384 PARAHO DEVELOP CORP

SURFACE OIL SHALE RETORTING MODULE PHASE I ENVIRONMENTAL IMPACT STA

340

Paraho

FOR THE GOOD OF MANKIND®

ENVIRONMENTAL IMPACT STATEMENT

TASK 7.1 PROGRESS REPORT

PARAHO DEVELOPMENT CORPORATION
Grand Junction, Colorado 81501

PR-T7.1-9/80

SURFACE OIL SHALE RETORTING MODULE

PHASE I

ENVIRONMENTAL IMPACT STATEMENT

TASK 7.1 PROGRESS REPORT

PARAHO DEVELOPMENT CORPORATION
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Third and Main Streets
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Prepared for:
The Department of Energy

Under Agreement DE-FC03-80ET14103

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Section 1.0

INTRODUCTION

1.1 THE PROPOSED ACTION

It is expected that DOE will be involved in the funding of a demonstration program concerning surface retorting of oil shale. This demonstration will involve building and operating a single retort and its associated support facilities. Such facilities will include mining, crushing, rock handling, gas handling, oil handling and storage, and processed shale disposal.

1.2 PURPOSE AND NEED FOR ACTION

(By DOE)

1.3 HISTORICAL BACKGROUND AND PRESENT STATUS OF ACTION

(By DOE)

1.4 PROPOSED SCHEDULE FOR ACTION

(By DOE)

1.5 SCHEDULE OF PERMITS AND APPROVALS

(See deliverable under Task 5)

1.6 MAJOR ISSUES AND AREAS OF CONTROVERSY

(By DOE)

Section 2.0

DESCRIPTION AND ANALYSIS OF THE MAJOR ALTERNATIVES

2.1 THE PROPOSED PROJECT

The proposed action includes constructing and operating a full-size module oil shale retort facility, using Paraho Development Corporation technology, on a 582 acre lease tract in Uintah County, Utah. Operating the 10,500 barrels per stream day of shale oil module and its supporting facilities will require mining production capacity of 23,600 tons per stream day of oil shale, crushing, transporting oil shale to the retort, retorting, transporting the shale oil to storage tanks, and disposing of fines and spent shale.

The Paraho process will use a rectangular vertical kiln retort with a shale and gas distribution system. The retort is a refractory-lined vessel designed to operate at near atmospheric pressure. Crushed shale enters the top and moves downward through four processing zones: 1) oil mist formation; 2) retorting; 3) combustion; and 4) cooling. A grate mechanism removes spent shale from the bottom to provide a continuous flow of shale. Air and recycle gas are injected at various levels of the retort to support combustion, retorting, and heat transfer. The gas flows upward from the retorting zone into the mist formation zone where oil vapors are condensed into a fog or mist. The gas and entrained oil mist is removed from the retort vessel by an off-gas collector system and is piped to an oil mist removal system. Shale oil is removed as a liquid product stream. Part of the oil-free gas will be recycled to the retort and the product gas combusted for energy recovery or disposal.

Retorted shale will be conveyed to a disposal site near the plant site and within the 582 acre lease tract. At base case design, 14,600 tons per stream day of retorted shale will be moved to the disposal site.

Mining will be accomplished by a conventional room and pillar mining system in the Mahogany zone of the Green River Formation in the Uintah Basin. A two-bench mining system will probably be used with operation on an essentially continuous basis (20 shifts/week). Mine access will probably be via a vertical shaft. Blasted shale will be hauled to a primary crusher located within the mine. Raw shale from the primary crusher will be delivered to a stockpile at the retort area. Shale from the stockpile will be crushed and screened to an optimum size for retorting.

After completion of an Environmental Impact Statement and a decision to proceed with Phase II of the Paraho Project, a construction period of approximately 18 months beginning in mid-1982 is planned. An operational period of approximately 24 months would occur beginning near the end of the construction period. This period will be planned to test and demonstrate the Paraho retorting technology.

A decision will be made after the operating demonstration period is completed as to whether to continue operation (expected), expand the operation, or cease operations.

2.2 ALTERNATIVE SITES (with respect to the Paraho Project)

Although a proposal to construct an experimental full-size oil shale retort with a capacity of 4700 barrels per day at Anvil Points, Colorado was made in 1974 by Development Engineering, Inc. (a subsidiary of Paraho Development Corporation), the Anvil Points location is really an alternative but seemed choice as a site. Paraho foresees a need for projects at both locations. The Utah site has the advantage of a location amenable to expansion from demonstration to commercial size plus the advantage of being under a state of Utah lease which permits commercial production of shale oil. The Anvil Points site has the advantage of being a less remote location more conducive to the conduct of a more research oriented project.

2.2.1 Mine

With the limited size of the Utah site (582 acres), there can be no significant alternative mine sites.

2.2.2 Plant

Because of the terrain, the location of potential processed shale disposal sites, the location of existing pipelines, and limited options for mine access, there will be little freedom of choice on plant sites. The plant will be located on the mesa at an exact location not yet determined.

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2.3 ALTERNATIVE PROCESSES

2.3.1 Mining

Because room and pillar mining of oil shale has been successfully demonstrated and because the material to be mined is at a depth which precludes surface mining for an operation of the size contemplated, no alternative mining processes were considered.

2.3.2 Retorting

The objective of constructing and operating a module retorting facility incorporating Paraho technology is to demonstrate the reliability, efficiency, and feasibility of the Paraho process on a commercially sized retort and to obtain technical, scale-up, cost and environmental data of value in developing the oil shale retorting industry. Thus no alternatives to the Paraho process could be considered. Variations in the design of the Paraho process are being considered.

2.3.3 Waste Disposal

2.3.3.1 Mine Tailings and Fines

During secondary crushing and screening, approximately 10% of the shale crushed will be removed as fines. Disposal of this material along with retorted shale was considered but combined disposal was rejected for two reasons. Experience has shown that the properly managed disposal of fines segregated from retorted shale can best avoid the possible hazard of slow combustion from the mixture of raw shale fines with warm, retorted shale. The segregated fines, properly compacted for storage, could be recovered at a later time for processing if desired.

2.3.3.2 Retorted Shale

Retorted shale may be disposed of above ground or in mined areas below ground. The below ground alternative would avoid possible aesthetic and leachate concerns associated with above ground disposal. But the underground disposal concept was abandoned because it would prevent the possible future recovery of the approximately 30 - 40% oil shale that remains underground in the form of pillars and barriers when conventional room and pillar mining is practiced. In addition, the mine-out cavity could be reserved as the necessary void for modified in situ retorting of the pillars and adjacent layers of the oil shale formation.

2.3.3.3 Aqueous Effluents

It is planned at this stage of project development to design the facility such that there will be no waste water effluent discharge.

2.3.3.4 Gaseous Effluents

Alternatives for handling gaseous effluents will be addressed as part of the Phase I Program.

Section 3.0

PROJECT DESCRIPTION

3.1 CONSTRUCTION PHASE

Construction phase information such as map locations, layouts, schedules, manpower, etc. for both the mine and the plant will become available as Phase I work progresses. In the meantime, general statements, ranges, or estimates based on other studies may be of some interest. The primary environmental factor during the construction phase will be fugitive dust from construction of roads, land cleaning, activity at the construction site and traffic on improved roads. Wet suppression will be used to control dust and preliminary studies indicate construction should not cause violation of air quality standards for particulates. See Section 5.0 for additional discussion.

3.1.1 The Mine

3.1.1.1 Location

Location of the mine on Utah State Lease Tract Sec. 32, T9S, R25E cannot be pin-pointed until ongoing studies to determine the type of access, material handling route and methods etc., have been completed. Figure 3.1-1 shows the location of the lease tract.

3.1.1.2 Layout

Figure 3.1-2 is a rough artist's conceptual sketch in a panel of a typical room and pillar two-bench mining system. Figure 3.1-3 is a

