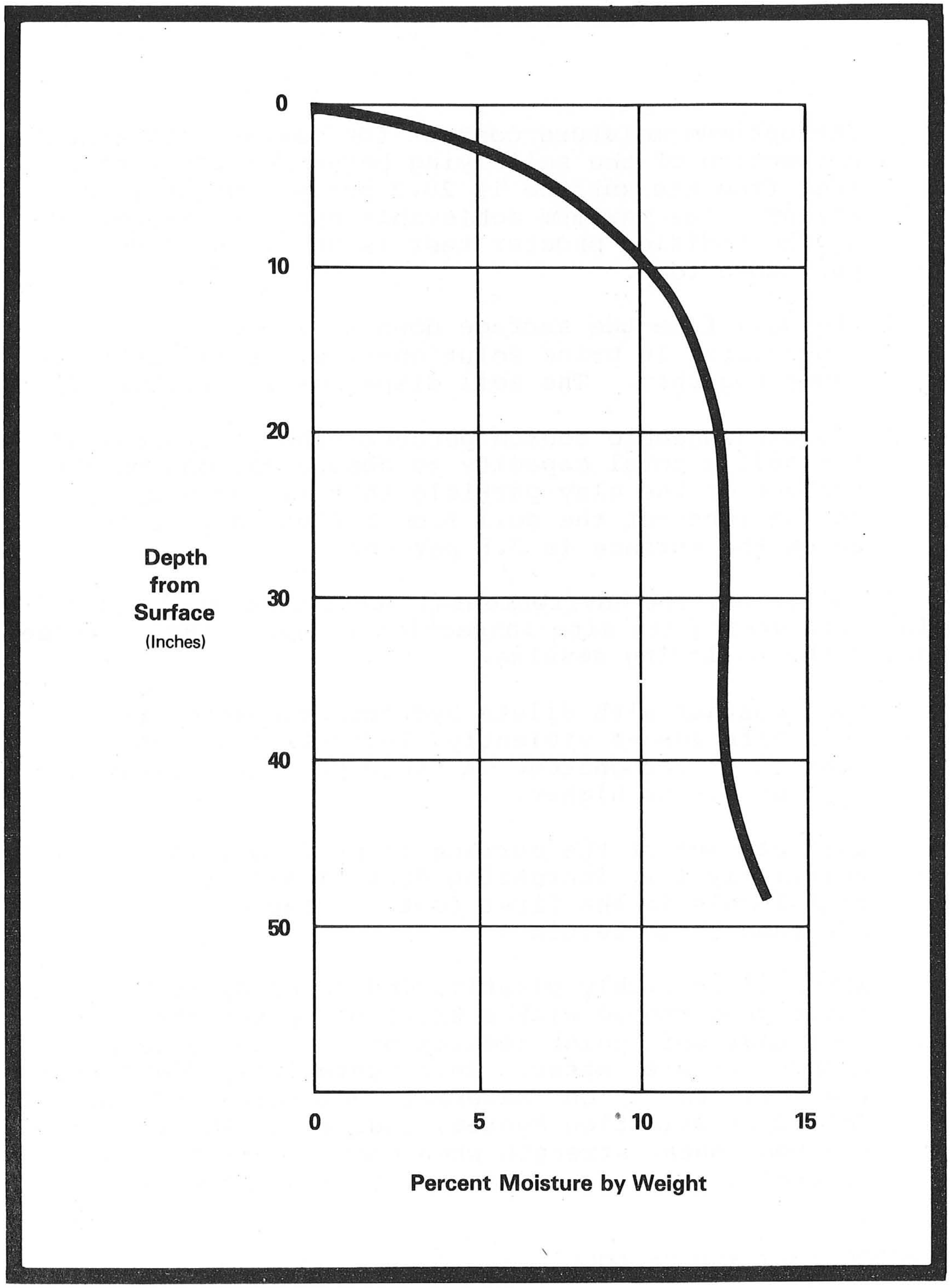


Figure 14

Approximate Moisture Content of Red Lake Playa Sediments at the Proposed Main Evaporation Pond Site, April 24, 1981

> The optimum moisture content for maximum mechanical compaction of the soil lying between 1 foot and 2 feet from the surface is 20.2 percent moisture by weight. The maximum achievable density determined by the modified procter test is about 106 pounds per cubic foot.

> The soil from the surface down to 1 foot flocculates in brine solution--i.e., soil particles clump together. The soil disperses in freshwater.

> The exchangeable sodium percent--the percentage of the soil's total capacity to absorb cations on the surface of the clay particle that is taken up by sodium ions--of the soil from 1 foot to 2 feet below the surface is 3.8 percent.

In addition, the environmental staff conducted several simple field tests during its site inspection in April 1981. These tests produced the following results.

> Upon contact with dilute hydrochloric acid, the soil effervesces violently, indicating a high content of carbonates. A field pH test indicated a pH of 8.6 or higher.

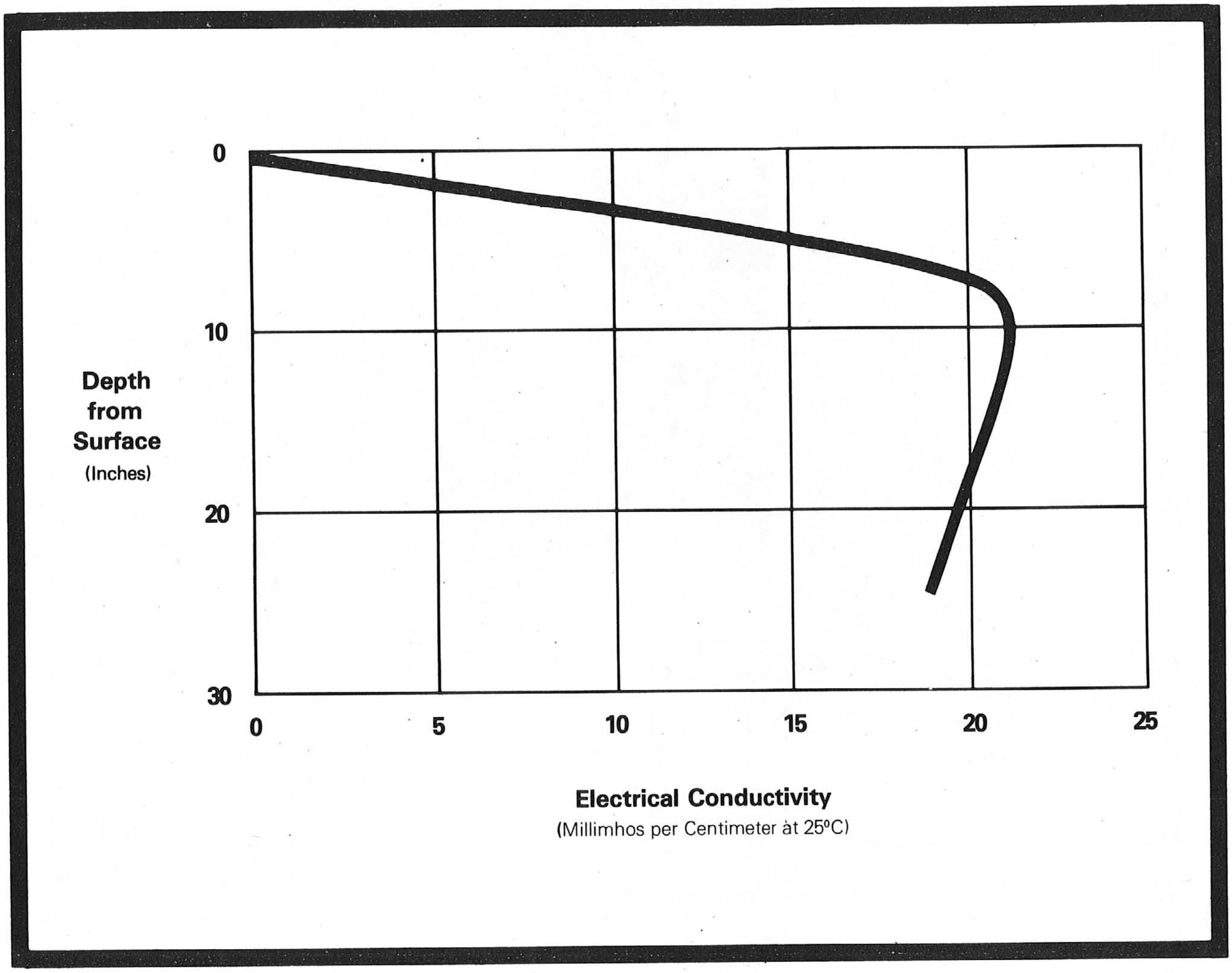
> Salt content of the surface inch of soil is relatively low, increasing dramatically to high levels in the first foot. (Figure 15 diagrams these levels.)

> The soil is highly plastic, indicated by its shine when rubbed with a knife blade and the fact that soil color remains on the hand unless washed off with water. This tentatively identifies the soil as a CH material according to the Unified Soil Classification System, indicating the soil has poor shear strength when compacted and saturated and is a poor construction material.