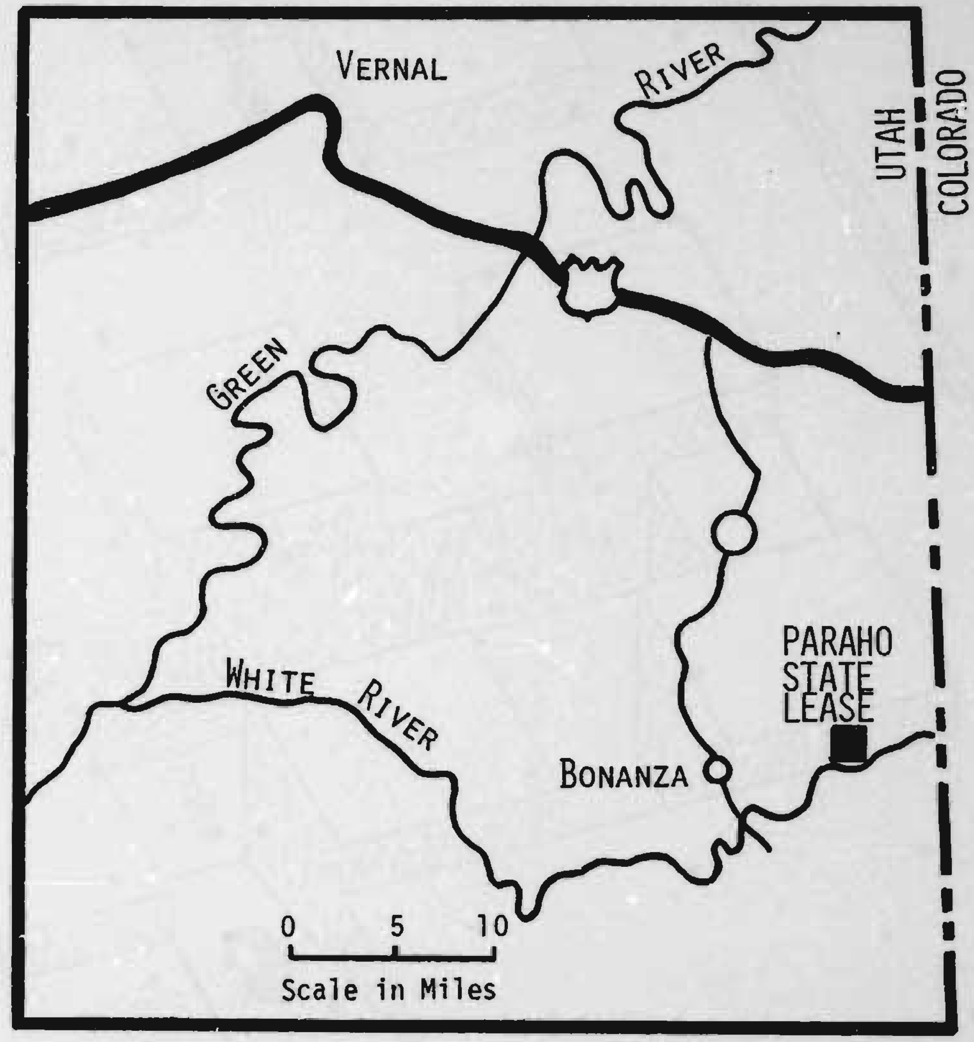
Figure 3.1-1

LOCATION

OF

PARAHO STATE LEASE

AREA OF LOCATION MAP



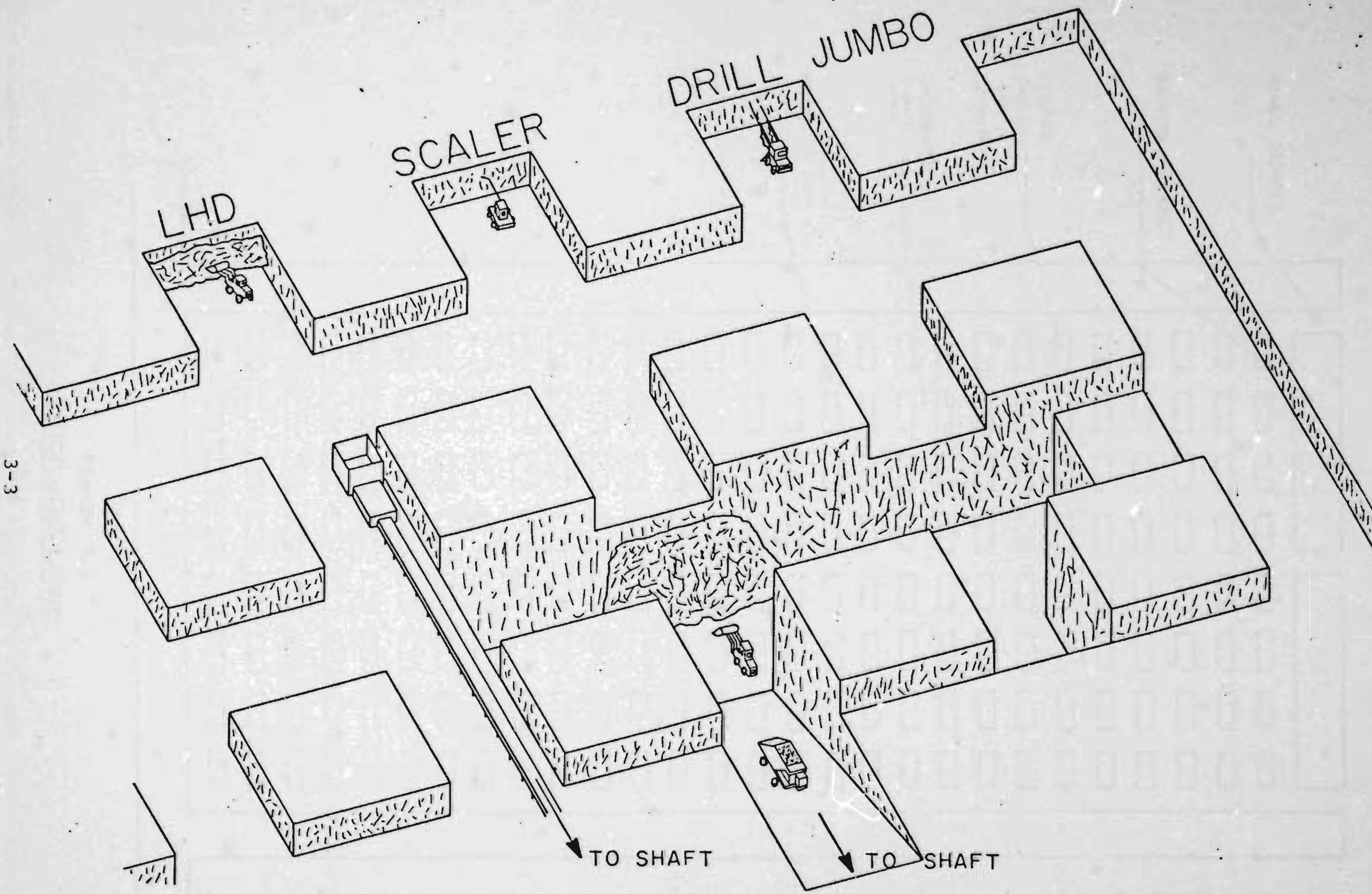


Figure 3.1-2
ROOM AND PILLAR TWO BENCH MINING SYSTEM

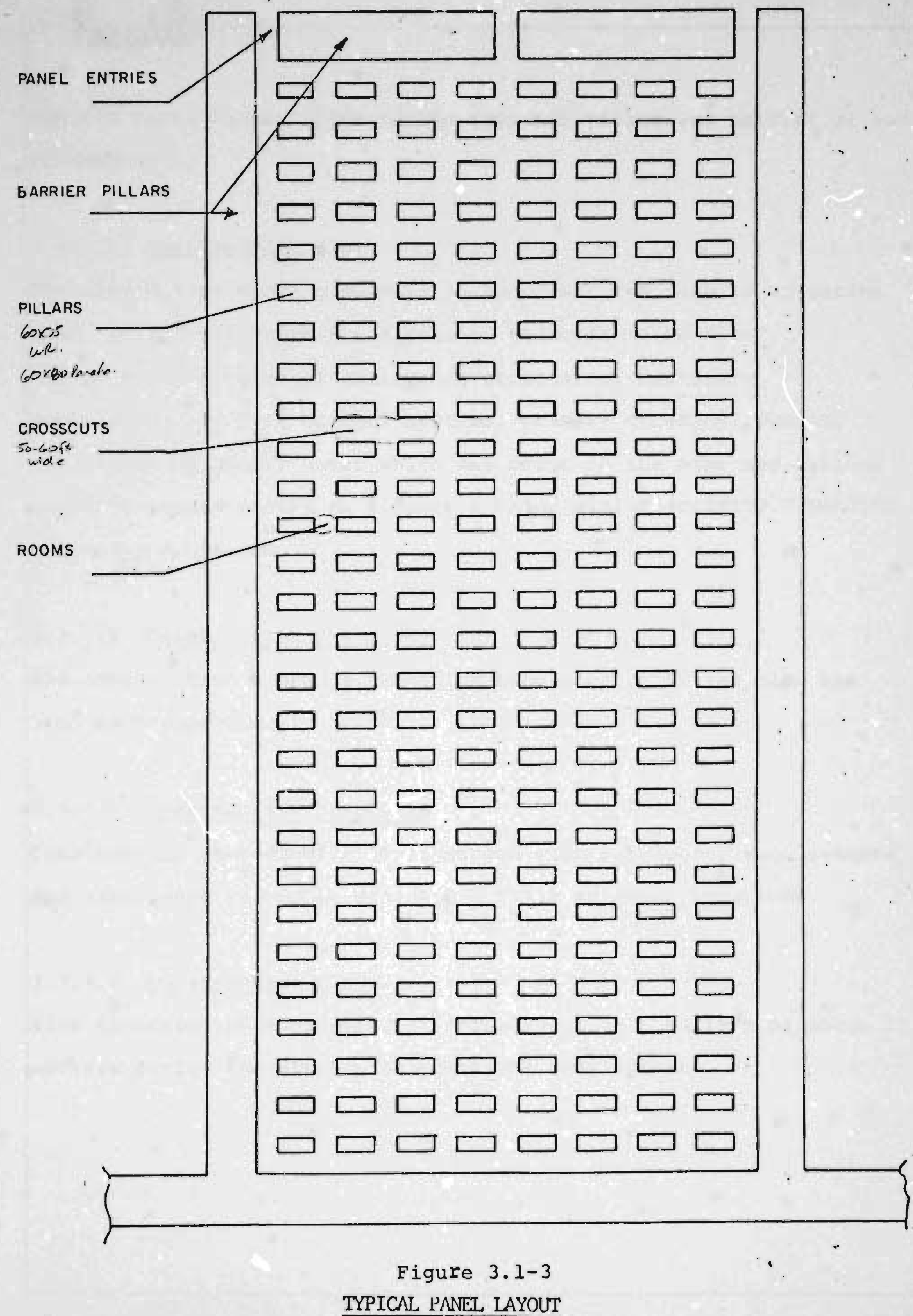


Figure 3.1-3

TYPICAL PANEL LAYOUT

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typical panel layout illustrating room and pillar and barrier pillar arrangement.

3.1.1.3 Construction Plan

The mine construction plan will include features such as an access road, an adit or shaft for access to the area to be mined, installation of various conveyance structures, buildings, ventilation and dust control systems, primary crushing, pumping facilities to handle water which may occur in the mine and various auxilliaries necessary to support a major mining activity. Details are being developed.

3.1.1.4 Construction Schedule

The construction schedule cannot be tabulated until the plan has been more specifically defined.

3.1.1.5 Construction Practices

Construction methods will be in accord with regulatory requirements and experience gained in mining oil shale at other locations.

3.1.1.6 Construction Force

Mine construction manpower will probably reach a maximum of about 75 workers during the first nine months of development.

3.1.2 The Plant

3.1.2.1 Location

Exact location of the plant has not yet been established pending decisions on other related factors such as type and location of mine access and preferred retorted shale disposal site. Variations in specific locations should be of very minor environmental significance.

3.1.2.2 Layout

A plot plan(s) will be provided to show the layout of the various plant units including crushers, conveyors, raw shale storage facilities, steam generator, retort, product gas treatment facilities, aqueous handling/disposal facilities, product storage and shipment facilities, and retorted shale and raw fines disposal facilities. Ancillary facilities such as the office, laboratory, shops, warehouse, roads, parking lots and various utilities will also be shown at the appropriate time in the design process. See Section 5.0 for discussion of these items.

3.1.2.3 Construction Development Plan

Initial construction, applicable to both the mine and the plant, will begin after completion of design and acquisition of required permits. This will include auxiliary facilities such as electrical and potable water supplies and sewage treatment facilities. These facilities would be placed in service as soon as possible to serve during the construction and operating life of the project. At the plant area, raw shale, and process water storage areas will be built. Construction will include appropriate ditching around the area to intercept and divert surface run-off, excavating a water storage basin, and related activities. Plant support items such as fencing, roadways, and a fire control system will be provided. Facilities to provide LPG, natural gas and/or other energy sources as available and needed during initial plant operation will be installed. Other facilities to be installed include a process water treatment and reuse system, cooling water system, and boiler feed water supply. And of course the shale crushing, retorting, oil recovery, and product storage and shipping facilities will be built.

3.1.2.4 Construction Schedule

Phase I design work has not yet reached the point of construction scheduling, but it may be estimated that overall plant construction time would require roughly 18 months.

3.1.2.5 Construction Practice

Construction will be in accord with applicable regulations and construction standards and good industry practice. Fugitive dust will be generated from construction activities such as earth moving, road building and heavy truck and vehicular traffic. Speed limits and wet suppression will be used to control fugitive dust during construction. See Section 5.0.

3.1.2.6 Construction Force

The number of construction workers will vary over the construction period but will peak at about 700. These numbers will be determined as Phase I progresses.

3.2 OPERATION PHASE

Information on the operation phase will be developed during the course of the Phase I work effort. This section discusses the project based on data and information currently available.

3.2.1 The Mine

3.2.1.1 Development Plan

Design of the mine will be provided by Cleveland-Cliffs Iron Co. (CCIC). During Phase I, geotechnical data available for construction of the Phase II modular plant will be reviewed. Since the proposed site lies within 1 1/2 miles of Tract Ub, some of the parameters required for mine design may be extrapolated from the comprehensive resource investigation and evaluation that has been made by CCIC of the Ua/Ub tracts. Additional investigative work may be required in the form of drilling, logging, hydrologic testing, physical properties, testing of selected core intervals, and gas monitoring. A thorough examination of all available geologic information will be made for the purpose of making a reliable determination of structural conditions, pertinent mineralogic characteristics, the occurrence of kerogen and accessory minerals, and other significant features of the projected zone of interest. Available hydrologic data will be assessed for reliability and completeness with regard to locations, extent, and characteristics of all aquifers and aquitards, as well as the chemical characteristics of subsurface water. Accurate, detailed hydrologic information will be particularly significant in the determination of methods for successful completion and long term maintenance of safe and reliable access routes to the mine production level. Likewise, such knowledge is essential for selection of optimal mining methods and parameters, and design of adequate pumping and water handling facilities. (The mine is not expected to be wet.)

Available rock mechanics data will be analyzed and assessed. Additional testing will be performed as needed. Effects of fraturing, the occurrence of saline minerals, thickness of the overburden, and compressive strengths and other rock properties of the mining zone and adjacent zones will be essential considerations in the design of mine openings and support pillars. Adequate safety factors will be incorporated in mine design to ensure the inherent safety of the mining system and long term stability of mined-out areas.

Access to the mine will be via vertical shaft or inclined adit through an outcrop - the former being the most likely possibility. Recent investigations of western oil shale have emphasized that methane in varying amounts may be encountered in the oil shale formation. Thus a careful effort will be made to determine the extent of potential methane occurrence in zones of interest. Methane occurrence will have a strong bearing on mine planning. It will require adequate recognition during ventilation system design and may impose additional constraints on mine design and equipment selection.

Primary crushing will be done in the mine to produce material having a size of minut 12 inches. Crushed shale will be moved to a surface stockpile.

Surface facilities will be designed and located according to operating requirements and scheduling of mine activities. They will include an access road, mine water disposal system (if needed), mine office/change house complex, overland conveyor, ventilation fan installation, appropriate drainage ditches, explosives facilities and various other ancillaries.

3.2.1.2 Development Schedule

The mine development schedule will be prepared during Phase I.

3.2.1.3 Mining Practices

Basic mining practices (functions) include drilling, blasting, scaling, and bolting. The mining cycle is expected to be carried out along two benches, or levels. The upper level mining cycle will include face drilling and blasting. Wassl are scaled and roof bolts installed. Then broken shale will be loaded on trucks and hauled to the primary crusher in the mine. The lower level cycle will normally begin when sufficient upper level mining has been completed to allow both cycles to proceed without interference. The lower cycle differs in that holes are drilled into the floor instead of a face. The functions will probably be accomplished as follows:

- Drilling - by rotary percussion units capable of drilling 3" to 4" holes at 5 ft/minute to a hole depth of 25 ft.
- Blasting - using 0.5 - 0.6 pounds AN/FO per ton, with electric detonation and giving 2000 - 4000 tons per round.
- Mucking - using 13 cubic yard permissible LHD's, or 12 cubic yard loaders, and 75 ton trucks.
- Scaling - mechanical scaler with 30 - 60 ft reach
- Bolting - automated units with 20 - 40 ft reach. 5 to 8 ft bolts (or longer).

There will be dust from the construction and operation of the mine. Exhaust gases from various equipment will exit the mine through the ventilation system along with dust from the underground operations and gases from explosives detonations. Dust control systems will be incorporated in the mine design and will probably include wet suppression techniques for mining, crushing, and shale handling systems, and a baghouse filter to service emission points around the crusher.

3.2.1.4 Water Requirements and Transport

In the mine, the only significant use of water will be for wet suppression of dust. This may be expected to consume roughly 6 acre-ft per year (depending on the final scheme for dust control) delivered by a piping system. If it is necessary to remove water from the mine, the systems may be integrated.

3.2.1.5 Explosives Requirements

The blasting agent will be primarily an ammonium nitrate - fuel oil mixture (AN/FO). From 0.5 to 0.6 pounds will be required per ton of oil shale which would mean the use of from 12,000 to 14,000 pounds per day of explosives. This activity will contribute to the particulates, CO, and NO_x carried off by the mine ventilation system.

3.2.1.6 Other Materials Requirements

There are no other significant materials requirements identified at this time.

3.2.1.7 Effluents

3.2.1.7.1 Solids

Solids consisting primarily of collected dust from the primary crusher dust collector will be hauled to the surface in suitable containers. This material will be disposed of separately from retorted shale as described later.

3.2.1.7.2 Air Pollutants

During module operation, mining activities include blasting, operating the mining equipment, extracting the oil shale, and conducting the primary crushing operation. Pollutant emissions will include particulates from all of these activities, and CO, NO_x, HC, and SO_2 generated by mining equipment and blasting. Table

3.2-1 shows uncontrolled emission rates, control measures used and emission rates for the pollutants emitted during mining operations.

Mine vent particulates would be controlled by wet suppression in the mine working areas and by routing the ventilation air through mined-out areas, to take advantage of baffled settling of airborne particles. A combined reduction efficiency of 98.5% is estimated (75% by wet suppression; 94% by settling, as the air moves in circuitous routes through the mining area).

During the early mining phases, particulate emissions are expected to be slightly higher because wet suppression above would be used until sufficient area had been mined out to permit baffled settling. Thus the 98.5% combined control efficiency would be reduced temporarily to 75% control by wet suppression above.

The primary crusher would be located in the mine. Material handling points and other dust emission points associated with this equipment would be covered with collection ducts. Collected air would be ducted through a baghouse having a 99% efficiency.

3.2.1.7.3 Aqueous Effluents

Since the only use of water in the mining operations will be for dust suppression, there will be no waste water discharge. Should it be necessary to pump out minewater (not expected), that water will

TABLE 3.2-1

SUMMARY OF DAILY EMISSION ESTIMATES DURING MINE DEVELOPMENT, MINING, CONSTRUCTION, AND OPERATION AT THE UTAH PARAHO PROJECT OIL SHALE FACILITY

ACTIVITY	SUBACTIVITY	MATERIAL HANDLED	POLLUTANT	UNCONTROLLED DAILY EMISSIONS (lbs/day)	CONTROL MEASURES	CONTROLLED DAILY EMISSIONS (lbs/day)
MINING AND MINE DEVELOPMENT/a	Mining	23,600 tons/day oil shale	Particulate	212	Wet suppression & baffled settling 98.5%	3.18
	Blasting	23,600 tons/day oil shale	Particulate	236	Wet suppression & baffled settling 98.5%	3.54
		14,000 lbs/day ANFO	NO_x CO	22.4 295	none none	22.4 295
	Mining Equipment	4,243 gal/day diesel fuel	CO HC NO_x SO_2 Particulate	382 119 1816 132 93	none none none none none	382 119 1816 132 93
	Primary Crushing	23,600 tons/day oil shale	Particulate	11800	Baghouse - 99% Wet suppression & baffled settling 98.5%	179
FACILITY CONSTRUCTION	Vehicle Traffic/b	270 VMT/day	Particulate (fugitive)	1243	Wet suppression 75%	311
	Excavation, Roads, and Pipe Lines		Particulate (fugitive)	955	Wet suppression 50%	478
FACILITY OPERATION/b	Secondary Shale Crushing & Shale Trans.	23,600 tons/day oil shale	Particulate	56700	Baghouse - 99%	567
	Gas Turbine/ Boiler/Thermal Oxidizer	122×10^6 SCF/day of gas	NO_x SO_2 Particulate	22800 13650 512	Gas treating-90% Gas treating-99% Gas treating-50%	2278 136 256
	Spent Shale Disposal Area	20 acres	Particulate (fugitive)	8.56	Wet suppression 75%	2.14
	Shale Storage	150,000 tons/year oil shale	Particulate (fugitive)	97	none	97
	Vehicle Traffic /c	180 VMT	Particulate (fugitive)	828	Wet suppression 75%	207

a Emissions given are for full-scale mining during module operation. Emissions during mine development are at most 20% of these.

b Emissions given are for maximum capacity module operation (23,600 TPD).

c Gasious emissions from vehicle traffic are not included in this table, but are considered in the dispersion modeling.

SOURCE: Pro-rated from Air Permit, PSD Permit for Anvil Points Oil Shale Facility.

be stored for use in dust control or possibly pumped to a lined pond for disposal by evaporation.

3.2.1.7.4 Occupational Health and Safety

During Phase I, regulations and requirements applicable to Phase II will be identified including permit needs. Safety requirements of both the Occupational Safety and Health Act (OSHA) and the Mine Safety and Health Act (MSHA) may apply due to the process characteristics of this project. Shale mining as well as crushing and conveying systems up to the retort will probably come under MSHA jurisdiction and Safety and Health Regulations for those operations will be those promulgated by the U.S. Department of Labor under the MSHA. It is expected that the rtort and other support facilities will also come under MSHA jurisdiction though this has not been determined.