D. TOPOGRAPHY AND GEOLOGY

1. Topography

Hualapai Valley is a closed surface drainage basin. It is the easternmost valley of the Basin and Range province, bounded on the west by the Cerbat Mountains and on the east by the Grand Wash Cliffs of the Colorado Plateau province. Figure 16 shows the physiography of the project area; figure 2 shows the topography. To the south, the Peacock Mountains and the Hualapai



Source: Electrical conductivity of sediments conducted at the sample site by Russel Barmore, USDA, and Cary Secrest, FERC, on April 24, 1981.

Figure 15

Approximate Electrical Conductivity of Red Lake Playa Sediments at the Proposed Main Evaporating Pond Site

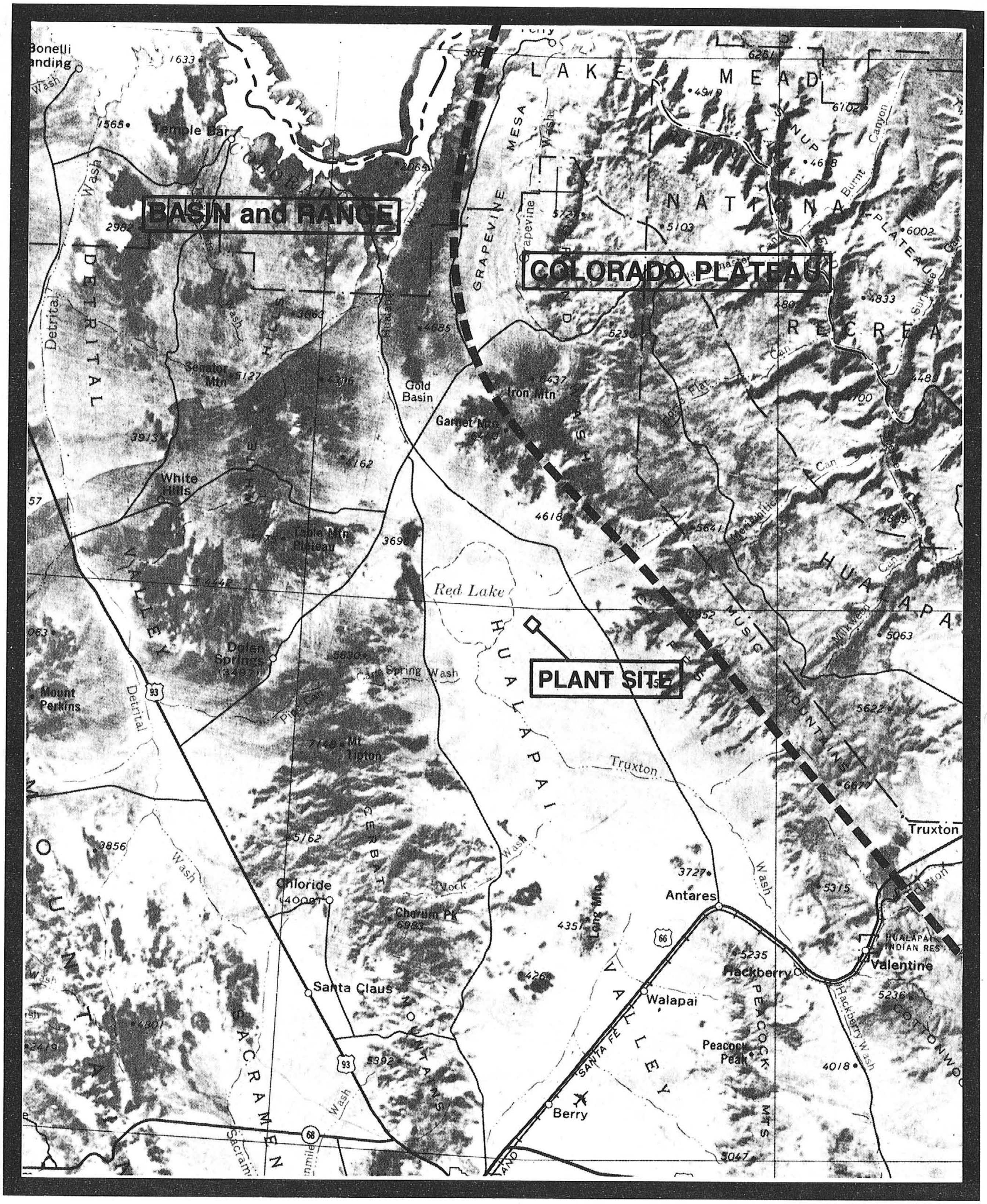


Figure 16
Physiography of Project Area

Mountains surround the valley, while a low topographic divide restricts surface drainage to the north. Red Lake is a playa located near the northern end of the valley.

The lowest elevation in Hualapai Valley at the level and featureless surface of the Red Lake playa is 2,754 feet above sea level. The playa covers approximately 20 square miles. Alluvial fans and pediments rise from the playa to the bases of the surrounding mountains at elevations of 2,800 feet to 3,200 feet.

Long Mountain is the largest of several isolated hills in the southern portion of Hualapai Valley. The valley floor at the south end of the valley is approximately 3,200 feet high and slopes northward toward Red Lake at an average drop of 20 to 30 feet per mile. Local relief along the proposed pipeline route is a few feet at dry stream channels and at various scattered dunes.

2. Geology

The Cerbat Mountains are a tilted fault block characteristic of the Basin and Range. The Grand Wash Cliffs, an expression of the Grand Wash fault, one of the major faults in northwestern Arizona, represents the western edge of the Colorado Plateau. The crest of the Grand Wash Cliffs is at 6,000 feet in the north end of the valley and 6,677 feet at the summit of the Music Mountains, the southernmost portion of the cliffs.

The consolidated rocks of the mountains surrounding Hualapai Valley consist of igneous intrusives and metamorphic, sedimentary, and volcanic rocks. (Figure 21, which shows the hydrogeology of the project area, also identifies the locations of these rock types.) The oldest rocks exposed in the mountains are granite gneiss and schist of Precambrian age. (See table 6 for an explanation of the geologic time scale.) Interspersed in these deposits are small granitic intrusions. Other intrusives are Late Cretaceous to early Tertiary in age.

Sedimentary rocks of Paleozoic age which cap the Grand Wash Cliffs consist of the Tonto Group--the Tapeats Sandstone, Bright Angel Shale, and Muav Limestone, with Devonian limestone above.

The alluvial deposits in Hualapai Valley are divided into the older alluvium of Tertiary age, the intermediate alluvium of late Tertiary and Quaternary age, and younger alluvium of Quaternary age. The older alluvium is the principal aquifer in Hualapai Valley. It consists of moderately consolidated fragments of granite, schist, gneiss, and volcanic rocks in a brownish-gray silty clay or sandy matrix and contains interbeds of weakly consolidated volcanic ash deposits. The grain size decreases from pebble- and boulder-size fragments in the deposits near the mountains to coarse sand and interbedded clay and silt in the bottom of the valley. The playa materials are primarily silty clay.

TABLE 6

GEOLOGIC TIME SCALE

Relative Duration of Major Geologic Intervals
Cenozoic
Mesozoic
Paleozoic
Precambrian

Era	Period	Epoch	Approximate Duration in Millions of Years	Millions of Years Ago
Cenozoic	Quarternary	Holocene	Approx. the last	10,000 years
		Pleistocene	2.5	2.5
	Tertiary	Pliocene	4.5	7
		Miocene	19.0	26
		Oligocene	12.0	38
		Eocene	16.0	54
		Paleocene	11.0	65
Mesozoic	Cretaceous		71	136
	Jurassic		54	190
	Triassic		35	225
Paleozoic	Permian		55	280
	Carboniferous: Pennsylvanian		45	325
	Carboniferous: Mississippian		20	345
	Devonian		50	395
	Silurian		35	430
	Ordovician		70	500
	Cambrian		70	570
Precambrian			4,030	

Scale: 0, 50, 100, 150, 200, 250, 300, 350, 400, 450, 500, 550, 4,600

a) Cavern Compressor Site

The presence of halite in Hualapai Valley was first confirmed in 1958 when the Kerr-McGee Corporation (Kermac) sank two mineral exploration holes to the southeast of Red Lake. One hole cored about 1,200 feet of coarsely crystalline halite, the other about 635 feet of similar material. The top of the salt was about 1,400 feet below the surface. A third exploratory well was drilled nearby in 1970 by El Paso. That well hit salt at approximately 1,500 feet and bottomed out in salt at about 6,000 feet, proving that the salt section is at least 4,500 feet thick in that area of the valley. Recent seismic profiling across the valley has made it possible to map the structure contours and formation thickness of the salt deposit (figure 17; also Appendix B, "Seismic Survey"). The salt desposit is a wedge-shaped body, thinning to the west and fault bounded to the east, where it is more than 7,000 feet thick. The salt body is approximately 5,000 feet thick 1,450 feet below the surface of the proposed cavern site. 1/