Health and safety concerns that will be addressed include:

- o Gases
- o Rock Falls
- o Temperature
- o Toxic and carcinogenic substances
- o Smoke and fumes
- o Fires and explosions
- o Dust
- o Noise

The major potential health problem associated with processing oil shale is the presence of polycyclic aromatic hydrocarbons (PAH). One such compound, benzo(a)pyrene, is a known carcinogen and found in shale oil at levels of about 3 ppm. This level is not significantly higher than levels found in crude petroleum. Additional carcinogenic and mutagenic compounds have been tentatively identified with shale oils. Retorted shale contains considerably lower levels of carcinogens. Workers may be exposed to PAH compounds through inhalation and dermal contact. Dermal contact can be mitigated by a high degree of automation, proper worksuits, and hygiene. Inhalation dangers can be offset by proper use of respirators.

3.2.2 The Plant

In this section, where possible, the function, estimated emissions and abatement plans for the various units and operations located above ground will be discussed. Numbers and discussion may require substantial revision when final design is reached. See Table 3.2-1 for a summary of estimated uncontrolled and controlled air emissions.

3.2.2.1 Raw Shale Storage Operations

Shale from the primary crusher (located in the mine) will be brought to the surface by yet to be established means (truck or conveyor) and delivered to an uncovered stockpile which will provide a 7 day surge inventory of 150,000 tons at the module site. Shale from the stockpile will be conveyed to a feed preparation unit near the retort. Fugitive emission from the stockpile are estimated to be 97 pounds/day. Shale from the secondary crusher and screens at the feed preparation unit will be conveyed directly to the retort, or to a covered retort feed storage pile which will be maintained at about 43,000 tons or two days supply.

3.2.2.2 Crusher and Conveyor Usage

Raw shale from the 7-day stockpile will be crushed and screened to -3", + 1/4" for retort feed. Equipment involved will include feed bins, belt feeders, crushers, and vibrating screens. Dust collection hoods will be provided at the crushing station, all screening stations, all conveyor loading and discharge points and at the receiving bin at the retort. The hoods will be ducted to an induced draft baghouse to clean the air and discharge it to the atmosphere. The 99% efficiency of the baghouse will reduce the estimated 56,700 pounds/day uncontrolled emissions from crushing and conveying to a controlled particulate emission of 567 pounds/day. About 10% of the crushed shale will be rejected as fines and sent to disposal. The method for handling collected shale dust from the baghouse has not yet been selected.

3.2.2.3 Retort Operation

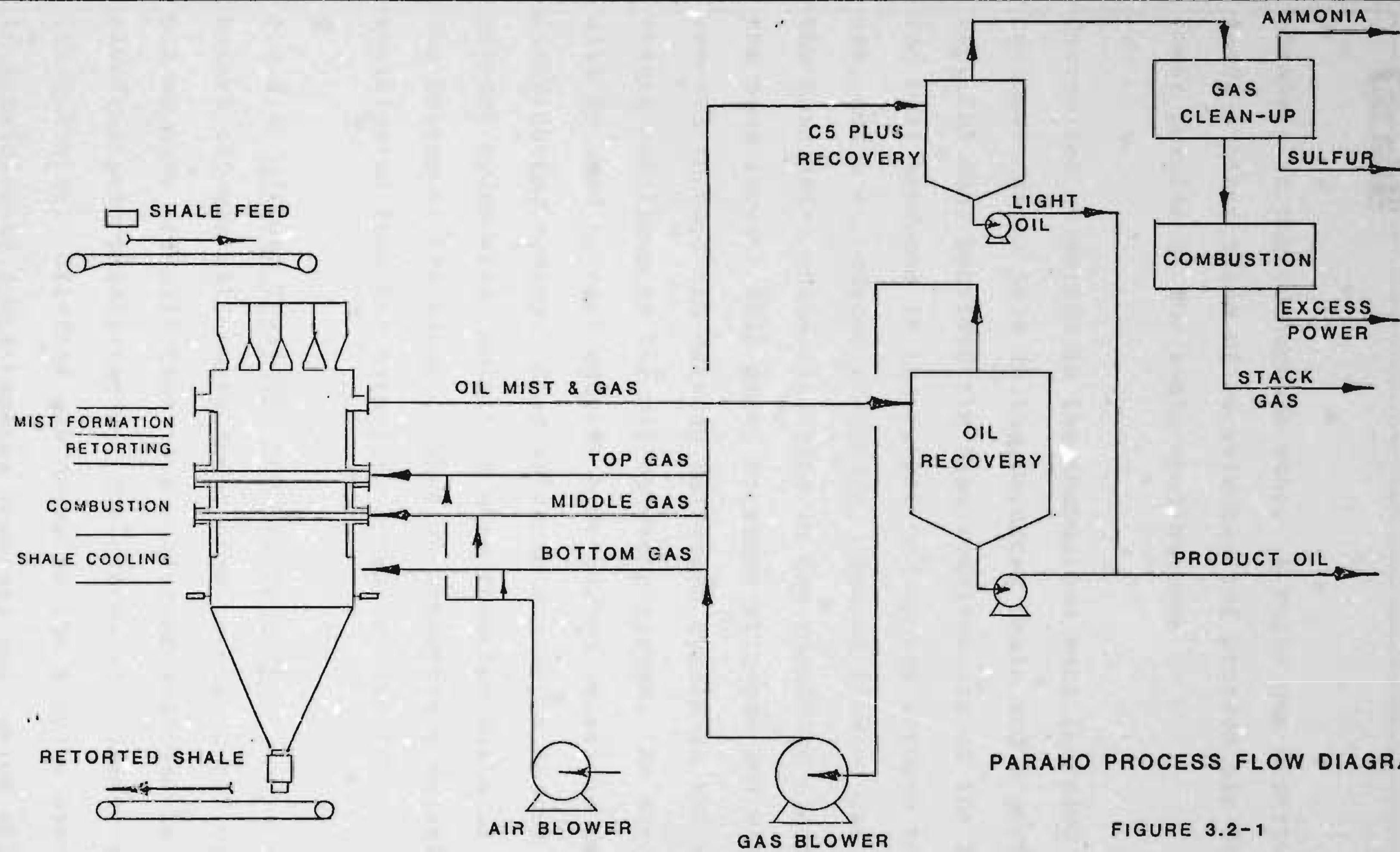
The retort will be of rectangular design about 135' long and 24' wide. The Paraho retort produces oil as a suspended mist in a gas stream. After retorting, the oil mist and gas stream is drawn off near the top of the vessel while retorted shale is removed from the bottom, sampled, and transported to the disposal area. A typical process flow diagram is shown in Figure 3.2-1.

The unit is designed to operate at slightly above atmospheric pressure. Major design criteria are:

- Throughput, pounds/hr/sq.ft. 455
- Oil yield (including C_5+ recovery) 94%
- Oil shale feed size -3", +1/4"
- Gas production, SCF/ton shale 7200
- Shale quality, gallons/ton 28
- Air rate, SCF/ton 4660
- Recycle gas rate, SCF/ton 14790

The design raw shale feed of 17,700 TPSD will be delivered by belt conveyor to the top of the retort. A feed distribution system will distribute the feed uniformly on top of the shale bed. Off-gas collectors remove the gas and entrained oil mist from the shale bed. Uniform bed descent is maintained by the Paraho patented grate mechanism which removes retorted shale from the bottom of the retort. The shale moves through four zones: Mist formation; retorting; combustion; and shale cooling. All zones extend across the full inside cross section of the refractory-lined vessel.

Recycle gas, mixed with controlled amounts of process air, is introduced into the retort through Paraho patented gas distributor



PARAHO PROCESS FLOW DIAGRAM

FIGURE 3.2-1

channels in the combustion zone. A third gas distributor system feeds another blend of recycle gas and process air directly into the lower portion of the shale cooling zone.

Controlled oxidation in the combustion zone (burning some of the residual carbon left in the retorted shale and a portion of the recycled gas) provides the heat requirements of the retort vessel. The heat produced in the retort decomposes kerogen to oil vapors, gas, and a carbonaceous residue. Upward flowing gas is cooled by the descending shale resulting in the formation of an oil mist in the zone above. This mist, together with gas and water vapor, is removed through the off-gas collector system at the top of the vessel and flows to the oil recovery system. An air purge system will be used to seal against hydrocarbon emissions from the feed distributing system. Star valves and a purge system will be used to prevent hydrocarbon emissions when retorted shale is removed from the bottom of the retort. Thus no atmospheric emissions are anticipated from the retorting operation itself.

3.2.2.4 Off-Gas Treatment and Oil Recovery

Retort off-gas will carry about nine pounds of oil mist per thousand SCF of gas. It will flow to a coalescer and then to an electrostatic precipitator. The system will remove at least 99% of the oil mist. Oil-free gas moves to the recycle gas blower, then, if feasible, to a C_5+ naphtha recovery unit which will target for an additional 5% product yield. Naphtha and product oil will go to separate storage tanks capable of storing 14 days of base case production. A portion of the oil-free gas in recycled to the retort and the remainder is treated for naptha recovery and for removal of ammonia and H_2S.

Uncontrolled and controlled estimated emissions of NO_4, SO_2 and particulates from off-gas combustion are shown in Table 3.2-1.

3.2.2.5 Power Generation

Clean product gas will be used as fuel for on-site electrical power generation. Off-site steam boilers will provide low pressure steam for plant start-up and required tank heating. Details are not yet available.

3.2.2.6 Aqueous Waste Handling

All aqueous wastes produced by the Paraho operation will be utilized by the facility. There will be no water run-off into the surrounding environment. There will be three liquids produced within the operation: product water separated from the crude product oil, process water condensed from the gas stream clean-up effort, and runoff collected from rainfall and snow melt. Major elements in the product and process water are carbon, nitrogen, and sulfur. See Table 3.2-2. Organic carbon is in the form of low molecular weight, water soluble organics. The inorganic carbon is present primarily as ammonium bicarbonates. Sulfur in product water is essentially sulfate. Trace element concentrations are shown in Table 3.2-3.

All captured or recovered water will be used on-site for dust control and revegetation of the retorted shale disposal area. Waste water not suitable to those needs will be evaporated from a specially lined pond. There will be no waste water discharge.

3.2.2.7 Synthetic Crude Oil Handling

Both naphtha and product oil will be sent to product storage tanks with 14 days production capacity. Facilities will be provided for metering and loading into trucks for transport from the module. Installation will follow normal petroleum industry practice with respect to spill prevention and safety requirements.

3.2.2.8 Retorted Shale and Raw Shale Fines Disposal

After shale has been discharged from the bottom of the retort, it will be conveyed to the retorted shale transport system for haulage to the disposal site located within the 582 acre tract and near the plant site. The quantity of retorted shale is expected to be approximately 14,600 TPSD at the base case rate. See Tables 3.2-4 and 3.2-5 for retorted shale properties.

In addition to conveyors and trucks (a dust collection system will serve transfer points), other equipment including a grader, crawler tractors, and water truck will be needed to work the disposal pile

Table 3.2-2

WATER PARAMETERS, WT% OF MAJOR ELEMENTS

Parameter	Product Water	Process Water
S	2.2 - 6.5	<0.1 - 0.3
N	2.1 - 6.1	0.5 - 0.7
C	2.4 - 8.1	app. 0.7
Organic C (Primarily Ammonium bicarbonate)	2.0 - 6.3	0.4 - 0.6

Sulfur in the product water is primarily sulfate.

Table 3.2-3

WATER PARAMETERS, TRACE ELEMENTS
ppm

Elements	Product Water	Process Water
Ag	<0.2 - 0.4	0.01 - 1
Al	0.26 - <1	0.2 - < 1
As	3.1 - 22.2	0.9 - 10.3
B	2.1 - 43	0.02 - <20
Ba	<0.5 - <3	0.1 - < 0.5
Ca	18 - 64	2.8 - 21
Cd	0.13 - 0.3	0.01 - < 0.5
Cl	36 - 81	0.5 - 32
Cu	0.18 - 11.8	0.05 - 0.2
F	1.4 - 43	0.04 - 0.96
Fe	1.5 - 8.4	0.9 - 2.2
Hg	0.0023 - <0.5	5 - 7
K	3.2 - 67.5	0.8 - 2.4
Mg	220 - 960	1 - 30
Mo	0.10 - 0.7	0.2 - 2
Na	39.6 - 521	11 - 60
Pb	<0.2 - 3.5	0.2 - 1
Se	0.2 - 11	0.1 - 2
Si	12 - 48	2 - 7
$SO_4^{=}$	3300 - 8500	460 - 1540
Zn	0.12 - 1.26	0.02 - 0.1

and reduce dusting. The probable disposal site will be an eroded depression or gully. Studies with Paraho retorted shale indicate that above ground disposal can be managed in an environmentally acceptable manner. Placement would be made so that water would not permeate through the disposal area and possibly contaminate ground or surface water. Upstream surface run-off would be diverted from the disposal area - or perhaps retained for dust control and revegetation purposes. Once completed, the surface would be stabilized by revegetation. Although a final plan has not been selected, the water harvesting technique developed by Utah State University and currently under test using Paraho retorted shale at Anvil Points is the most likely alternative. Figure 3.2-2 illustrates how disposal may be accomplished. Fugitive dust emission from the shale disposal area of about 20 acres is expected to be neglibible.

Disposal of raw shale fines will be handled separately to avoid spontaneous combustion hazards and permit possible future retrieval of a fuel resource. Details must be developed.

3.2.2.9 Other Facility Operation Activities

The significant "other facility" will be the product gas treatment equipment. This product gas will be used for on-site electrical power generation, but it must first be treated for the removal of NH_3 and H_2S. Design details are not yet available. A very rough estimate of controlled emissions from the use of cleaned gas may be seen in Table 3.2-1 under facility operations. Quantities and disposal procedures for liquid or solid waste from the gas cleaning operation will have to be determined.

3.2.2.10 Laboratory and Other On-Site Auxiliaries

On-site facilities will include a laboratory for chemical analyses, an administration buiding, a warehouse for operating and maintenance supplies, a shop for maintenance of operations, a transportation fuel storage area, a mine service and dry building, explosives facilities, and water supply facilities. Most of these will have no environmental impact. The laboratory will be designed and operated to protect personnel from exposure to toxic or hazardous chemicals and to prevent improper release of such materials to the atmosphere or sewer system. Facilities will be permanent all-weather structures constructed in accord with applicable regulations.

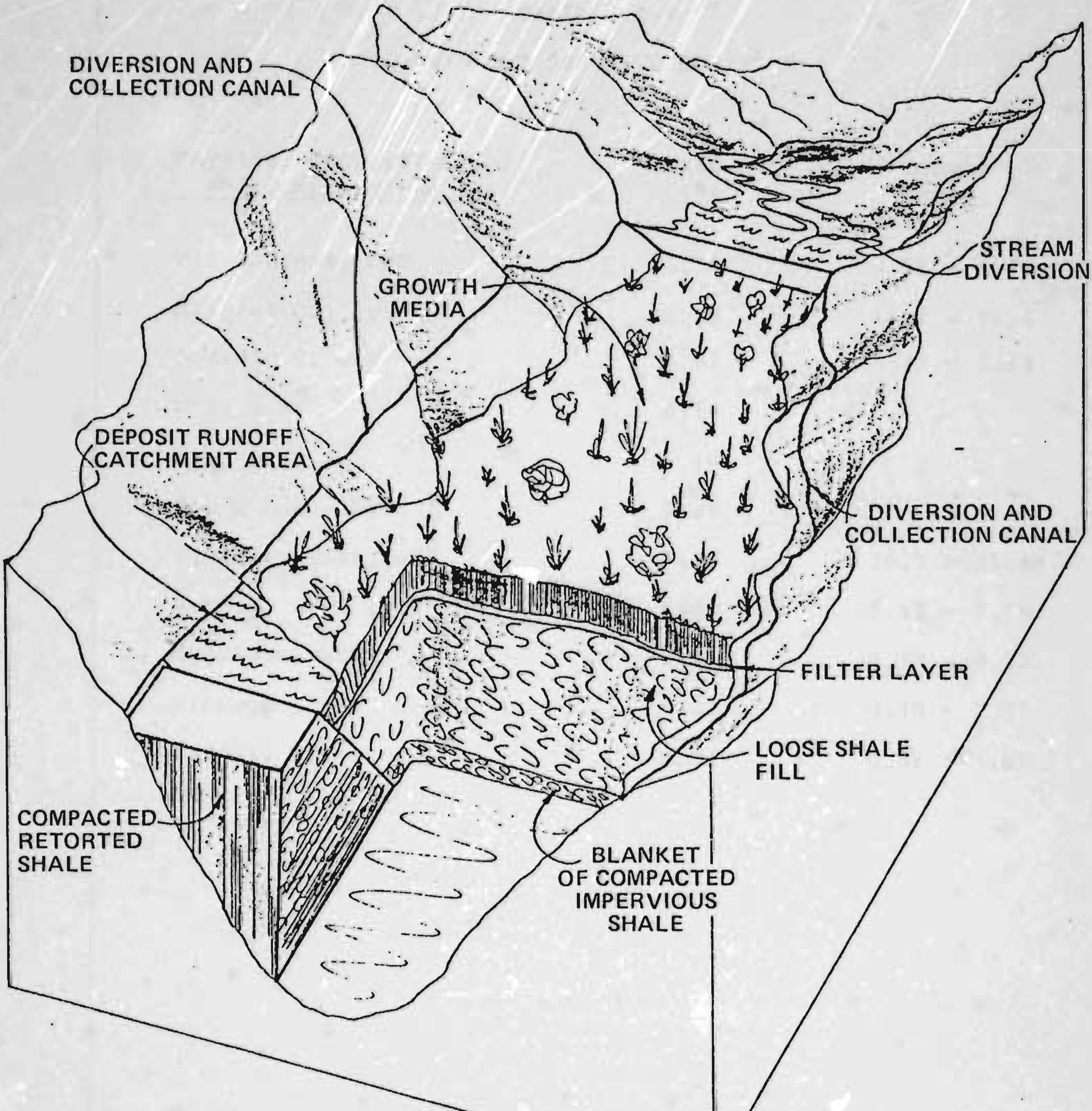


Figure 3.2-2

SCHEMATIC OF TYPICAL CROSS-VALLEY FILL

Table 3.2-4

RETORTED SHALE COMPOSITION

Physical Properties and Composition	Base Case	Normal Range
Oil Content, GPT	0.28	0.28 - 0.71
Mineral CO_2, wt%	15.86	14.1 - 18.6
Organic C, wt%	1.97	1.27 - 3.59
Oil, wt%	0.10	
H_2O, wt%	0.16	
Gas & loss, wt%	0.29	
Ignition loss, wt%	17.72	16.7 - 21.88
Carbon, wt%	6.30	5.57 - 7.96
Hydrogen, wt%	0.17	0.13 - 0.32
Nitrogen, wt%	0.21	0.10 - 0.32
Sulfur, wt%	0.82	0.59 - 1.07

Table 3.2-5

RETORTED SHALE PHYSICAL PROPERTIES

Size classification	Silt gravel (5% < 2 inch)
Bulk density (design case)	57 lb per cu ft
Density compacted	100 lb per cu ft
Compressive strength	Meets road base standards 215 lb per sq inch
Permeability	Impervious (< 1.0 ft per year)
Leaching	Meets standards (< 1.5 wt% leached)
Auto ignition and dusting	None

3.2.2.11 On-site Housing Description

A camp will be established to accommodate construction workers and will include portable dining and recreation facilities. Housing, consisting of prefabricated, portable dwellings, will be provided on-site or on other nearby available land. The construction work force is not expected to include many local residents but will be comprised of workers imported into the region for the 18 month construction period. An operating force of about 300 people will remain through the 24-month operational phase of this project.

3.2.2.12 Sanitary System

A sewage collection, treatment, and disposal system will be provided to handle wastes from the service facilities at the mine and plant. A package type plant will probably be used with effluent discharge to a lagoon for disposal by evaporation or re-use for dust control. Plant size and performance will be in accord with state requirements.

3.2.2.13 Water Usage and Disposal

The plant will require water for drinking and sanitary purposes, fire water, miscellaneous process uses, dust suppression, cooling, and boiler feed. Overall water demand will be approximately 1 barrels of water per barrel of shale oil produced. However, water produced in the retort amounts to about 1/4 of a barrel of water per barrel of oil produced. This produced water can be recovered and re-used for dust control, etc. This gives a net water demand of

0.75 barrels per barrel of oil produced or 330,000 gallons per day (370 acre ft per year or 0.51 CFS). The required water supply will be obtained from the White River via pumps and a pipeline. Paraho has access to 4 CFS of an approved water right application. The water will be treated as necessary and sent to storage tanks. A booster pump at the plant will provide water for various services.

There will be three liquid waste streams for the Paraho operation:

- Product water separated from crude product oil.
- Process water condensed from gas clean-up.
- Runoff collected from rainfall and snow melt.

Process water production is by far the largest of the three. Table 3.2-2 gives an indication of product and process water quality.

Table 3.2-3 shows trace elements for these two streams. All water will be used on-site for dust control and vegetation of the retorted shale disposal area. Water which cannot be used on site will be evaporated in a specially lined evaporation pond. No liquids will be discharged from the plant site.

3.2.2.14 Electric Usage

Electric power transmission distribution systems and substations will be required for mining and retorting activities. It is estimated that 15 megawatts of electric power will be required to support this sized facility, but the requirements will depend on final design and the estimated requirements may change significantly. Adequate standby power generating capacity may also be advisable in event of failure of the primary system to supply mine ventilation fans, escape hoists, emergency lights, etc.

The required power supply will be obtained by constructing a new transmission line to the site from an existing Moon Lake Electric Association transmission line located west of the Paraho lease.

3.2.2.15 Natural Gas Usage

The present design basis assumes that natural gas will not be available.

3.2.2.16 Solid Waste Disposal

A solid waste collection and disposal system will be provided for miscellaneous trash, garbage and other waste products generated by the project operations. A land fill concept will be incorporated in the retorted shale disposal area if state and local authorities approve.

3.3 POST-OPERATION PHASE

The purpose of the Phase I program is to complete the design and plan for conducting a demonstration of the Paraho retort technology using a full size retort. This demonstration will occur in what is called Phase II.

After completion of the Phase II objective of demonstrating the technology, the facility may be abandoned, continued in operation, or expanded. What occurs will be largely a function of the success of the technology, available resources, and available financing.

3.3.1 Commercial Plans

Paraho intends to license its retorting technology to owners of oil shale resources. Successful demonstration of the techology during Phase II will result in expansion of this licensing program.

In addition, Paraho may expand its operation at the Phase II site. Currently this expansion would be expected to be up to about 30,000 BPD of shale oil production.

Evaluation of this on site commercial expansion possibly will be the topic of a "Commercial Feasibility Study" expected to be done under a DOE Grant program. However, this scenario will also be evaluated as part of the Phase I program in order to determine potential indirect effects to the environment as defined in 40CFR 1508.8(b) in case the module demonstration facility is in fact expanded to a commercial size.

How this discussion is handled within the format of the environmental impact statement is still being determined. In any event, the aspects of environmental effects will be based on the results of the single module Phase I work and will involve factoring up the developed results.

The commercialization evaluation will not be done in the detail required for the modular demonstration program since process information, control technology, and corporate plans may change significantly prior to implementation.

In general, the on-site expansion would involve simply adding two more retorts to the Phase II single retort facility, expanding mining operations, and probable shipment of product by pipeline rather than truck. Additional property beyond the Phase II site will probably be required in order to justify such a commercial program. Property contiguous to the Phase II site also contains commercial grade oil shale resources.

3.3.2 <u>Dismantling Plans</u>

Plans for dismantling the Phase II facility, whether it occurs at the end of the two year test programs or after extended operations, will involve removal of above ground structures, regrading and reseeding of distrubed areas, stabilization of processed shale disposal areas, sealing of mine openings, and other actions to leave the area safe and acceptable aesthetically. Details will be developed during Phase I.

3.3.3 Reclamation Plans

The objective of the reclamation efforts will be to return the area to as near its original use and appearance as practical. Techniques used will emphasize use of native vegetation types, minimal use of supplemental irrigation water, and minimal use of "topsoil" in vegetating processed shale.

Disturbed areas will be graded to meet existing contours. Planting and seeding will be done in the Fall of the year. Sites will be protected from grazing during the early growing seasons.

Processed shale disposal sites will also be contoured. Trenchs filled with "topsoil" will be dug along the contoured areas. Native plant species, probably in the form of rooted cuttings, will be planted in the "topsoil" trenches. Soil sealers will probably be used to foster water "harvesting" which promotes collection of precipitation in the trench areas.

Section 4.0

AFFECTED ENVIRONMENT

In order to expedite submission of this document, which is preliminary in nature, the document that discusses the "Affected Environment", Section 4.0, is included as Appendix A.

Section 5.0

ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION

The comments which follow relate only to possible impacts of the Paraho project itself and these comments are limited in many respects because data are not yet available. Obviously socioeconomic and many other impacts can only be judged in concert with other development projects.

5.1 CONSTRUCTION

5.1.1 Land Use

The proposed site for the Paraho Project is in an unpopulated area three miles from the small town of Bonanza. The lease tract and adjacent land in dry, sparsely vegetated and used primarily for winter sheep grazing. Construction activity will disturb an as yet undetermined number of acres on the lease site as roads are build, the water supply and sewage systems installed, electric power lines brought in, mine development begun etc. Such activities will obviously result in some reduction in the amount of grazing land available in the area. However, the loss in animal unit months (AUM's) would be minimal compared to the total area available in Uintah Basin. Recreation quality in the area would be reduced. Noise, quantity of traffic, decreased air quality, and the increased number of persons recreating in the area would decrease the recreational quality of the area.

Paraho

5.1.2 Socioeconomic Impact

Proposed employment and resulting increased income would result in new demands for goods and services in the project area. These "demands" would produce additional employment, termed non-basic, to serve the needs. Together the two types of employment will generate a new population in the area which would be distributed primarily in Uintah County. The largest portion is expected to reside in Vernal (75 - 80%) with the remainder distributed over the area or in communities like Jensen, Roosevelt (in Duchesne County), or Rangely, Colorado. This distribution would probably be too wide to be traceable. The new population will require housing and community services which would cause impacts and affect public finances. Effects on public finances would result because of increased demand and cost. However, the project would generate new revenues from sources such as sales and property taxes.

The full effect of the new populations and corresponding requirements for housing and community services would be realized as an effect on personal lifestyles. Lifestyles are the consistent ways of life, or style of living, that reflect the attitudes and values of the people in the communities.

5.1.2.1 Employment

The construction work force will peak at around 700. New basic employment to supply goods and services to workers and their families would probably number about the same. Paraho proposes to hire locally as much as possible but this cannot be quantified. New people will unquestionably be recruited to the area to satisfy employment demand - particularly during construction. It is assumed that a number will remain after the construction period because the region contains considerable energy resources including oil shale, tar sands, coal, natural gas and oil that would ultimately be developed and provide employment for Paraho and non-basic workers. Based on the Uintah County population of 20,247 in 1980, it would not seem that the Paraho project in itself would have a drastic impact on employment patterns. As a result of new and possibly higher paying jobs, people may be drawn into the new employment and into the area from other jobs in the region causing a disruption of other industries. This effect on the local economy will be slightly mitigated due to the availability of family members to fill some local jobs as in the service industry. Local businesses would benefit financially from the prosperity that would be created by increased demand for goods and services. The new population and increased disposable incomes would produce a need to expand existing businesses and attract new ones.

5.1.2.2 Housing

The Paraho Project in the construction phase will undoubtedly increase pressure on the housing market tending to increase the cost of houses and also financing. This pressure would be mitigated by the approximate 10% vacancy rate for housing units in Vernal and Uintah County in 1980, by the intent of Paraho to provide construction housing, and by the use of mobile housing by many construction personnel.

5.1.2.3 Education

Schools in the area are generally overcrowded now so any increase in school population will add to the problem. Local school district officials are aware of the potential impact and are making plans to expand the capacity of the school system.

5.1.3 Impact on Native American Communities

Although unemployment has been high among the Ute Tribe on the Reservation, the Indian communities are located at some distance from the Paraho site and it is uncertain what the projects' economic impact will be, if any, on those communities.

5.1.4 Political Impact

It seems unlikely that the Paraho Project, especially in its construction phase, would have any particular adverse political impact in the area since local people and their government representatives seem generally in favor of energy development.

5.1.5 Aesthetic Impact

The majority of the intrusive visual, olfactory, and noise factors associated with the project - or its construction - will be localized within the ridgetop basin and canyon landscape units. Many of the facilities and land modifications of the project will be seen only from on-site access roads, from vantage points, or from the air. The natural land topography is well suited to absorb, or locally contain and subordinate, the alterations to the land to be caused by the project. The White River Canyon, which is the most recreationally used unit, could be affected by only two major project components - the stacks from the process plant and the processed shale pile if it should be located in a tributary. The water intake structure and pump station will have a usual impact during construction, but will be submerged during operation of the state dam.

5.1.6 Noise Impacts

On tract noise impact throughout the project will be limited to personnel working close to machinery and equipment. The noise generated by construciton equipment will be replaced during operations by noise from mining, crushing and screening, shale loading, retorting, etc. The noise generated by some of these activities may be in excess of 90 dBA in certain areas. This will include many areas that are accessed only during occasional maintenance operations. High noise exposure workers will be protected by regulations and guidelines governing occupational noise exposures and noise control procedures and techniques specific to the facility operation.

Off-tract noise will be generated by three major sources: facility construction, facility operation, and traffic to and from the facility. The first two will be attenuated by distance, atmospheric absorption, and bluffs and rough terrain acting as natural barriers to provide substantial accoustic isolation to nearby communities such as Bonanza. Traffic generated noise will not be confined to the facility. Its impact will depend on traffic volumes, the path of the main access road and proximity to nearby communities.

5.1.7 Impact on Historic Places and Landmarks

There is no evidence construction or operation will have any impact on historic places or landmarks. The only site of historical significance in the immediate area is the Ignacio Stage Stop some three miles to the west.

5.1.8 Impact on Archeological Sites

Survey of the site did not yield any archeological sites of consequence. Although paleontological survey on Section 32 did disclose fragments of mammal bones, turtle shells, and some petrified wood in the resistant sand ledges of the lower Uintah Formation, it was concluded that no insurmountable paleontological problems would threaten the eventual development of the area nor the more immediate consideration of drill sites for acquiring more resource data.