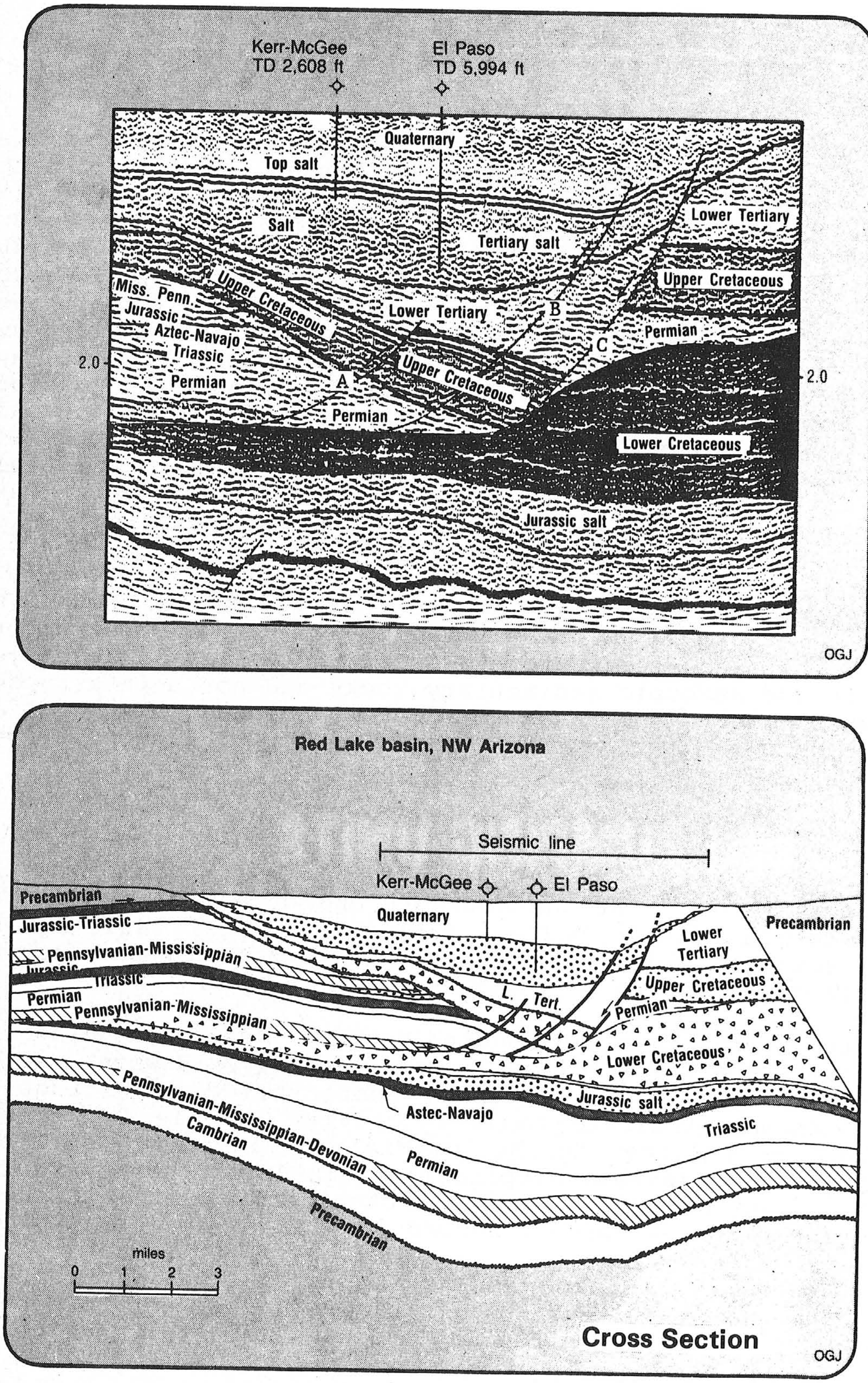
The seismic survey also suggests that the Cerbat Mountains are a series of thrust plates--that is, the geologic structure below the Cerbats and the western side of the valley is a complex of Paleozoic and Mesozoic sedimentary rocks and not uninterrupted Precambrian basement rocks, as previously assumed (figure 17). Pataya considers seismic profile lines 2, 3, and 4 proprietary.

b) Seismicity and Faulting

Hualapai Valley is at the southern end of a region known as the Intermountain Seismic Belt--a distinct zone of faulting and earthquake activity which extends from western Montana to northwestern Arizona. (Figure 18 identifies this belt.)

The area immediately surrounding Hualapai Valley has historically experienced a low level of seismic activity. However, seismic quiescence within the relatively short period of earthquake recording does not indicate fault inactivity. While few earthquakes have been recorded in the immediate vicinity of Red Lake, the Tertiary and Quaternary displacement history on nearby faults suggests that the region is indeed tectonically active. Earthquakes greater than the largest recorded event are, in fact, quite possible. However, the large events (magnitude 6.0 or greater) that have occurred in southern California and northwestern Mexico appear to be associated with the San Andreas, Imperial, and other

1/ The isopach map (appendix B, figure B-3) also includes what is interpreted to be Lower Tertiary on figure 17.



KEY

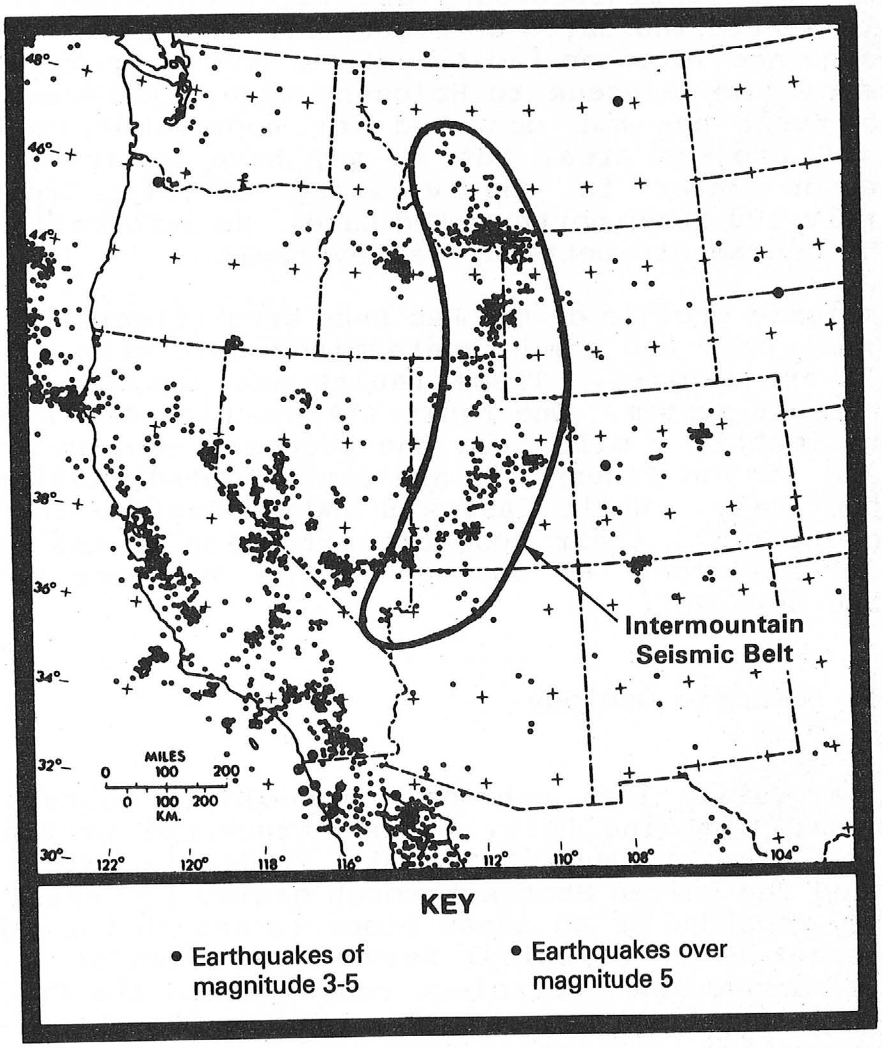
TD--Total Depth

A, B, C--Unnamed Faults

Source: Hansen, Moulton, and Owines, "Utah-Arizona Overthrust-Hingeline Belt," *Oil and Gas Journal* (November 24, 1980), p. 195.

Figure 17

Seismic Line Number 1: Red Lake Area



Source: U.S. Army Waterways Experiment Station.

Figure 18

Earthquake Epicenters in Western North America: 1961-1970

related faults; because of the distance between the plant site and these faults, recurrent activity would have little or no effect on the proposed facility.

The major faults in the vicinity of the proposed project--the Grand Wash, Hurricane, Toroweap, and Sacramento-Detrital Valleys fault systems--are indicated on figure 19. Evidence suggests that the Hurricane and Toroweap fault systems have been recurrently active at least from Miocene to Holocene time. Movement along the Grand Wash fault has not occurred for approximately 10 million years in the project area, but it may have occurred during the Pleistocene or later in the vicinity of St. George, Utah, approximately 100 miles north of Red Lake. No information is available on the Sacramento-Detrital Valley fault.

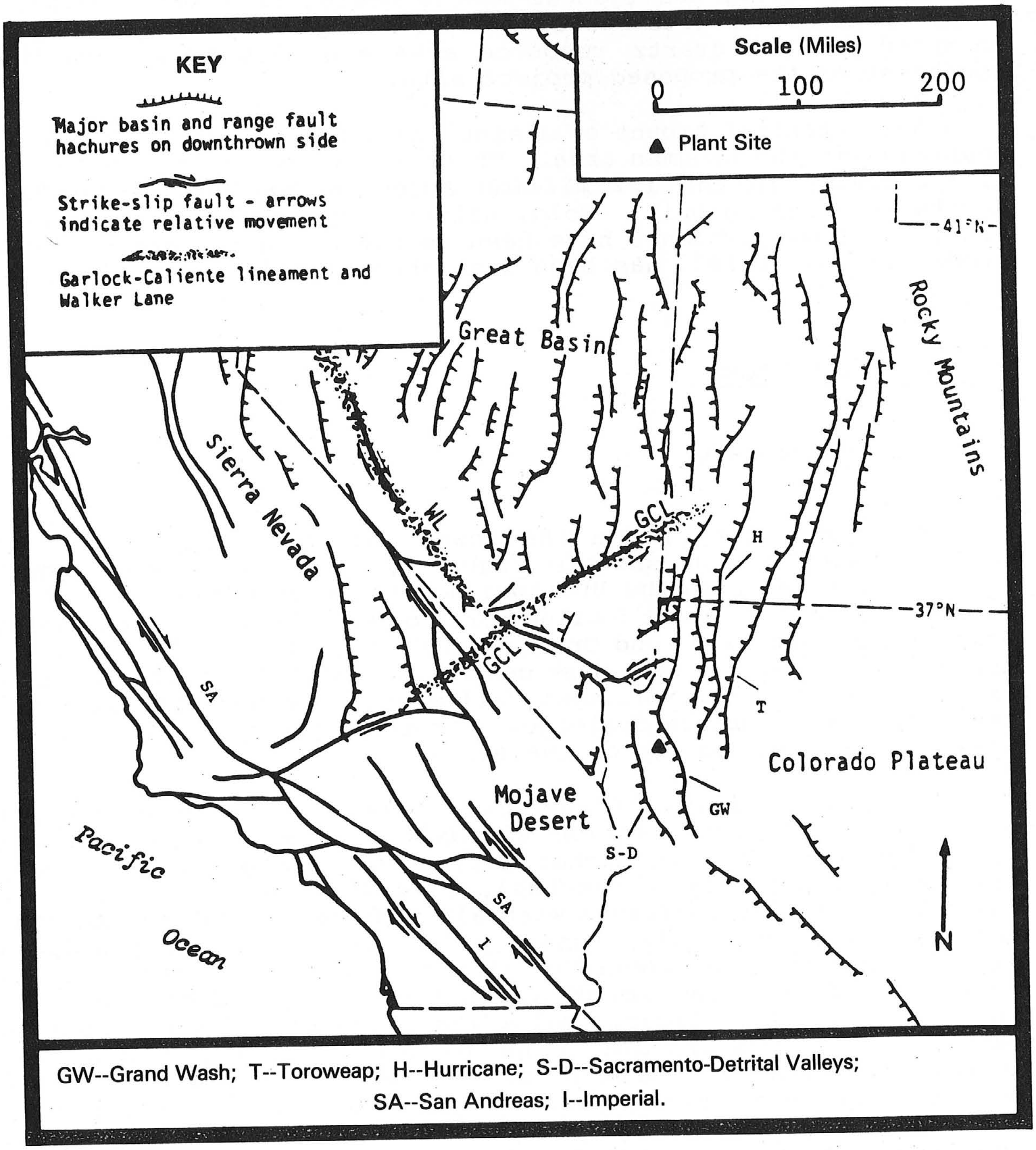
The seismic profile of the Red Lake area (figure 17) indicates that the salt body and some undetermined thickness of overlying valley fill are faulted. These faults are probably part of the Grand Wash fault system. One fault ("A" on figure 17) is, in profile, approximately 1 mile from the proposed caverns. The other two ("B" and "C" on figure 17) are approximately 1.5 and 2 miles away, respectively. While faults B and C displace the salt body upwards to the east, their possible extension to the surface has not been investigated. No obvious scarps or other active fault features are apparent.

c) Economic Geology

Hualapai Valley lies astride the geologic feature known as the Overthrust-Hingeline Belt. This structural province, which runs from the Brooks Range in Alaska along the Rocky Mountains in Canada and the United States through Mexico to Central America, is presently regarded as an ideal place to search for oil and gas. The most recent U.S. Geological Survey estimates of undiscovered recoverable conventional petroleum resources in the Colorado Plateau and Basin and Range region (of which the Overthrust-Hingeline Belt is the primary exploration frontier) are 14.2 billion barrels of oil and 90.1 trillion cubic feet of natural gas. 1/

Much of the public land in and around Red Lake and the proposed plant site has been leased for oil and gas exploration and development. There are 23 oil and gas leases currently in effect, covering approximately 77 square miles in the immediate vicinity of Red Lake. Four of these leases expire in May 1983, the others in March 1988. So far, little if any exploratory drilling has been done.

1/ U.S. Department of the Interior, "News Release" (Washington, D.C., February 25, 1981). Figures are mean value estimates.



Modified from R.W. Greenfelder *et al.*, "Seismotectonic Regionalization of the Great Basin," Geological Society of *America Bulletin* (September 1980), p.519.

Figure 19

Major Faults Near the Proposed Project

The fact that a large salt body underlies a sizeable portion of Hualapai Valley has led the BLM to designate an area southeast of Red Lake as a halite resource area, though no halite mining has occurred yet. A quartz resource area has also been identified southeast of the proposed project site.

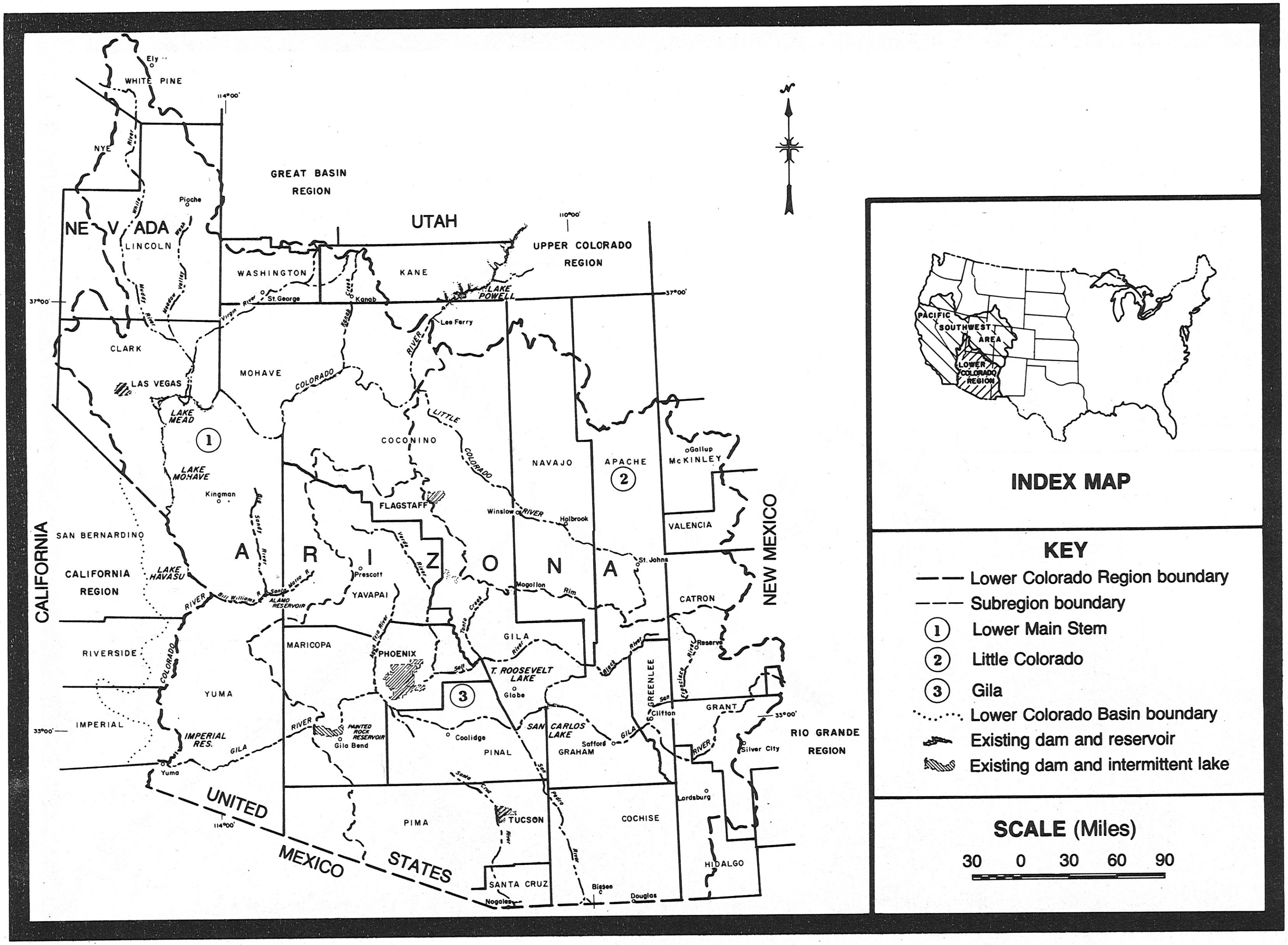
A substantial amount of mining has occurred in and around the mountains in the Kingman area. There are approximately 700 active mining claims in the 1.2 million acres of the BLM Cerbat/Black Mountains Planning Unit. Gold, silver, copper, lead, molybdenum, zinc, and some gemstones have been recovered in the area. Annual production as of 1977 has been less than $1 million for each commodity.