5.1.9 Transportation Impacts

The project, especially during construction, would place increased demands on the area's road system. This would mean increased highway maintenance costs to the State and Uintah County. Trucks loaded to capacity and running frequently would be the primary factor, but data is lacking to quantify it. Increased traffic affects land use and noise components of the environment. The public finance subcomponent of socioeconomics would also be affected.

5.1.10 Impact on Geological and Mineral Resources

Construction would have negligible impact on these resources.

5.1.11 Water Use, Availability, and Quality

5.1.11.1 Surface Water

Surface water will be taken from the White River for use as a potable water supply and for dust control by wet suppression. Paraho has access to 4 CFS but construction water needs will be only a fraction of that. White River flow is quite variable. Although mean annual flow was 695 CFS during the 1923 - 1979 period, the 10 year - 7 day low flow is estimated to be 125 CFS. A drought in 1977 resulted in a mean daily flow of only 13 CFS on July 4. Quality is seasonally variable but may be generally regarded as very hard and somewhat alkaline. Water quality is discussed in detail in Section 4.4.1.2.

5.1.11.2 Groundwater

No significant alluvial aquifers are located within the area to be disturbed for construction of the plant site and auxiliary facilities. Mine shafts may pass through the Bird's Nest aquifer to the mining zone. These shafts would be lined and grout-sealed near water bearing zones to prevent hydrologic connection with the mining zone. This should ensure confinement of the aquifer and minimize dewatering requirements. The amount of water which will be removed from the Bird's Nest Aquifer in the vicinity of the mine shafts is expected to be negligible in comparison to the groundwater in storage. The overall effect of construction activities on the groundwater hydrology of the area should be insignificant.

Considering the conditions described above, there should also be no significant effect on the groundwater quality due to construction activities.

5.1.12 Air Quality Impacts

During construction, the main source of air pollution will be fugitive dust produced by earth-moving equipment and heavy traffic on unpaved roads. Construction will proceed simultaneously in several areas - process area, water pump station, water pipeline, access road and catchment dam. Activity at the process area will likely be most concentrated and could be expected to produce the most dust. Although preliminary calculations indicate the rational 24 hour secondary standard for particulates (150 mg/m^3) would not be exceeded, construction-generated fugitive dust may have two minor effects on local meteorology. First, small dust particles that remain airborne may act as condensation nuclei to cause a minor increase in local precipitation. This would be beneficial in such an arid region but change, if any, would likely be small. The second effect may be occasional reduction in visibility in the vicinity of the construction activity.

5.1.13 Impacts on Ecological Resources

5.1.13.1 Vegetation

Vegetation will be altered (removed) in three major areas: the process area, road construction, and the retorted shale disposal area. In all, perhaps 100 acres will be affected.

5.1.13.2 Wildlife

As vegetation is removed or destroyed, the area will become incapable of supporting the normal resident and transient animal populations. Most highly mobile animals such as large animals, birds, and flying insects will leave; less mobile small rodents, reptiles, and insects may be destroyed along with the vegetation. Those animals forced away from the construction area will move into presently occupied neighboring areas, thereby increasing competition for food and shelter and increasing exposure to predation. Animal populations in the affected areas will restabilize over a period of time. This process may be relatively short-term and will be limited to a small area surrounding the preempted acreage. When viewed in the regional context, the nearly total loss of affected vegetation and wildlife on the tracts in the construction areas is expected to be minor because of the vast contiguous area of similar habitat.

Because of the pattern of seasonal and distribution of the deer and antelope populations near the project, the local animals will be only marginally affected by the development. The affected area is primarily the sagebrush-greasewood vegetation types, which is thought to be the preferred browse for antelope. However, deer use of the site area is believed to be minimal, due to their few numbers. The antelope herd remains mostly several miles north of the project site.

The apache pocket mouse, the deer mouse, the desert woodrat, and the desert cottontail rabbit--the most common small mammals in the area--are found in all three vegetation types in the area, and hence may be affected by the construction and operation of the project. Nearly all individuals of the burrowing species will be permanently lost; the larger nonburrowing species will tend to be displaced during site preparation and during the deposition of processed shale. While these losses will be locally substantial (between 30 to 35 percent of on-site populations), regional impacts may not even be measurable. The nearly total loss of rodents in the disturbed areas is not an irreversible, long-term loss. Almost all the species potentially affected have a high reproductive potential and can recover from population losses of this magnitude in a few generations. In addition, rodents are expected to be among the first vertebrate groups to become reestablished on the vegetated processed shale pile and in revegetated disturbed areas.

The expected influx of people either directly or indirectly associated with the development of the project will have an impact on the habitat and on the wildlife in the area. Increased noise, vehicular activity, and visibility of people around the area will directly affect wildlife populations, causing sensitive species, such as deer, antelope, raptors, and some song birds, to avoid intensively used areas. Migration of these animals to surrounding habitats will probably result in more competition and predation in these areas, and the animals that the surrounding habitat cannot accommodate may be lost.

Greater recreational use will be made of the area. Increased hunting and fishing will directly affect wildlife populations and will most likely reduce populations of game species. In addition, any off-road use of recreational vehicles will disturb the shallow soils and the plants they support and hence further disrupt habitats in the area. Paraho will work with the Utah Division of Wildlife Resources, the Bureau of Land Management, and others to minimize these effects.

No major impacts on aquatic habitats are anticipated from construction of facilities. The White River will undergo significant change if the White River Dam and Reservoir is constructed. Prior to the filling of the reservoir, there may be minor impacts associated with the construction of Paraho's intake structure and pump station. Construction of the pump station may locally affect resident species (e.g., deer and Canada geese) in the riparian zone. Surface runoff will bring about minor changes in water quality (in the form of suspended solids), but these changes are expected to be indistinguishable from the effects of ambient turbidity on algae or insect larvae in the river.

The use of a diversion-intake system for water supply requirements is not expected to affect the aquatic community in the White River.

5.1.13.2.1 Endangered or Threatened Fauna

Two endangered raptor species, the peregrine falcon (a predator on other birds), and the bald eagle have been observed near the site, but no breeding sites have been located in or near the area. It is anticipated that these casual visitors will avoid the area, and will be only marginally affected by the proposed project.

The endangered Colorado squawfish (Ptychocheilus lucius), the humpback chub (Gila cypha), and the humpback sucker (Xyrauchen texanus) (which may be placed on the endangered species list) have been found in the White River near the site. The very rare bony-tailed chub (Gila elegans) is thought to reside only in the Green River.

The threatened species, Gilia mcvickerae, is normally found within the sagebrush and juniper habitats, but has not been observed on-site. Elimination of some sagebrush-greasewood vegetation however, represents a potential for the destruction of some of these threatened plants..

5.2 OPERATION

For the most part, knowledge of the impact of operation on a specific environmental area versus the impact of the construction phase on that area is not sufficiently accurate to differentiate between the two. This is not always the case, however. Therefore only those sections where it is felt there will be a significant difference in operation vs construction phases will be discussed. Although operation is scheduled for only 24 months, it is assumed for purposes of discussion here that there will be developments that extend that operation indefinitely.

5.2.1 Land Use

Same as 5.1.1

5.2.2 Socioeconomic Impact

Fewer people will be involved (about 300) and a higher proportion of them will live in permanent rather than mobile homes. Because there will be fewer people, some of the pressures caused by numbers of people and their buying power will slacken.

5.2.3 Impact on Native American Communities

Same as 5.1.3

5.2.4 Political Impact

Same as 5.1.4

5.2.5 Aesthetic Impact

Same as 5.1.5

5.2.6 Noise Impacts

Section 5.1.6 covered both construction and operational phases. In the operational phase, the noise from construction equipment will be replaced in part for the noise from operating equipment such as blowers, pumps, crushers, motors, etc. The operating phase may be noisier but the impact on the surrounding area probably will not be materially different. This aspect will be examined during the Phase I program.

5.2.7 Impact on Historic Places and Landmarks

Same as 5.1.7

5.2.8 Impact on Archeological Sites

Same as 5.1.8

5.2.9 Transportation Impacts

Major effects of transportation services will shift from construction equipment to trucks used in product transportation. Impacts will consist of deterioration of highway road beds, increased traffic flow, and increased air emissions.

5.2.10 Impact on Geological and Mineral Resources

Successful operation of the Paraho project would add new technology and lead to increased recovery of oil shale mineral resources in the Uintah Basin where there is significant potential for helping meet the nation's energy needs.

5.2.11 Water Use, Availability, and Quality

The operation phase will require substantially more water from the White River, but the estimated 0.51 CFS demand is very small in relation to total flow. Any withdrawal for consumptive use, regardless of size, has some effect on downstream water quality by reducing dilution. Individual impacts may not be measurable, but collectively, salinity and other properties are affected.

5.2.12 Air Quality Impacts

Air quality is perhaps the impact of most interest. Until design is farther along, data for modeling to estimate emission impacts on ambient air quality cannot be performed. Previous modeling work at another nearby site indicates there should be no problem. Table 3.2-1 presents data concerning expected emissions from the operation of the facility.

Operating the retorting facilities presents three possible sources of air pollution. Shale handling and processing can produce large fugitive dust emissions unless proper control measures are used. Combustion of fuel gas in the gas turbine/boiler/thermal oxidizer complex can result in NO_x, SO_2, and particulate emissions.

Fugitive dust and minor emission levels of CO, HC and NO_x will be generated by vehicle traffic during operation. Table 5.2-1 shows probable emission control techniques.

Shale rock is usually processed and handled several times between the time it is removed from the mine and the time it is placed in the processed shale disposal area. Fugitive dust from the shale rock is emitted furing secondary crushing and screening, conveyor transport, and loading into the storage bins, retort, or disposal pile. Fugitive dust control measures are shown in Table 5.2-1.

Fuel gas combustion is the other major air pollutant source during facility operation. One of the retorting products is low heating value off-gas. Analysis of the gas from previous small-scale Paraho term ambient air quality standards, with the exception of particulates and hydrocarbon, could be met by substantial margins.

The hydrocarbon concentration value (including methane) estimated by the White River Shale Project (WRSP) working on Ua/Ub within two miles of Paraho's site exceeded by the primary standards, but the source of hydrocarbons, particularly the fines-type retort preheaters, are known to emit an unknown quantity of methane that is excluded from the regulatory limit. There is some evidence that as much as 80 percent of the hydrocarbons in off-gases may be methane. If such is the case, the non-methane hydrocarbon concentrations

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SURFACE OIL SHALE RETORTING MODULE PHASE I ENVIRONMENTAL IMPACT STA

Table 5.2-1

PROBABLE CONTROL MEASURES

Pollutant	Control Technique	Efficiency (%)
Particulates (from mine)	Wet Suppression & baffled settling chamber	98.5
Particulates (shale handling)	Baghouse	99
Particulates (shale handling)	Wet Suppression	75
Particulates (construction)	Wet Suppression	50
NH_3 (NO_x)	Gas Treating - water wash for ammonia removal	90
H_2S (SO_2)	Gas Treating - H_2S Stretford removal	99
Particulates	Gas Treating - Particulate removal by ESP's, water wash, and Stretford cartridge	50

resulting from plant emissions would have been quite low (e.g., less than 12 micrograms per cubic meter).

Based on monitoring data from nearby Federal Prototype Oil Shale Lease Tracts U-a and U-b, the hydrocarbon standard is now occasionally exceeded in the area, although there are no apparent hydrocarbon sources present other than natural vegetation. Since background nonmethane hydrocarbon levels are frequently quite high (e.g. 100 to 150 micrograms per cubic meter), the levels occurring with additional plant emissions are quite likely to exceed ambient air standards. However, it is important to note that the hydrocarbon "standard" is actually a guideline to be used as a tool for controlling exidant formation. Oxident levels are within structures.

Long term analyses conducted by WRSP also indicated that annual regulatory limits would be met for each of the three pollutants (particulates, sulfur dioxide, and nitrogen oxides) for which there are annual standards.

Therefore, with the possible exception of hydrocarbon levels, which may occasionally exceed standards at certain on-site locations, it is expected that all emission and ambient air quality standards including PSD incremental allowances, would be met during all phases of construction and operation of Paraho's proposed 10,500 bbl/day oil shale facility. Both primary (protection of human health) and secondary (protection of plants and animals) ambient air quality standards are expected to be achieved by reasonable margins, and no significant on-tract or off-tract impacts are expected.

The nearest Class I area to the proposed Paraho facility is the Flat Tops Wilderness Area in Colorado, 160 miles to the east. Impacts from the Paraho facility on this area are expected to be negligible. (Dinosaur National Monument has been proposed as a Class I area.)

In summary, preliminary data indicate the proposed facility will comply with all air quality standards, including PSD standards, and State of Utah ambient standards.

5.2.13 Impacts on Ecological Resources

Same as 5.1.13

5.3 POST OPERATION

(Cannot be addressed at this time)

Section 6.0

PROJECT MODIFICATIONS TO MITIGATE IMPORTANT IMPACTS

6.1 CONSTRUCTION

6.1.1 Monitoring

In the broad sense, corporate recognition of environmental and social responsibility, a clear policy for guidance, and a management staff to implement it, is a monitoring essential. In the narrower sense, many activities such as operation of air emission sources can only be coducted under permits which require emission monitoring, etc. It is premature at this point in the Phase I program to note what other kinds of monitoring may be appropriate such as off-site ambient air quality, employee health, etc.

6.1.2 Modifications to Mitigate Impacts

6.1.2.1 Land Use and Ecological Impacts

Impacts on land use and area ecology caused by road construction, materials storage, etc., that remove or damage vegetation will be mitigated by efforts to minimize unnecessary disturbance to the land. When disruption is temporary as in pipeline construction, timely restoration measures (revegetation) will help shorten adverse effects. Proper drainage for runoff will minimize erosion damage.

6.1.2.2 Socioeconomic Impact

Early pre-construction meetings with local community leaders and officials will facilitate planning and ease impacts. Good planning on providing construction housing will be an important way of relieving real estate impacts.

6.1.2.3 Air Quality Impact

Fugitive dust from road building, site clearing, traffic on unpaved roads, etc., will be the major air quality factor. Various controls can reduce emissions substantially. Watering twice daily can reduce emissions by about 50%. Chemical suppressants for dust control can achieve an 80% control efficiency on completed cuts and fills. Limiting vehicle speeds to 20 miles per hour can reduce emissions by 65%. Speed limits and wet suppression techniques will be used as mitigating measures.

6.2 OPERATION

6.2.1 Monitoring

(Same as 6.1.1)

6.2.2 Modifications to Mitigate Impacts

6.2.2.1 Noise Impacts

Because of the isolated location of the project site, noise would not be expected to be of major concern off-site. On site, high noise levels will be generated by mining, material handling, and processing. High noise exposure of workers will be limited by regulations and guidelines covering occupational noise exposures and subsequent noise control procedures and techniques specific to the facility operation.

6.2.2.2 Water Use Impact

Since there will be no aqueous discharge from the plant, the impact of water use on the water environment will be attributable to the consumptive nature of the water use. Any consumptive use has a downstream effect - on salinity for example - but planned water use is so small, these effects can probably not be measured except as the cumulative effect of many consumptive withdrawals. Nevertheless, efforts will be made to minimize consumptive water use. The efforts must be balanced, however, by the advantages of using water for wet suppression of fugitive dust.