E. WATER RESOURCES

1. Surface Water

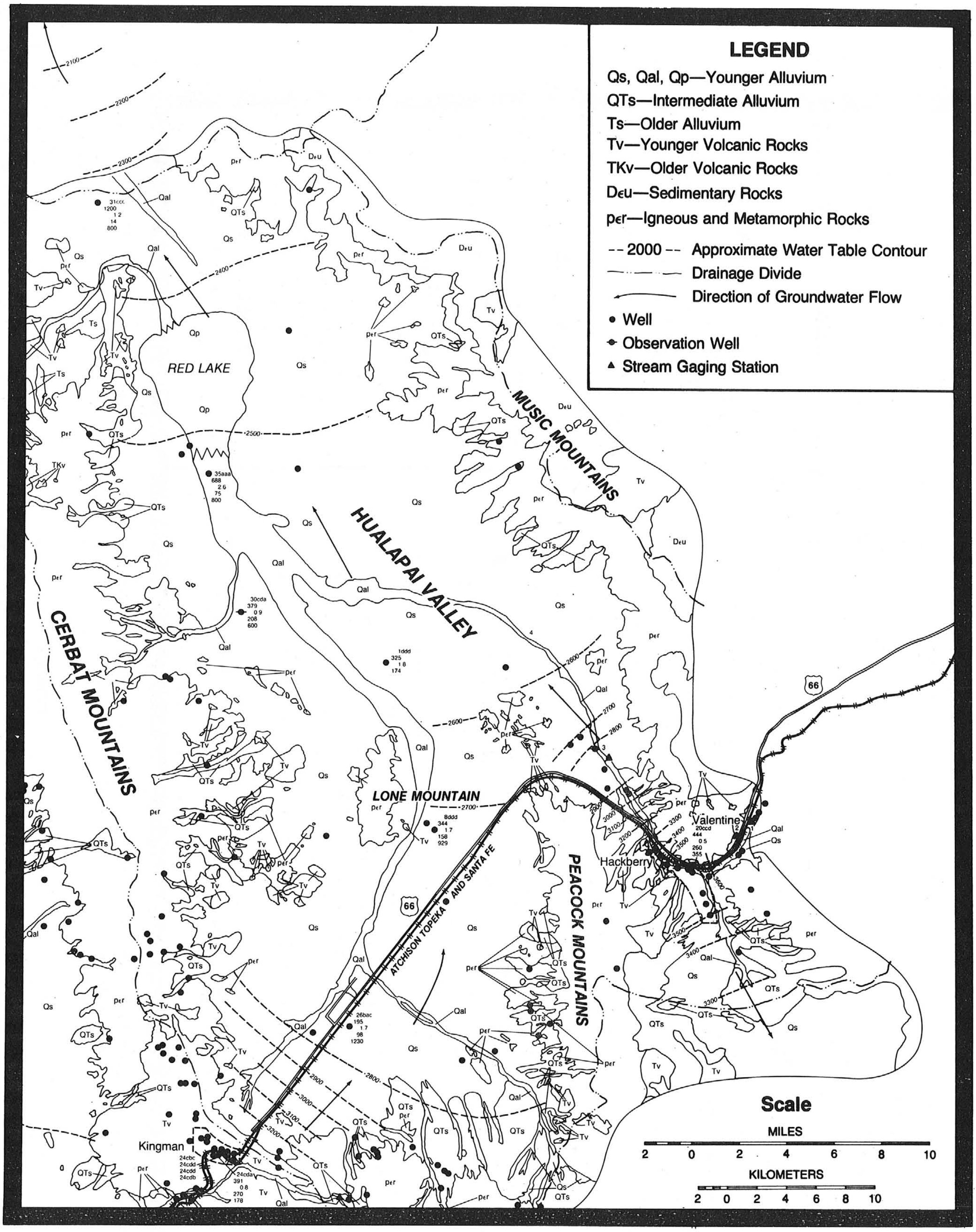
Hualapai Valley is in the Lower Mainstem Subregion of the Lower Colorado Region, shown in figure 20. The valley trends north-south, extending from the Hualapai Mountains on the south to a low topographic divide about 5 miles north of Red Lake. Truxton Valley, east of the Cottonwood and Grand Wash Cliffs, and a small valley to the south of where Truxton Wash passes through the Cottonwood Cliffs are tributaries to the Hulapai Valley and together with it form a basin of closed surface drainage. Figure 21 presents a generalized view of the hydrogeology of the area.

While the climate of Hualapai Valley is typically semiarid (average annual precipitation approximately 6 inches), subhumid conditions occur at the higher altitudes (average annual precipitation approximately 20 inches). Between these two extremes, rainfall typically increases with altitude because of the mountain geography. Consequently, runoff primarily depends on precipitation or snowmelt on mountain slopes adjacent to the valleys. Streams flow from the mountain canyons onto dissected alluvial fans and the valley floor. Below the streams' emergence from the canyons, the flows are diminished by infiltration and evapotranspiration. Although substantial streamflow can occur in the mountains because of high intensity storms, flows seldom reach the middle of Hualapai Valley. While a few streams in the surrounding mountains are perennial, the valley streams (including Truxton Wash, the principal stream in Hualapai Valley) are ephemeral.



Adapted from: Lower Colorado Region State-Federal Interagency Group for the Pacific Southwest Interagency Committee, *Lower Colorado Region Comprehensive Framework Study Main Report* (1971), p. ii.

Figure 20
Lower Colorado Hydrologic Region



Modified from Gillespie and Bentley, plate 1.

Figure 21
Selected Wells and Water Level Contours in Hualapai Valley

The mean annual surface water inflow into the valley is estimated to be about 4,000 acre feet. 1/ No long-term streamflow records are available for Hualapai Valley.

Between 1964 and 1967, when one continuous gaging station and two partial record stations were maintained by the U.S. Geological Survey on Truxton Wash, only two major flows occurred. The flood of December 10, 1965, caused by rain falling on snow, was approximately 36 hours long and reached Red Lake. The peak discharge for the flood decreased downstream from 1,120 cubic feet per second (cfs) in Truxton Wash at Valentine (peak flood stage approximately 2.8 feet) to 520 cfs at the gage in Truxton Wash near Hackberry. The August 18, 1966, flood followed a high intensity thunderstorm. It lasted approximately 12 hours and did not reach Red Lake. The estimated peak discharge decreased from 1,960 cfs at Valentine (peak flood stage approximately 3.5 feet) to 402 cfs at the gage at Truxton Wash near Hackberry.

The maximum peak observed was on August 2, 1904, when a flow estimated at 49,000 cfs occurred in Truxton Canyon. On July 30, 1904, however, Truxton Wash in Truxton Canyon, which is normally dry, had a depth at one Santa Fe Railway bridge of more than 30 feet and "a very high velocity." 2/

Whether streamflows reach Red Lake and to what extent flooding occurs is a function of the amount and intensity of precipitation, the proximity of the precipitation to the lake, and the ambient soil moisture. Flows are more likely to flood Red Lake after extended periods of wet weather.

2. Groundwater

Hualapai Valley is an intermontane basin filled with alluvial deposits, evaporites, and volcanic rocks to a depth of approximately 10,000 feet. The valley floor slopes northward from an altitude of nearly 4,000 feet at the south to an elevation of 2,754 feet at Red Lake. The alluvial deposits are divided into older, intermediate, and younger alluvium.

1/ J. B. Gillespie and C. B. Bentley, Geohydrology of Hualapai and Sacramento Valleys, Mohave County, Arizona: U.S. Geological Survey Water-Supply Paper 1899-H (Washington, 1971), p. 21.

2/ E. C. Murphy, Destructive Floods in the United States in 1904: U.S. Geological Survey Water Supply Paper 147 (Washington, D.C., 1905), p. 115.

The older alluvium of Tertiary age is the principal aquifer in the valley. The unit, the lowermost alluvial deposit in the valley, is exposed in isolated outcrops near the mountains.

The intermediate alluvium is an extensive near-surface deposit lying above the older alluvium and under the younger alluvium. From 200 to 500 feet thick, it is exposed in discontinuous outcrops near the mountains and in small isolated patches in canyons in the mountains. While the intermediate alluvium is not an important aquifer because most of it lies above the water table in the project area, it is capable of transmitting large quantities of groundwater in other areas.

The younger alluvium covers extensive areas in Hualapai Valley. It is generally above the water table except in some of the mountain canyons, where the stream deposits yield small amounts of water to wells. Tertiary volcanic rocks are an aquifer near Kingman.

Numerous springs discharge in the mountains and hills throughout the Hualapai groundwater basin. Most of the springs issue from igneous, metamorphic, and volcanic rocks in the mountain areas. No springs are known to issue from the alluvium on the valley floor. According to Gillespie and Bentley, the median spring discharge is about 2 gpm.

According to a U.S. Geological Survey seismic refraction survey across Hualapai Valley north of Red Lake, alluvial deposits above the water table are about 620 feet thick. The base of the alluvium is about 3,000 feet deep. Depth to water is about 500 to 900 feet northeast of Kingman and about 300 feet south of Red Lake.

Recharge to the alluvial deposits, primarily from infiltration of streamflow, is primarily associated with Truxton Wash. Much of the recharge also occurs near the apexes of the dissected alluvial fans which extend into the mountain canyons. Recharge from precipitation on the valley floor is negligible because of the generally high evapotranspiration rate and because of the relatively impervious layers of clay and caliche near the land surface.

Gillespie and Bentley estimate groundwater recharge in the Hualapai basin to be 5,000 acre feet annually. This value is based on an estimated annual subsurface outflow from the Hualapai basin of 5,000 acre feet and the assumption that, under natural conditions, the long-term groundwater recharge in a basin is equal to the groundwater discharge. Total storage in the valley is estimated to be 10.5 to 21 million acre feet.

Gillespie and Bentley estimate that 1,000 acre feet of the annual outflow flows out of the basin southeast of Hackberry. The remainder moves generally northward through the valley. Groundwater flow from the southern part of the Hualapai groundwater basin may be redirected northeastward by fine-grained materials beneath Red Lake and in nearby areas that act as a barrier. In a recent report on groundwater conditions in Hualapai Valley, W. H. Remick estimates that the outflow north is from 2,000 to 2,500 acre feet annually and that the southeast outflow is from 400 to 1,300 acre feet annually. 1/ On the basis of a 1936 report of a large spring near the mouth of Hualapai Wash, now submerged by Lake Mead, R. L. Laney suggests that the outflow north ultimately discharges into Lake Mead. 2/

Table 7 presents information about water quality and some aquifer parameters for selected wells in Hackberry, Kingman, and Hualapai Valley. Most of these wells are shown on figures 21 and 22. Groundwater generally is of good quality for most uses. In some instances, however, fluoride and total dissolved solids concentrations exceed acceptable levels.

Fluoride concentrations in samples from wells and springs in the Hualapai basin range from 0 to 6.5 milligrams per liter (mg/l). Drinking water regulations for the State of Arizona allow a maximum contaminant level for fluoride in the area of 1.6 mg/l. About one-third of the samples analyzed had fluoride concentrations which exceeded this level.

The maximum contaminant level allowed for dissolved solids proposed in EPA's secondary drinking water regulations is 500 mg/l. The few wells or springs which have dissolved solid concentrations that exceed this level are usually near the edge of the older alluvium or within the fractured or weathered crystalline rocks or the thin patches of alluvium in the mountains. One significant exception is a well south of Red Lake. (See well [B-26-16] 29 bbb in table 7.) The water sample taken from that well had a dissolved solids concentration of 9,600 mg/l. Remick attributes this high concentration to the presence of shallow evaporites, common in the Basin and Range physiographic province, which might have been encountered by the well. Because of the absence of test wells on the southeastern side of the valley, the quality of water and the extent of the shallow evaporites are unknown. Bentley and Gillespie indicate that the change of groundwater from the sodium-calcium bicarbonate type to the sodium chloride type through the valley can also be attributed to evaporite deposits.

Water pumped from the Hualapai groundwater basin has increased from 20 acre feet per year before 1960 to 6,000 acre feet annually in 1980. The Hackberry well field, used as a municipal water supply for Kingman, began operation in 1960. By 1965, extensive pumping from this field was causing an annual decline of the static

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1/ Map Showing Ground-Water Conditions in the Hualapai Basin Area: Mohave, Cocenino, and Yavapai Counties, Arizona--1980, D.W.R. Hydrologic Map Series Report No. 4.

2/ Ibid.

TABLE 7

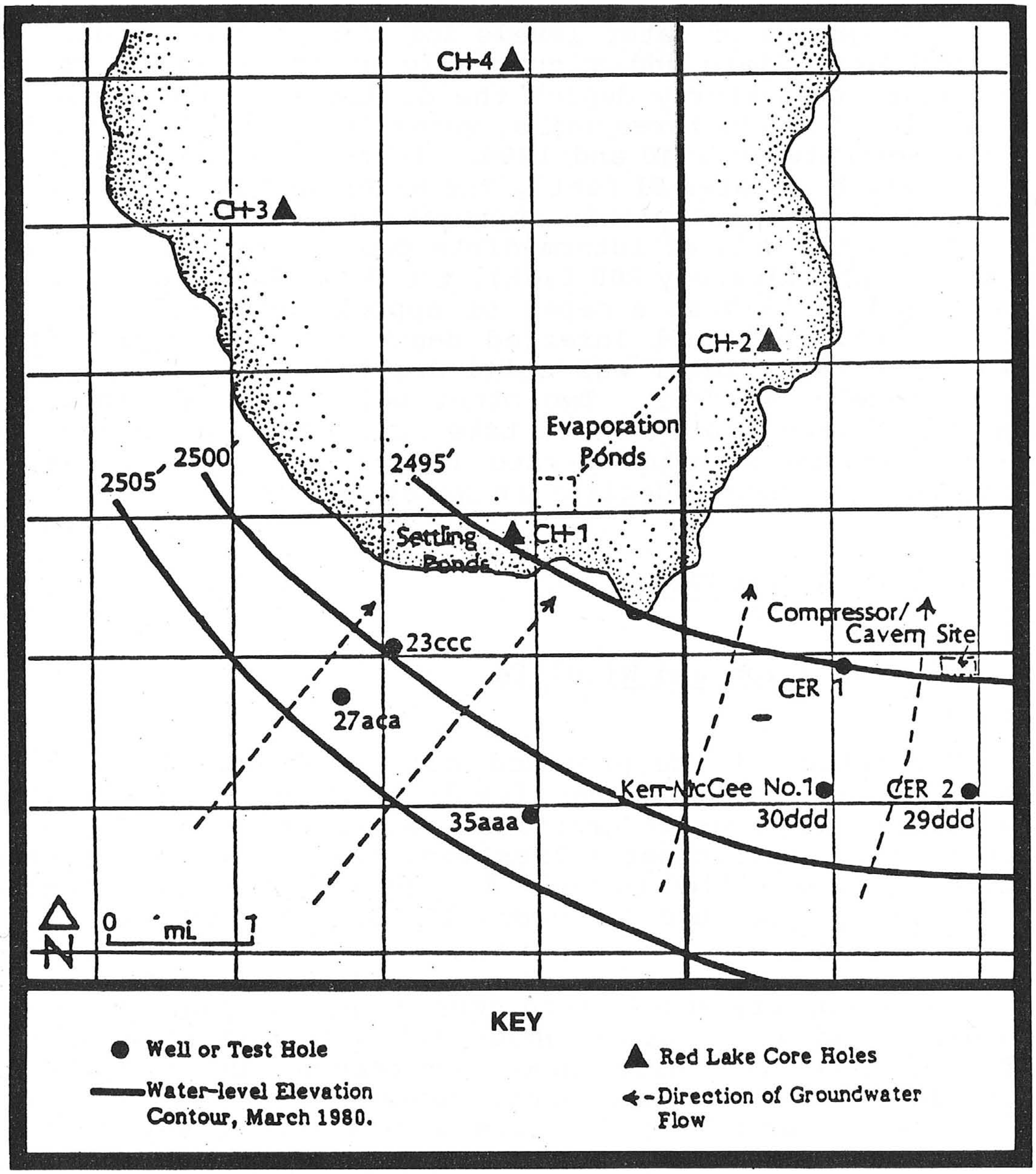
SUMMARY OF AQUIFER AND WATER QUALITY DATA

				Aquifer Test Data						Water Quality Data											
Well	Depth (Feet)	Permeable Material (Feet Below Ground Level)	Depth to Water (Feet)	Test Date	Well Discharge Rate (Gpm)	Well Drawdown (Feet)	Specific Capacity (Gpm per Foot of Drawdown)	Transmissivity (Gallons per Day/Foot)	Storativity	Calcium (Mg/l)	Magnesium (Mg/l)	Sodium (Mg/l)	Potassium (Mg/l)	Carbonate (Mg/l)	Bicarbonate (Mg/l)	Sulfate (Mg/l)	Chloride (Mg/l)	Fluoride (Mg/l)	pH	Conductivity Micromhos at 25°C	Total Dissolved Solids (Mg/l)
*(B-21-17) 24 cda	178		120	1962	105	44	2.4			66	25	25 Combined				31	48	0.8			391
*(B-22-16) 26 bac	1,230		530	2/10/67	660	51	12.9	44,000		16	14	32 Combined		0	16.4	13	11	1.7	7.7	324	195
*(B-23-13) 20 ccd	355		129	11/10/64	580	80	7.2	22,000		50	33	45 Combined		18	228	39	58	0.5		676	444
*(B-23-15) 8 ddd	929			3/5/65						48	9	53 Combined		0	132	45	57	1.7			344
*(B-24-16) 1 ddd				2/15/67						30	24	49 Combined		0	164	34	75	1.8	7.8	573	325
*(B-25-16) 30 cda	600			3/9/67						35	29	58 Combined		0	240	51	59	0.9	7.9	629	379
(B-26-16) 28 ddc Kermac #2	2,135	100-150			240	100	2.4	2,100													
**(B-26-16) 29 bbb CER #1	650	0-250 Some		12/18/79								6,000					16,346			16,000	9,600
**(B-26-16) 29 ddd CER #2	710	260-270 370-400		1/11/80						1,102	1,177		19.3		51	1,845					
**(B-26-16) 30 ddd Kermac #1	2,608	100-160 300-320 820-840																			
**(B-26-17) 23 ccc Neal #1	719	0-200 400-719	262	4/10/81	1,500	63	24	172,000	0.00076	2	1	72					28		9.1		218
(B-26-17) 23 - 2,200 feet due east of Neal #1/CER #3	a/ 750	500-750		4/10/81	2,000	125		17,440	0.00073								517 Nacl		~ 8.1		698
**(B-26-17) 27 aca	613	0-613																			
*(B-26-17) 35 aaa **	800	0-60 500-700	266	3/9/67	1,500	134	11.2	34,000		25	3	234			72	17	355	2.6	7.8	1,320	688
(B-27-17) 29 ccc North of Red Lake				1/66						7	6	289		56	509	25	90	3.0	8.7	1,270	727
(B-28-17) 31 ccc	800			6/10/65						3.6	1.2	460 Combined		41	120	95	528	1.2	9.5	2,210	1,200

* Shown on figure 21.