Parahl

6.2.2.3 Air Quality Impacts

Mine vent particulate emissions will be controlled by a combination of wet suppression on working areas and by routing ventilation air through mined-out chambers which will serve as baffled settling chambers.

Operating the retorting facilities presents the possible sources of air pollution as discussed in Section 5.2.12. Shale handling and processing can produce large fugitive dust emission unless proper controls are used. Combustion of fuel gas can result in NO_x, SO_2, and particulate emissions. Wet suppression, collection and baghouse filtration, and gas cleaning are mitigating measures that will be taken. Table 5.2-1 shows probable control techniques. Road paving may also be an effective pollution control step for fugitive dust produced by vehicular traffic on unpaved roads.

Shale rock is usually processed and handled several times between the mine and the time it is placed in the processed shale disposal area. Fugitive dust is emitted during secondary crushing, screening, transport, and loading into storage bins, the retort, or disposal pile.

Fuel gas combustion is the other major air pollutant source during facility operation. One of the retorting products is low Btu off-gas which contains NH_3 and H_2S. To control NO_x and SO_2 emissions from gas combustion, the gas will be treated for NH_3 and H_2S removal before burning. The treatment process has not been finalized. Flame temperature in the combustion chamber will be low enough to prevent significant NO_x formation from the nitrogen in combustion air.

The flare system to safely dispose of process gases during start-up, transient or emergency conditions will be of the smokeless type and will be designated to meet noise criteria.

6.3 POST OPERATION

When the plant is abandoned, the equipment will be removed and, to the extent practical, the site will be restored to its original state. The retorted shale disposal area will be revegetated and the land will return to its original use - grazing.

Paraho

Section 7.0

EVALUATION OF THE PROPOSED ACTION

7.1 SUMMARY OF UNAVOIDABLE ADVERSE IMPACTS

In the course of the proposed action, constructing and operating the Paraho module, and associated mining and spent shale disposal, all reasonable mitigating measures will be taken to reduce the environmental impacts, and to comply with applicable Federal, State, and local regulations. However, certain impacts are both unavoidable and adverse:

- Approximately 100 acres of land surface, its vegetation and wildlife will be disturbed by plant site, storage areas, conveyors, roads and utility corridors, shale disposal areas, pipelines, and mine development. Much of this distrubance is expected to be temporary.
- Approximately 20 acres of a drainage depression will be filled with retorted shale. Recontouring and revegetation will create a new surface which will alter topography permanently, disturb some wildlife habitats, and probably change the vegetation cover.
- Approximately 1,000,000 barrels of shale oil will remain unrecovered in unretorted fines from crushing and screening 17 million tons of shale. However, since plans for ultimate disposal fines remain uncertain, potential for recovery and/or re-use exists.
- Some atmospheric emissions will be added to the regional air environment, temporarily degrading local air quality during construction and operation. These emissions will include particulates, sulfur dioxide, nitrogen oxides, carbon monoxide, and hydrocarbons. Despite control efforts, fugitive dust levels will increase during construction and operation of the facility, due to emissions from disturbed land, unpaved roads, and shale handling.
- There will be an increase in general noise levels in the area over the almost three-year project period. Noise levels at the site and for mining and shale disposal will

comply with statutory limits. Nearby towns such as Bonanza should not be affected, but some impact on wildlife near the site may result.

Paraho

7.2 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

The proposed action to mine 17 million tons of oil shale on the 582 acre Paraho lease tract in Utah will involve the following irreversible and irretrievable commitment of resources:

- Mining and processing 17 million tons of oil shale, averaging approximately 28 gallons per ton, will yield as much as 9.5 million barrels of shale oil. Mining this quantity of shale by underground room-and-pillar methods with a 60 percent in-place recovery of the resource will commit 28 million tons of raw, in-place oil shale to the proposed action.

- About twenty acres of drainage depression on the site will be filled with disposed retorted shale. Drainage and catch-basins are planned to control runoff and leaching. The disposal area will be vegetated and cared for until the new cover is self-sustaining.

- Due to the activities described above, approximately 100 acres of naturally occurring flora and existing wildlife habitats will be lost. However, most of this will be reclaimed by revegetation. The lost wildlife habitats are not critical.

- 370 acre-ft/year of water (740 acre-ft over 2 years), primarily for domestic use, mining, and dust control, will be consumed onsite during operations. Most of this water is expected to come from the White River. The remainder will come from process waters. All water consumed will be surface water, it is not expected that any groundwater will be used onsite.

- Approximately 20 megawatt-years of outside electrical power will be consumed over a 2 year operating period. this in turn will require the offsite consumption of 68,400 tons of bituminous coal (or its heating value equivalent in natural gas, 1.51 billion SCF) for power generation.

Parah

7.3 <u>SHORT-TERM USES VS. LONG TERM PRODUCTIVITY</u>

(Not yet developed)

7.4 BENEFIT - COST ANALYSIS

7.4.1 Benefits

During the 24 month operating period the project will produce approximately 9.5 million barrels of oil. Of additional benefit will be the value of the knowledge gained in operation of a module - knowledge that should provide improved designs for future units with respect to mechanical design, process performance, and environmental controls. The local economy will benefit wages paid over the life of the project.

7.4.2 Costs

Costs for the construction and operation of the facility will be determined as part of the Phase I program.

7.4.3 Balance and Conclusion

(Not yet developed.)

APPENDIX A

4.0 AFFECTED ENVIRONMENT

4.1 Land Use, Socioeconomic and Political Profiles, Transportation and Cultural Resources

4.1.1 Land Use

The proposed site for the Paraho oil shale project is located in the northeastern corner of Utah in Uintah County, four miles west of the Colorado border. The project site and surrounding area are dry, sparsely vegetated and are used mainly for winter sheep grazing.

4.1.1.1 Federal

The project site is located within the Bureau of Land Management (BLM) Bonanza Planning Unit which includes most of southern Uintah County. On October 29, 1968, all of the public land within this planning unit was classified for multiple use management (BLM, 1973). Uses permitted within a multiple use area include farming, grazing, mining, and limited recreation activities.

Although grazing is the primary land use within the planning unit, various other uses occur. A small area of land along the Green River is irrigated for agricultural use. There are currently three withdrawal sites within the designated area. The BLM is managing 337,262 acres, of which 291,000 acres are oil shale land; 449 acres are being utilized by the BLM and Federal Power Commission for a power plant site, and the BLM is managing 256 acres of Public Water Resources (BLM, 1973). Oil and gas fields, coal, and other mineral sites are also located in the planning unit. The U.S. Fish & Wildlife Service (USFWS) has set aside 1,601 acres for a wildlife refuge (BLM, 1973) located in the west central area of the County.

Within the planning unit, 84% is Federal land; 11.3% is State-controlled, and 4.7% is privately owned. A complete list of land status within the planning unit is presented in Table 4.1-1.

4.1.1.2 State

The proposed site for the Paraho project is on State-owned land on which a grazing lease is presently being honored. However, Utah policy states that, if an alternate, acceptable, more productive use is proposed, the State may terminate grazing on the site (Wall, 1980). The proposed oil shale project is considered to be such an acceptable, more productive use. Paraho Development Corporation was assigned State Mineral Lease No. 35894 on February 23, 1979, for the purpose of shale oil extraction. The site is 582.34 acres, described as Township 9 South, Range 25 East, Sum Section 32.

4.1.1.3 County

The Paraho site is located in the southeastern portion of Uintah County, the sixth largest county in Utah. The County comprises 5.5% of the State with 4,463 square miles or 2,856,320 acres. Land ownership in the County is comprised of 78% Federal land (65% of which is public domain land managed by BLM); 8% is State owned and 14% is privately owned (Vernal Chamber of Commerce, 1980). Land ownership information is detailed in Table 4.1-2.

County land is primarily used for farming, ranching, and mineral extraction, which constitute 70% of the total acreage (Vernal Chamber of Commerce, 1980). Cropland comprises 3%, grazing has a wider use with 47% of the County land. Mineral and geothermal leases comprised 18% of the County in 1977, with most land leased for oil, gas and oil shale (Vernal Chamber of Commerce, 1980). These land uses are presented in Table 4.1-3.

TABLE 4.1-1

BONANZA PLANNING UNIT LAND STATUS

Status	Administrative Agency	Acreage	Percent of Total
Public Domain	BLM	337,262	82.5
Public Water Resource	BLM	256	0.1
Wildlife Refuge	USFWS	1,601	0.4
Power Site Withdrawal	BLM & FPC	449	0.1
Reclamation Site Withdrawal	BLM & WPRS	3,526	0.9
Subtotal - Federal		343,094	84.0
State	State	46,295	11.3
Private	Private	19,278	4.7
Total		408,667	100.0

Source: BLM, 1973, Bonanza Unit Resource Analysis.

TABLE 4.1-2

LAND OWNERSHIP
UINTAH COUNTY

Owner	Acreage	Percent of Total
Federal (total)	2,214,699	77.6
BLM	1,447,582	50.7
Indian Reservations	426,840	14.9
Forest Service	270,430	9.5
National Park Service	50,062	1.8
Fish & Wildlife Service	10,966	0.4
Water & Power Resources Service	8,829	0.3
State	231,420	8.1
Private	410,201	14.3
Total	2,856,320	100.0

Source: Vernal Area Chamber of Commerce, 1980, "Vernal City & Uintah County - the Nation's Energy Storehouse."

TABLE 4.1-3

LAND USE
UINTAH COUNTY

Land Use	Acres	Percent of Total
Land in Farms & Ranches	1,480,801	51.8
Total Cropland	72,922	2.6
Harvested Cropland	31,076	1.1
Pasture Cropland	26,323	0.9
Other Cropland	15,523	0.5
Woodland	461,176	16.1
Other Land	873,781	30.6
Mineral & Geothermal Leases[a]	513,799	18.0
Oil & Gas	243,727	8.5
Oil Shale	68,395	2.4
Metallic Minerals	15,578	0.5
Bituminous Sands	30.459	1.1
Non-Metallic	8,120	0.3
Coal	146,234	5.1
Geothermal	1,236	0.1
Grazing[b]	1,000,500	35.00
Industrial	840	.03
Residential	3,200	.11
Commercial	600	.02
Parks & Recreation	50,800	1.80
Lakes & Reservoirs	4,000	0.14
Total		106.9[b]

(a) Data as of 1977
(b) Grazing is a double use in some areas (6.9%)

Source: Vernal Area Chamber of Commerce, 1980, "Vernal City & Uintah County - the Nation's Energy Storehouse."

Uintah County adopted a zoning ordinance and map on June 4, 1962. The entire southern portion of the County, in which the Paraho site is located, is zoned "Mining & Grazing" (M & G-1).

The City of Vernal is the only incorporated city in the County and is approximately 28 miles northwest of the project site, about 50 road miles. The City of Vernal also has adopted a zoning ordinance, and the provisions of the City zoning map have been incorporated into the County zoning map. The majority of Vernal is zoned Residential-Agriculture (RA-1). Other zoning designations are: Highway Service (H-1) along Highways 40 and 44 at the outer edge of the city; Industrial (I-2) at the western edge of town, which includes the airport; Commercial (C-1) on Highway 40 through the center of town, and Agriculture (A-1) on county land surrounding Vernal.

4.1.1.4 Land Use Plans and Policies

Land use plans for the lease area are set forth by the Bureau of Land Management, the State of Utah and Uintah County. Primary uses allowed by all three governmental agencies include mining, agriculture, and limited recreation.

Although the site is not located on Federal land, it is surrounded by BLM land. The plans for the BLM area are set forth in the Bonanza Planning Unit Management Framework Plan (MFP) which designates this area for mineral extraction. Therefore, the proposed land use is compatible with the BLM plan.

The County zoning ordinance designates the area for mining and grazing. The County has a General Plan, which is in the process of being rewritten to help guide the County through the development of energy resources (Miller, 1980).

4.1.1.5 Other Planned Energy Projects

There are three other planned oil shale projects which may be constructed in south Uintah County, Utah: White River Shale Project, Geokinetics, and TOSCO Sand Wash. In addition, two other energy-related projects are planned--the Deseret Generation and Transmission Power Plant, and the White River Reservoir, Dam and Hydro Plant. Figure 4.1-1 presents the location of these projects relative to the Paraho site.

White River Shale Project

The White River Shale Project is a consortium of oil companies--Phillips Petroleum, Sun Oil, and Sohio Petroleum, which hold Federal leases on Tracts U-a and U-b. The proposed development would involve three phases: initial mine access; single retort operation, and commercial operation using the surface retort process. Peak construction activities are anticipated to involve 4,200 employees, and mine operation will employ 1,420 to 2,050 persons. At full commercial capacity, which is not expected for 10 to 12 years, production of 100,000 barrels per day is anticipated.

Geokinetics

Geokinetics is presently leasing 30,000 acres of land 70 miles south of Vernal from both the State of Utah and private individuals. An experimental plant has been in operation for the past three years and has produced about 15,000 barrels of oil utilizing a modified horizontal in-situ process. Peak construction employment is expected to be 50 persons, with operation expected to employ 50 to 500 persons. Production is planned to reach 20,000 barrels per day. Future development plans are not known at this time.

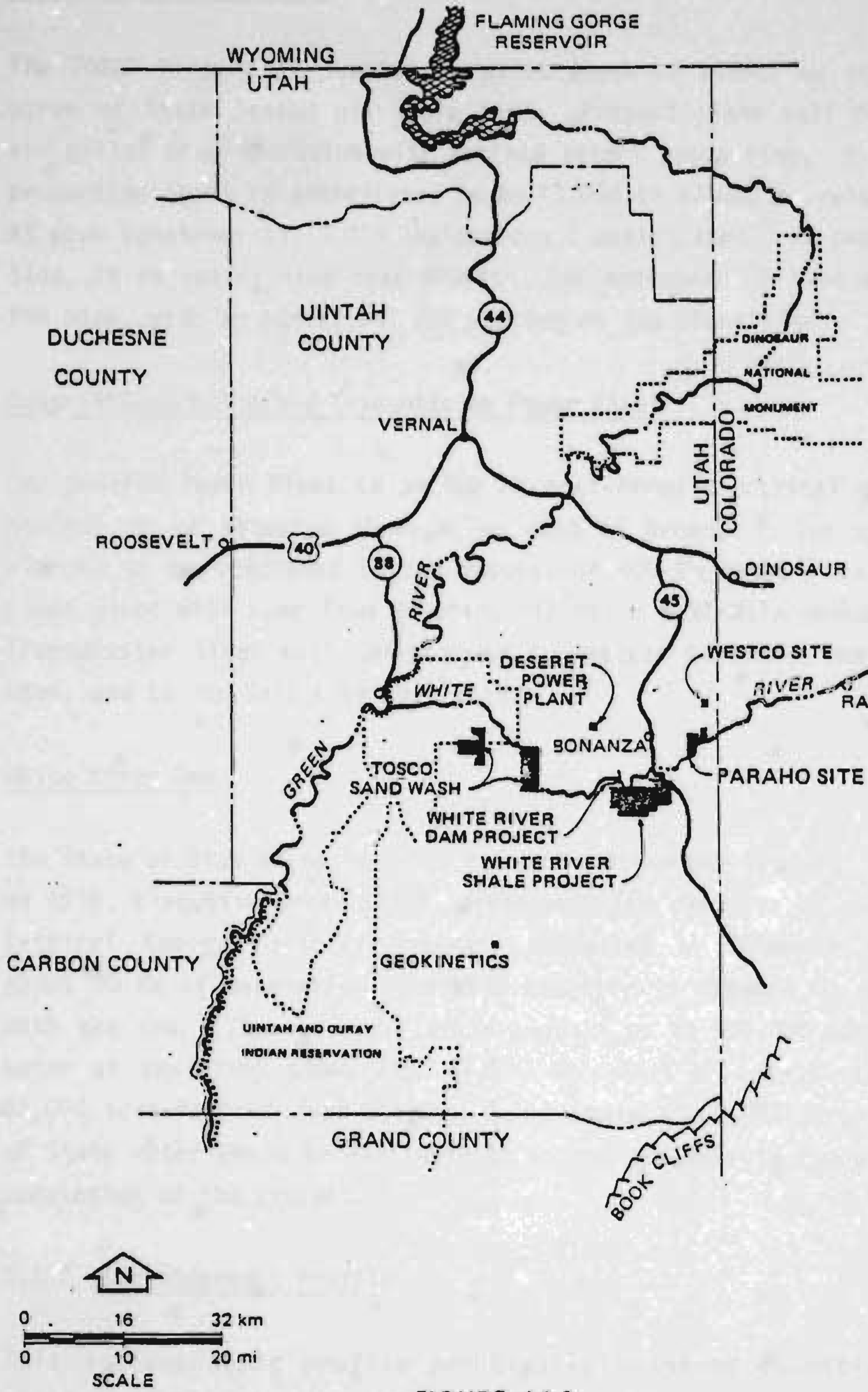


FIGURE 4.1-1

PROJECT LOCATION MAP

TOSCO Sand Wash Project

The TOSCO Project is located 35 miles south of Vernal on over 19,000 acres of State leased oil shale land. Present plans call for a room and pillar mine operation with surface retort processing. By 1988 the production level is anticipated to be 43,000 to 47,000 barrels per day. At peak construction, 3,075 employees are anticipated. At peak production, it is anticipated that 500 to 1,560 employees will be working in the mine, with an additional 700 working on the plant site.