** Shown on figure 22.

a/ Well was screened from 250 feet to total depth. Screened intervals in other wells are unknown.



Source: Southwest, *Red Lake, Arizona, Gas Storage Facility Information* (Las Vegas, February 1979), p. 67.

Figure 22
Water Level Elevation Contours

water level ranging from 5 to 7 feet, and pumping was reduced to approximately 50 percent. After 1969, the Hackberry well field was discontinued as a municipal supply.

Hydrographs of water levels for two currently unused wells in the Hackberry Field and a currently unused well in Truxton Wash northwest of Hackberry depict the decline in water levels because of pumping. In all three wells, water levels declined approximately 50 feet between 1940 and 1980. In the shallowest (original inferred depth to water 51 feet), the water level began to increase in 1978 and in 1980 was within approximately 15 feet of the original level. In the well of intermediate depth (original inferred depth to water approximately 200 feet), the decline stopped and the level stabilized in 1970 at a depth of approximately 250 feet. In the deepest well (original inferred depth to water approximately 500 feet), the water level was still declining in 1980 at a depth of approximately 540 feet. Two other wells in the main part of the Hualapai Valley south of Red Lake have been pumped for a minimum of 15 years at an unknown rate from depths of 260 feet and 450 feet; neither show a decline in water levels.

F. BIOLOGICAL RESOURCES

1. Vegetation and Wildlife

Vegetation at the proposed storage site and along the proposed pipeline route include five distinct plant communities--shadscale, saltbush, desert grassland, shrub-grass disclimax, and Mohave thorn. Their general locations and a list of representative species are identified in table 8. The Red Lake playa is essentially unvegetated because of seasonal flooding, soil compaction, and soil salinity.

The temporary access road connecting the plant site to Stockton Hill Road would cross about 4.5 miles of shadscale and 1.2 miles of shrub-grass disclimax. A permanent access road connecting the plant site to Antares Road, about 5 miles to the east, would also be constructed. A detailed vegetation survey of that route has not been performed, but a BLM vegetation map indicates that the road would cross saltbush and a small amount of desert grassland.

The extent of plant cover and species diversity in most of the plant communities has been significantly affected by cattle grazing. Generally, intensive grazing in the valley reduces common grasses so that less palatable shrub species develop. Off-road vehicles using the area may also contribute to vegetation changes.

Hualapai Valley lacks the faunal diversity found in the surrounding foothills and mountains. Desert bighorn sheep are absent,

TABLE 8

PLANT COMMUNITIES IN PROPOSED PROJECT AREA

Community	Representative Species	Approximate Location a/
Shadscale	Shadscale, four winged saltbush, galleta, fluff grass	Vicinity of cavern/ compressor site to milepost (MP) 1
Saltbush	Four-winged saltbush, galleta, Anderson thornbush	MP 1-MP 11.8
Desert Grassland	Galleta, black grama grass, fluff grass, desert trumpet, banana yucca	MP 11.8-MP 28.5
Shrub-grass Disclimax	Snakeweed, black grama grass, desert trumpet, fluff grass, banana yucca	MP 28.5-MP 29.8
Mohave Thorn	California buckwheat, black grama grass, snakeweed, Mohave thorn	MP 29.8-MP 30.4

a/ Mileposts starting at storage site.

while only small numbers of mule deer and pronghorn occur in the project area. Small herds of pronghorn have been reported about 5 miles southeast of Red Lake, but it is uncertain whether these animals are transients or permanent residents of the valley. According to the Proposed Livestock Grazing Program: Cerbat/Black Mountain Planning Unit; Final Environmental Impact Statement, published by BLM in 1978, most of Hualapai Valley is designated as a pronghorn establishment area.

Small rodents, desert cottontails, and black-tailed jackrabbits are common throughout Hualapai Valley. The relative abundance of Merriam's kangaroo rats is typical of overgrazed range where shrubs dominate the vegetation. The usual mix of desert birdlife occurs in the area. Some of the more common species include the Gambels' quail, horned lark, cactus wren, verdin, and sage sparrow.

As would be expected in this environment, waterfowl and shorebird use of the project area is very limited. The Hualapai Valley is not within a major migratory flyway; however, small numbers of these birds are occasionally seen on ponds and on Red Lake when periods of heavy rainfall coincide with migration.

Predators are a prominent component of fauna. Coyotes, kit foxes, and various species of raptors are commonly observed in the area. Because of the scarcity of nesting sites, raptors primarily use the area as a hunting ground. However, burrowing owl nesting has been noted near the southern terminus of the proposed pipeline route.

Reptile diversity in the arid environment is typically high, and amphibians are limited in species and abundance. Thirty-nine species of reptiles occur in the valley and surrounding mountains. They are widely distributed, with some species occurring in virtually every vegetation type.

A detailed description of the vegetation and wildlife occurring in Hualapai Valley and surrounding mountains appears in BLM's Proposed Livestock Grazing Program, incorporated by reference.

2. Endangered and Threatened Species

In compliance with section 7 of the Endangered Species Act of 1973, as amended, the FERC staff requested that the U.S. Fish and Wildlife Service (FWS) provide a list of federally listed or proposed endangered or threatened species which could be present in the proposed project area. In its April 23, 1981, letter to the FERC staff, the FWS indicated that no listed or proposed endangered or threatened species would be affected by the Pataya storage project.

The zone-tailed hawk and the desert tortoise, both listed as threatened or sensitive by the State of Arizona, occur in the project area. The zone-tail hawk hunts for rodents, birds, and reptiles throughout the valley, but it does not nest near the cavern site or along the pipeline route. The desert tortoise also occurs throughout the project area, but at very low densities. Tortoises in the valley would most likely be found in areas containing rocky slopes or outcrops.

Two plant taxa currently under review by the FWS for possible listing as endangered or threatened--*Astragulus lentigniosus* var. *ambiguus* and *A. titanophilus*--could occur near the plant site or along the pipeline route. A third taxa under review, *Opuntia phaecantha* ssp. *superbospina*, occurs near the southern end of the pipeline. Until listed by the FWS, these plant taxa are not protected by the Endangered Species Act. However, *Opuntia phaecantha* ssp. *superbospina* is protected by the Arizona Native Plant Law, which protects all cacti species in the state.

G. LAND USE, RECREATION, AND AESTHETICS

1. Land Use

White men settled in Hualapai Valley in the 1860's, when the first ranchers raised a few cattle to feed the cavalry, miners, and friendly Indians. In 1882, the Atchison-Topeka and Santa Fe Railroad was completed. Crossing the valley, it provided transportation for livestock, thereby opening the valley to more intensive grazing.

Grazing continues to be the principal use of land today, although ranching employs less than 2 percent of the local labor force. The inherently low level of forage growth, coupled with past overgrazing, makes vast ranches necessary. 1/ The average ranch in the region is operated by a single family and encompasses 120 square miles. Because a ranch typically supports only 220 livestock, most ranchers supplement their income with outside employment. 2/

1/ Ranchers contend the range is in the same condition it was a hundred years ago. A recent study by BLM (*Proposed Livestock Grazing Program*) concludes otherwise.

2/ This average is derived from 23 ranches surrounding the project site in the BLM Cerbat/Black Mountain Planning Units of the Kingman Resource Area. Ranches actually vary widely in size and stocking rate.

Most ranchers own no more than half of the land they use. The other half is owned by the Federal Government and managed by the the BLM. In most of the valley, the ownership pattern, shown in figure 23, resembles a checkerboard of square-mile blocks. This gives BLM partial control over private land because it is difficult to use private land without crossing adjacent Federal land. As principal land planner and administrator in the valley, BLM controls livestock grazing, rangeland improvements, and other public uses of the land. 1/ Ranchers apply to BLM for grazing rights on public land. The area they apply for is called an allotment, which generally includes the rancher's private land. BLM administration has resulted in disputes with ranchers. The most recent began in 1978 when BLM proposed to reduce livestock grazing an average of 21 percent to improve range quality. Before 1973, BLM did not control livestock grazing levels.

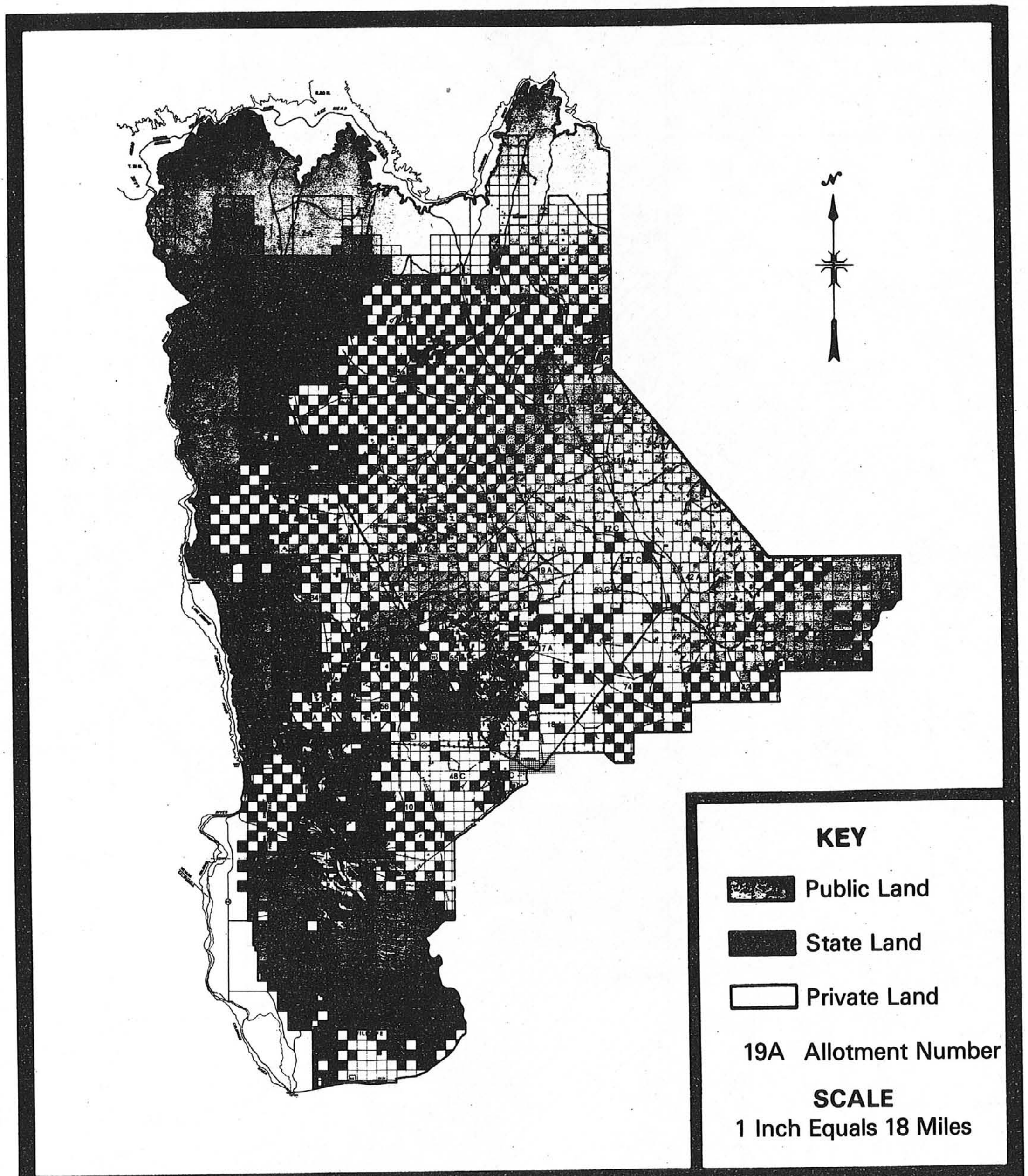
To reduce this kind of conflict and to increase the usefulness of public lands, BLM plans to consolidate the checkerboard pattern of public and private land by exchanging public land in areas where little public benefit exists for private land where the public benefit is greater. All public land in the project area is currently planned by the BLM to be exchanged for private land, converting much of Hualapai Valley to private ownership. The exchange areas are shown in figure 24. However, land exchanges must be initiated by the private landowner.

The construction of homes in the valley has been hindered by the lack of power and water. Although subdivided land abounds throughout the valley, there are virtually no houses between the northern suburbs of Kingman and Red Lake. This contrasts sharply with the Sacramento Valley to the west, which has hundreds of trailer homes.

Red Lake and the surrounding environs was the subject of a 1973 study by the Arizona Department of Economic Planning and Development to determine if it should be retained as a natural area. Under this designation, Red Lake would be preserved for the study of dry lake beds and their associated plants and animals. The study found that while Red Lake has high scientific value, it would not be feasible for the state to acquire the land. Thus, the state has taken no action to establsh a study area.

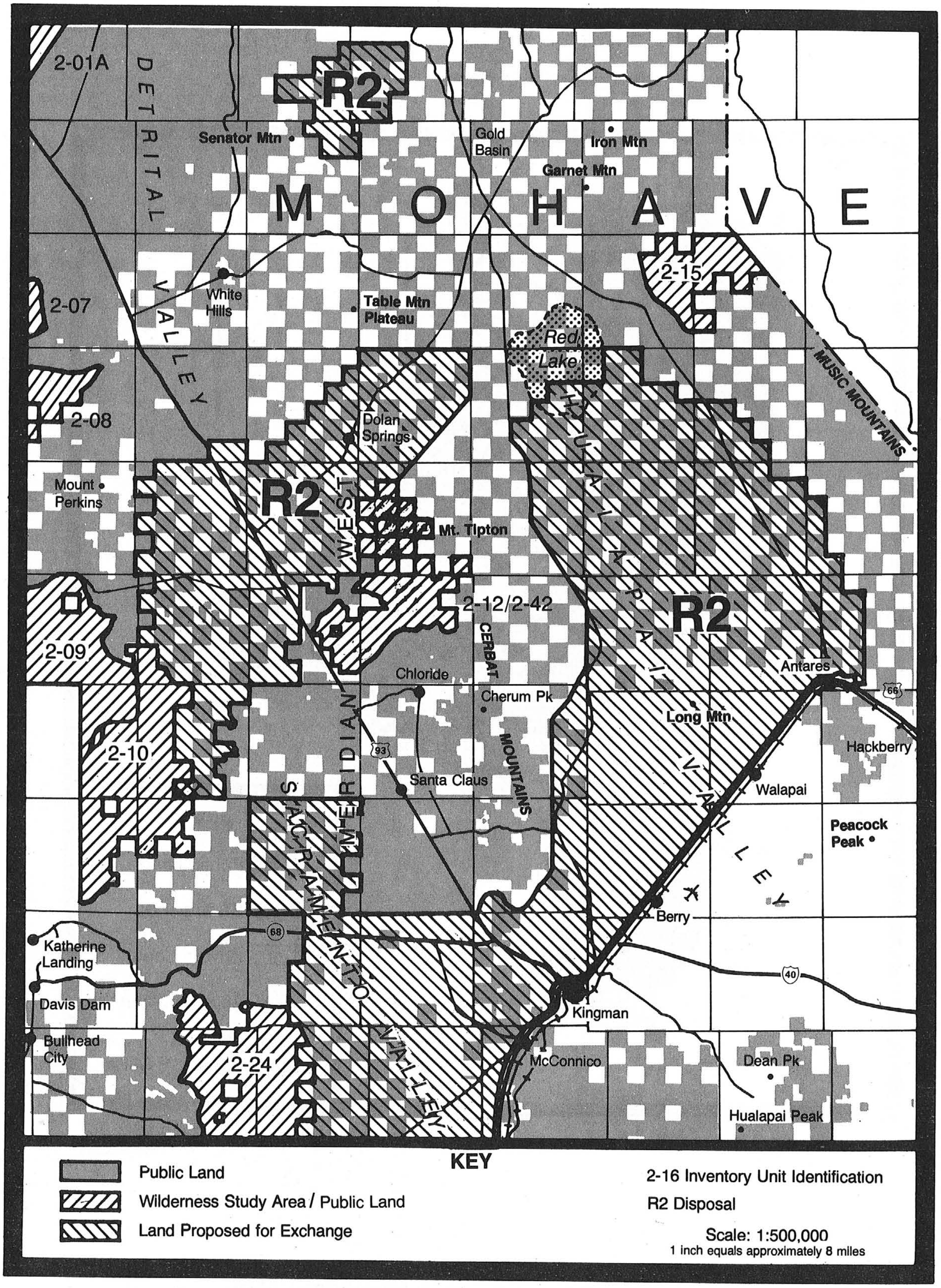
The BLM is investigating two other natural areas near Red Lake for possible wilderness designation. This would influence future uses of the areas. Designated WSA 2-15 and WSA 2-12/2-42, these areas are visible from the project site, but they would not be crossed by the proposed facilities. (Figure 24 shows these areas.)

1/ Mohave County also plans land use through land zoning. However, county zoning is subordinate to BLM management where Federal land is involved. Previously zoned agricultural-residential, the project site is now zoned for unlimited industrial use.



Adapted from BLM, *Proposed Livestock Grazing Program.*

Figure 23
Land Ownership Pattern in Hualapai Valley



Adapted from BLM, Wilderness Study Areas (November 1980).

Figure 24
Public Land in Project Area Proposed for Exchange