Deseret Generation and Transmission Power Plant

The Deseret Power Plant is an 800 MW coal-fired electrical generation project to be situated three miles west of Bonanza. The project is planned to be completed in two stages, of 400 MW each. Coal for the power plant will come from Colorado fields on a 31-mile conveyor belt. Transmission lines will carry power to western Colorado, northeastern Utah, and to the Salt Lake City area.

White River Dam

The State of Utah plans to build the White River Dam Project. In April of 1979, Executive Order 12/29, designated the dam area as part of the Critical Energy Facility Program, requested by Governor Matheson. About 30 MW of generation generator capacity is planned in connection with the dam. The reservoir would contain up to 105,000 acre-feet of water at any given time, with 67,000 acre-feet of active storage and 38,000 acre-feet of dead storage. Approximately 100,000 acre-feet/year of State water would be available to energy projects in the area, upon completion of the project.

4.1.2 Socioeconomic Profile

This socioeconomic profile principally examines conditions currently existing in Uintah County, focusing on the City of Vernal and surrounding area. It is anticipated that these areas would receive the greatest potential impact from the proposed project.

4.1.2.1 Population

Uintah County is a sparsely populated area in the northeastern corner of Utah. Based on preliminary data from the 1980 Census, population in the County is approximately 20,247 persons, a gain of approximately 60% over the 1970 population of 12,684 persons. Since the gain in population from 1960 to 1970 was about 10%, a significant increase in growth patterns is evident. Based on the 1980 population, the County has a population density of 4.5 persons per square mile.

Population in Utah increased from 1,059,273 in 1970 to 1,428,682 in 1980, a gain of 35%. Population density in the state is 12.9 persons per square mile. Thus, compared to the State of Utah, Uintah County has been increasing at a faster rate, but is less densely populated.

Further 1980 data on population characteristics for Uintah County are not yet available. However, based on the 1970 census, the latest available information, the County is 89.2% white, and 10.5% Indian. The age distribution indicates approximately 35.1% of the population was over 35 years, 22.6% was between 17 and 34 years, and 42.3% was under 16 years. Females comprised 49.3% of the total population and males 50.7% (Utah Industrial Development Division, 1980). Table 4.1-4 contains a summary of Uintah County population.

Based upon the preliminary 1980 data, the City of Vernal has a population of 6,486 persons, a gain of 66% over the 1970 figure of 3,908. The 1980 population of Maeser, a community three miles from the City of Vernal, was 2,171 persons, an increase of 74% over the 1970 figure of 1,248.

TABLE 4.1-4

UINTAH COUNTY
POPULATION SUMMARY

	1980	1970	Percent Change
Total Population	20,247	12,684	59.6
Vernal Division	15,699	9,322	68.4
Vernal City	2,171	1,248	74.0
Maeser (CDP)(a)	6,486	3,908	66.0
Remainder of Division	7,042	N/A	-
Uintah and Ouray Division	4,548	N/A	-
Ballard Town	538	N/A	-
Remainder of Division	4,010	N/A	-

(a) CDP - Civil District Population

N/A Not Available

Source: Census Bureau, 1980.

The American Indian Reservation population (noted as the Uintah and Ouray Division on Table 4.1-4) shows 4,548 persons in 1980. There is no corresponding data for 1970.

4.1.2.2 Housing

The total number of dwelling units in Uintah County is 6,632 (Bureau of Census, 1980), with 72% of the existing housing stock in single family units, with the remainder in mobile homes, and multiple family units (UBAG, 1980). Thirty-six percent of the housing units are in the City of Vernal and, like the County, are comprised primarily of single famly units. The average number of persons per household is 3.4 for the County and 3.0 for Vernal.

The City of Roosevelt is the only other major Utah community readily accessible to the project area. The town is located in Duchesne County, just west of the Uintah County line, about 55 miles northwest of the project site. There are 1,223 dwelling units in Roosevelt, with an average 2.9 persons per dwelling unit and a 9% vacancy rate.

Growth in the Uintah Basin has been strong in the past ten years, as indicated by growth in Vernal, with an 85% increase in housing units since 1970; Roosevelt has shown a 109% gain during this time (Bureau of Census, 1980).

There are scattered dwelling units between Vernal and the Paraho site. Due to their small size, however, specific data are not available. Community clusters are located at Naples, three miles south of Vernal; Jensen, five miles west of Vernal; and Bonanza, approximately three miles northwest of the project site. Ouray, Randlett and Fort Duchesne are all very small Indian Reservation communities located between the project site and Roosevelt. Table 4.1-5 presents selected housing information for Uintah and Duchesne Counties.

TABLE 4.1-5

SELECTED HOUSING STATISTICS
UINTAH AND DUCHESNE COUNTIES

	1980 Total Units	1970 Total Units	Percent Change	Vacancies	Vacancy Rate	Persons Per Unit
Uintah County	6,632	3,713	78.6	749	11	3.4
Vernal	2,373	1,283	85.0	233	10	3.0
Duchesne County	4,432	2,348	88.8	996	22	3.6
Roosevelt City	1,223	585	109.1	104	9	2.9

Source: Bureau of Census, 1980. Preliminary Census Data.
UBAG, 1980.

4.1.2.3 Utilities/Communications

Electricity

There are two sources of electricity for Uintah County, the Utah Power and Light Company (UPL) and the Moon Lake Electric Association, Inc. The UPL serves the Ashley Valley, in which Vernal is located, via a 138 kV transmission line from Castle Gate near Price, Utah (Aycock, 1980). This line is shared with the Water and Power Resources Service (formerly the U.S. Bureau of Reclamation). UPL presently has approximately 6,000 accounts in the valley (5,400 residential and 600 commercial/industrial).

UPL does not charge a connection fee for a normal hook-up. The minimum monthly service charge for a residence is $2.55, and $4.44 for a business utilizing one-phase service, $13.32 for three-phase service (Aycock, 1980).

There are plans to construct a new substation in Maeser, three miles west of Vernal. Within the next two to three years another substation is planned to be built in the southeast area of Uintah County, if needed (Aycock, 1980).

The Paraho site is located within the Moon Lake Electric Association service area. Although the site does not contain any electrical facilities, a 79 kV transmission line passes within three miles of the northern edge of the site. Also, a 12 kV distribution line passes less than one mile from the western edge of the site. Both the 79 kV and 138 kV transmission lines are utilized for their service area which encompasses approximately all of the Uinta* Basin except Ashley Valley.

Note: The spelling of Vinta refers to physiographic features; the spelling of Uintah refers to political or organizational features.

Moon Lake Electric does not impose a hook-up fee under normal circumstances. The residential monthly minimum is $4.00, a small business is $5.00. and a large is $50.00 or $0.75 per kVa (Lee, 1980).

The Moon Lake Electric Association estimated future energy needs based on potential new growth in the area. In order to ensure an adequate supply of power, Moon Lake has purchased part ownership in the Deseret Power Plant.

Natural Gas

Natural gas is delivered to Uintah County by the Utah Gas Service Company. This gas is purchased from the Northwest Energy Company. A limit has not been set upon deliverable amount. The service is currently dependable and supplies are plentiful for the area.

Water System

Maeser and Vernal each have their own water systems, but they share the same lines. The system started in the early 1900s as a means of watering stock with an outlet every one-half mile (Henderson, 1980). It was later approved for culinary use, however a low pressure problem exists. Distribution line capacities should be increased and greater storage capacity is needed.

The current rate of delivery for the entire system is 3.0 MGD. The monthly minimum charge is $3.00 for up to 10,000 gallons, with a charge of $0.40 per 1,000 gallons over this amount.

The water system in the Ashley Valley is currently going through some major changes. The Valley-Wide Water and Sewer District has just been formed and service expansion is planned.

There presently exists 2.5 million gallons of storage capacity. The Valley Wide Water and Sewer District Master Plan calls for a 4.8

million gallon increase, 1.5 at Asphalt Ridge and 3.3 at Chocolate Rock in the Ashley Valley (Henderson, 1980). This would provide a total storage capacity of 7.3 million gallons, an increase of almost 200%.

Additional water to meet the future needs of Vernal is to be obtained from the Red Fleet Reservoir, which is currently under construction.

Currently, no water system exists at the project site.

Sewage Treatment/Disposal

The City of Vernal is the only area in Uintah County with a sewage collection system. All other communities are served with septic tanks. A new sewage treatment system is under construction in Vernal. The present system, which includes primary treatment and a trickle filter, is overloaded largely because of ground water infiltration. The first phase of the new expanded treatment facility will have a capacity for a population of 20,000 (Henderson, 1980). When the entire system is completed it will have a serving capacity for 60,000 people.

The present sewage service hook-up fee is $350, with a monthly minimum service charge of $7.00 (Utah Industrial Development Division, 1979).

Solid Waste

The City of Vernal and Uintah County jointly own and operate a solid waste landfill which will be adequate for at least the next 10 years (Henderson, 1980).

Telephone Service

Uintah County is served by the Mountain Bell Telephone Company. There are approximately 5,000 customers in the Vernal area with over 11,000 telephones (Vernal Area Chamber of Commerce, 1980). It is estimated that present facilities could service any additional customers which might located in the area.

Other Communications

The Vernal Express is a weekly newspaper serving the Vernal area. Three daily papers are also distributed, the Deseret News, the Salt Lake Tribune, and the Denver Post.

The City of Vernal has both AM and FM radio stations which serve the Uinta Basin and portions of northwestern Colorado. Roosevelt also has an AM station serving the Basin.

Television reception is good due to a reflector system operated by the County. Four commerical stations are available for viewing, with cable TV service available for a monthly fee.

The City of Vernal has a post office, United Parcel Service, a Western Union Telegraph Office, and Air Parcel Service (Vernal Area Chamber of Commerce, 1980).

4.1.2.4 Community Services

Health Care

The primary health care facility in the Vernal area is the 36 bed Uintah County Hospital, which opened July 12, 1980. Staffed by seven doctors and 39 nurses, the hospital offers general care, plus general, orthopedic and reconstructive surgery. The hospital has been designed for future expansion to 117 beds, depending upon the needs of the area. Cases involving specialties such as coronary and neurological care are usually transferred to Salt Lake City.

The old county hospital will be converted to a convalescent home. It is anticipated that this will be a 34-bed facility, but planning is in the preliminary stage and no schedule for completion has been determined (Ethintton, 1980). In addition to these facilities and personnel, the Vernal area has seven dentists, two veterinarians, and two chiropractors.

The county has ambulance service available at all times, with one fully equipped ambulance, plus one back-up vehicle. These are provided through the state-sanctioned Emergency Medical Technician (EMT) program, whereby trained volunteers are available to operate the ambulance service and provide emergency medical treatment. The ambulance transports patients to the county hospital which has a lifeline to Salt Lake City for major cases (Downard, 1980).

Police Protection

Police protection is provided to the City of Vernal by a police force consisting of 15 officers and three office personnel. In addition, the Uintah County Sheriff's Department, stationed in Vernal, has a staff of 10. Detention facilities are located at the Sheriff's station in Vernal, and consist of jail facilities for about 30 persons (Downard, 1980).

The Vernal Police Department is currently planning to expand facilities and personnel, based upon current population projections for the region (4.1.2.1). At this time, plans are non-specific, as growth is still in the anticipatory stage. The organization and procedures of the department, however, are organized to facilitate expansion of personnel without other operational changes. It is known that there will be a need for additional facilties, and the police department is considering several options: one would be to combine with the sheriff's department; another would be to expand existing facilities utilizing Federal assistance (Downard, 1980).

Fire Protection

The City of Vernal and Uintah County jointly operate a volunteer fire department. There are currently 25 volunteers, recently increased from 20 (Slaw, 1980).

The fire department is equipped with two 1,250 gallon pumpers, one 750 gallon pumper; one small pumper (used for grass fires) and one 500 pound dry chemical truck. The airport has a Class A truck equipped with 500 pounds of dry powder and 500 gallons each of water and foam (Slaw, 1980).

4.1.2.5 Educational Facilities

Public schooling is provided by the Uintah County School District, with most of the facilities located in Vernal. The Uintah School District consists of nine schools, plus provision for special education and adult education classes. Of these facilities, six are located in Vernal, with the remainder in the outlying areas (see Table 4.1-6). Of the district's 1979 fall enrollment population of 5,154, 4,318 of these attended school in Vernal, and the remaining 836 attended schools in the outlying areas. In addition, about 75 to 100 students living in the Uintah County District attended Union High School, located in the Duchesne County School district, because their homes are closer to Union High School (Uintah Basin Oil Shale Study, 1980).

Enrollment figures for the 1979-1980 school year show that district elementary, junior high and high school facilities average 16% over capacity, ranging from 41% to 3%, at the various schools. These figures do not include the special adult education centers. Overall, the elementary schools are 24% over capacity, due primarily to crowded conditions in the three schools in areas outside of Vernal. The junior high school enrollments for 1979 averaged 11% over capacity while the senior high was 4% over capacity.

TABLE 4.1-6

1979 EDUCATIONAL FACILITIES
UINTAH COUNTY SCHOOL DISTRICT

Schools	Location	Fall Enrollment	Capacity	Percent Over Capacity	Personnel	Pupil/Teacher Ratio
Elementary (K-6)					115(a)	28:1
Ashley	Vernal	662	500	24		
Central	Vernal	415	400	04		
Maeser	Vernal	757	500	27		
Naples	Vernal	635	373	41		
Todd	Roosevelt	573	525	08		
Subtotal		3,042	2,298	24		
Discovery(c)	Vernal	542	550			
Junior High (7-9)					57(a)	20:1
Vernal Jr. High	Vernal	887	775	13		
West Jr. High	Roosevelt	263	250	05		
Subtotal		1,150	1,025	11		
High School (10-12)					37	22:1
Uintah High	Vernal	834	834	04		
Other					23(b)	
Uintah Young Learing Center(d)	Vernal	68	120		10(a)	7:1
Young Mother Program(e)	Vernal	60	80		1(a)	--
Subtotal		128	300	--		
Total District		5,154		16	218	25:1

Notes: (a) Certified teachers.
(b) 2 Counselors, 21 administrative.
(c) Opens fall 1980; not included in calculations.
(d) Special Education.
(e) GED Classes.
(f) UCSD estimate 1980.

To help meet the need for additional facilities, a $10 million bond issue has been proposed and will be voted on September 9, 1980. The bond issue would provide funds for the construction of a high school on the west side of Vernal, a middle school to accommodate 600 students in grades 6, 7 and 8, (to be completed for the 1982-1983 school), and a vocational wing for Uintah High School. In addition, the school district has purchased the old Maeser Church and three parcels of land in and around Vernal, to be used for future school sites (UCSD, 1980).

In addition to the Uintah County School District programs, there is a private preschool in Vernal, plus a vocational center and four colleges and universities within 150 miles of Vernal (see Table 4.1-7).

4.1.2.6 Economics/Public Finance

Economic Base

Mining and related activities provide the major portion of the economic base for Uintah County, with mineral production most prominent in southern portions of the County. Mineral resources include shale oil, conventional crude oil, natural gas, tar sands from which hydrocarbons are obtained, coal and gilsonite, and others.

Oil shale is the most abundant mineral resource in the Basin, with total reserves estimated to be from 900 to 1,500 billion barrels of shale oil in place (Vernal Area Chamber of Commerce, 1980). For comparison, present U.S. oil consumption is less than 10 billion barrels per year. The richest deposits are situated in the eastern part of Uintah County where the proposed project site is located.

Crude oil and natural gas were discovered in 1948 about ten miles east of Vernal. The Uinta Basin is presently the top producer in the Rocky Mountain Region. Production of crude oil has risen from 8 million barrels annually in 1971 to 27.8 million barrels in 1975. Recoverable

TABLE 4.1-7

EDUCATIONAL OPPORTUNITIES
ACCESSIBLE TO VERNAL RESIDENTS

School	Location	Distance/ Direction	Enrollment
Country Meadows Preschool	Vernal, Utah	--	20
Uintah Basin Vocational Center	Roosevelt, Utah	30 miles/ southwest	860
Utah State University Extension	Roosevelt, Utah	30 miles/ southwest	600
Rangely College	Rangely, Colorado	60 miles/ southeast	600
College of Eastern Utah	Price, Utah	112 miles/ southwest	970
Brigham Young University	Provo, Utah	150 miles/ west	27,390

Source: Uintah Basin Association of Governments, 1980.

natural gas has been estimated at over 2 trillion cubic feet (Vernal Area Chamber of Commerce, 1980).

Coal has been produced in the Uinta Basin since the mid-1930s. Exploration has been minor, however, and the small scale production is mined for local use.

Gilsonite, which is also known as asphaltite or uintaite, has been mined in the Uinta Basin since 1888. Open pit mining operations produce approximately 450,000 tons annually. Eighty-five percent of the known gilsonite in the world is located in the Uinta Basin (Vernal Area Chamber of Commerce, 1980).

Besides actual mining operations, much of the economic base of the County is from mining related support services and trades. Such businesses include equipment suppliers and repair services, various construction contractors, engineering consultants, automotive sales and service, machine shops, ore transport and oil field specialists.

Tourism provides another major economic activity for Uintah County. Flaming Gorge National Recreation Area is just across the northern border, in Wyoming. Ashley National Forest comprises most of the northwestern quadrant of the County, with many camping areas throughout. Dinosaur National Monument is located in northeastern Unitah County. The City of Vernal is the entryway to all three of these recreation areas. The County has 20 motels and hotels, 18 of which are in Vernal, as well as 24 eating establishments. Stores selling and renting camping equipment, guides, hunting and fishing gear establishments, guides and outfitters also benefit from tourism in the area.

Agriculture, especially grazing, has been a fairly stable economic sector. Grazing is carried out mainly on open range in southern Uintah County. Sheep and cattle are the main agricultural products, although feed crops such as barley and alfalfa are also produced.

The U.S. Forest Service administers timber sales and logging carried out in the Vernal District of the Ashley National Forest in Uintah County. In fiscal year 1980 (October 1, 1979 though September 30, 1980) the Forest Service conducted sales for 8.2 million board feet; approximately the same amount is expected to be available for bid in 1981 (Jepsen, 1980).

Employment

Employment in Uintah County closely reflects its economic base characteristics. Twenty-two percent of the work force is employed in mining, 21% in trade and 19% in services (Utah Department of Employment Security, 1980). Government also plays a major role, with 18% of the work force in its employ (Table 4.1-8).

Employment in the County coincides very closely with Uintah Basin's employment data (Table 4.1-8). Employment on the state-wide scale, however, shows some differences. Mining comprises only 3% of the employment in the State, as opposed to 22% in the County. Manufacturing, which is a very minor employment sector in the County (4%), employs 15% of the labor force in the state.

In 1978 agriculture accounted for 7% of the work force in Uintah County with 585 persons employed (Utah Industrial Development Division, 1979). The actual agricultural employment in the County is likely to be higher because many workers are not covered by insurance provisions, which provides the basis for these data.

The unemployment rates in Uintah County over the last two years have been substantially lower than the State or even the Basin rate. The county had a low of 1.6% unemployment in May 1980 which rose to 3.9% in June 1980 (Utah Department of Employment Security, 1980a). The County unemployment rate was lower than the both state and the Uintah Basin as of June, 1980 (see Table 4.1-9).

TABLE 4.1-8

NON-AGRICULTURAL PAYROLL EMPLOYMENT IN UTAH
FOR THE STATE, UINTAH BASIN, AND UINTAH COUNTY, 1978

Industry	No. of Employees	Percent of State	No. of Employees	Percent of District	No. of Employees	Percent of County
Mining	15,854	3.0	2,225	21.3	1,457	21.9
Construction	34,698	6.6	766	7.4	423	6.4
Manufacturing	80,005	15.2	391	3.7	295	4.4
Trans., Comm. & Public Util.	31,735	6.0	654	6.3	478	7.2
Trade	127,028	24.2	2,277	21.8	1,382	20.8
Finance, Insur., & Real Estate	24,288	4.6	215	2.1	127	1.9
Services & Misc.	90,845	17.3	1,539	14.7	1,263	19.0
Government	120,995	23.1	2,373	22.7	1,226	18.4
Total	525,448	100.0	10,440	100.0	6,651	100.0

Note: Uintah Basin is comprised of Daggett, Duchesne and Uintah Counties.

Source: Utah Department of Employment Security, 1980

TABLE 4.1-9

CIVILIAN LABOR FORCE AND COMPONENTS
FOR THE STATE, UINTAH BASIN, AND UINTAH COUNTY

Seasonally Adjusted Unemployment Rate	State (Percent)	Uintah Basin (Percent)	Uintah County (Percent)
June 1980	5.3	4.3%	3.9%
May 1980	5.3	2.8	1.6
April 1980	5.0	4.3	4.2
June 1979	4.4	3.7	3.5
June 1978	4.6	4.3	4.0

Note: Uintah Basin is comprised of Daggett, Duchesne and Uintah Counties.

Source: Utah Department of Employment Security, 1980a.

Income

The mining industry in Uintah County contributed 31% of the payroll wages in 1978, although only 22% of the labor force was employed in mining (see Table 4.1-10 for payroll wage data). In Uintah Basin, 33% of the payroll was from mining; however state-wide, only 5% of the payroll wages were from mining. The average monthly wage for mining in 1978 was $1,345 in Uintah County, the highest average wage of all County employment sectors (Utah Department of Employment Security, 1980).

The trade industry accounts for 16% of the County's total payroll wages, with one of the lowest average monthly wages at $735. The service industry, with 14% of the wages in the County, has the lowest average wage of $710 per month, yet accounts for 19% of the employment.

The county average wage is $952 per month, higher than both the Uintah Basin average of $948 and the state average of $918. It is the fourth highest average monthly wage of all 31 counties in Utah.

Tax Base Characteristics

Property taxes for the City of Vernal, as well as Uintah County, are assessed by the Uintah County Assessor's Office. Based on January, 1979, the assessed value of all property in the County was $73,838,400 (Utah Industrial Development Division, 1979). Properties in Uintah County are all taxed at the same rate, with some areas paying additional levies for special district funds (see Table 4.1-11).

The tax rate has consistently decreased since 1972, as shown on Table 4.1-12. The general County levy and the special districts are the only portions of the levy which had an overall increase. Much of the decrease is due to the impact of increased energy and resource development in the County. County income from property taxes could

TABLE 4.1-10

NON-AGRICULTURAL PAYROLL WAGES IN UTAH
FOR THE STATE, UINTAH BASIN, AND UINTAH COUNTY, 1978
($MIL)

	State		Uintah Basin		Uintah County	
	Payroll Wages	Percent of State	Payroll Wages	Percent of District	Payroll Wages	Percent % of County
Mining	$ 296.4	5.1	$ 38.8	32.7	$23.6	31.0
Construction	465.6	8.0	11.3	9.5	5.8	7.7
Manufacturing	1,027.4	17.8	3.4	2.8	2.6	3.4
Trans., Comm. & Public Util.	515.7	8.9	9.4	7.9	7.3	9.6
Trade	1,058.1	18.3	18.3	15.4	12.2	16.0
Finance, Insur. & Real Estate	259.1	4.5	2.2	1.9	1.5	2.0
Services & Misc.	762.7	13.2	12.8	10.8	10.8	14.2
Government	1,400.5	24.2	22.6	19.0	12.3	16.1
Total	$5,785.5	100.0	$118.8	100.0	$76.1	100.0

Note: Uintah Basin is comprised of Daggett, Duchesne and Uintah Counties.

Source: Utah Department of Employment Security, 1980.

TABLE 4.1-11

UINTAH COUNTY TAX LEVIES FOR THE YEAR 1979
(In Mills)

General County Purpose Over-all Levy	12.34
County Library	.78
Tort Liability	.35
Hospital Bond and Sinking	2.81
Subtotal County	16.28
District School	40.57
Uintah Water Conservancy District	.70
Central Utah Water Conservancy District	1.88
Uintah County Mosquito Abatement District	1.16
Total County	60.59
Special Districts	
Ashley Valley Water and Sewer Improvement District	4.00
Maeser Water Improvement District	2.31
Vernal City	3.24
Jensen Water Improvement District	4.00
Ballard Water Improvement District	3.80
Ouray Park Water Improvement District	6.41
Tridell-Lapoint Water Improvement District	4.00
County Property Outside Uintah Water Conservancy District	59.89
Agriculture and Wildlife Damage and Prevention	
All Sheep and Goats	80.00
All Range Cattle	5.00
All Turkeys	5.00
Cattle other than Range Cattle	3.00

Source: Uintah County Assessor's Office, 1979.

TABLE 4.1-12

UINTAH COUNTY MILL TAX LEVY
INCLUDING CITY OF VERNAL
(1972-1979)

	Special Districts	School District	County Levy	City of Vernal	Total
1972	1.30	49.82	11.8	15.00	77.92
1973	1.69	45.54	9.8	11.50	68.53
1974	2.30	44.66	9.7	11.50	68.16
1975	4.50	45.32	11.8	3.50	65.12
1976	4.50	45.82	11.8	3.50	65.62
1977	4.40	46.57	12.6	3.50	67.07
1978	3.52	46.57	15.9	3.50	69.49
1979	3.74	40.57	16.28	3.24	63.83
Percent Change 1972-1979	+188	-19	+38	-78	-18

Source: City of Vernal Budget, 1980-1981.

more than double if the proposed new Deseret power plant goes into operation (Henderson, 1980). With energy development on the increase, tax levies should continue to decrease.

The taxing formula for determining the assessment level varies according to use. A certain percent of the fair market value has the tax levy imposed upon it. Residential properties are taxed at 11.02% of fair market value, commercial at 10.73%, and unimproved real estate at 4.60% (Utah Industrial Development Division, 1979). Mining is taxed much higher, at 21% of its value (Henderson, 1980).

Shale oil recovery is taxed the same as a non-metallic mineral, as opposed to the oil and gas taxing formula. Shale oil production is taxed on gross proceeds but this applies only to the products sold. If stockpiled ore or inventory were taxed, some ore could be taxed twice. If the land is leased, no taxes are applied for the land, only for improvements. However, royalties would be paid to the owner. For the first year, improvements are taxed on 20% of their initial cost. Thereafter, depreciation on the improvements is allowed to 10% of the original cost over a 10-year period (Cooper, 1980).

In addition to the County property tax, Utah has a 4.75% State sales tax on most goods and services. The State receives 4.0% and the city, or County in unincorporated areas, receives 0.75% (McDonald, 1980). Utah is one of 45 states that imposes a corporate income tax. The 4% tax is applied to net income before Federal taxes are deducted (Vernal Area Chamber of Commerce, 1980).

The State has no inventory tax; it was eliminated in 1969. Utah is a "free port" state, with no ad valorem taxes on inventory of any kind.

Residents and businesses in Utah are subject to all applicable federally imposed taxes.

Public Finance

Numerous taxing units receive funding for their operation in the County (Table 4.1-13). The three major tax units are Uintah County, City of Vernal and Uintah County School District. Major items included in the County budget are the court, County departments, County sheriff, County hospital, roads and the airport (as seen in Table 4.1-13). In fiscal year 1978, actual expenditures totaled $2,383,313. The 1979-80 budget jumped to $7,695,535, an increase of 223% (Uintah County Budget Report, 1980). The major increase in cost was for the hospital, which was newly constructed in 1979. Based on 1979 expenses, County expenditures were $1,186 per capita.

The City of Vernal develops an annual budget each fiscal year, from July 1 through June 30 of the following year. The budget sets sources of revenues and expenditures anticipated for the operation of the City for the coming year. The estimated revenues from the 1980-1981 general fund are $2,794,765 (Vernal Budget, 1980).

In addition to the revenue or general fund, revenue expenditures are made for operation and maintenance of Vernal. Budgeted expenditures for 1980-1981 total $2,365,609. Table 4.1-14 is a summary of general fund revenues and expenditures for the City of Vernal.

4.1.2.7 Recreation

The City of Vernal has a variety of sports and recreation facilities. These include an indoor swimming pool, a nine-hole golf course, and several tennis courts. A sports mall offers racquetball, weightlifting, basketball and volleyball. The City also has a softball complex, trap shooting, and rifle and pistol ranges. Other pursuits available in the vicinity of Vernal include rodeos, lake and white-water boating, fishing, hunting, camping, hiking, cross-country skiing and snowmobiling. Within Uintah County, Steinaker Lake and Utah Natural History

TABLE 4.1-13

COUNTY OF UINTAH, UTAH
STATEMENT OF REVENUES AND EXPENDITURES
YEAR ENDING DECEMBER 31, 1978
($000)

	Budget	1979 Actual	Over (Under) Budget	1978 Actual
REVENUES				
Taxes				
Property	$ 852.0	$1,195.0	$ 343.0	$ 921.9
Delinquent	15.0	20.0	5.0	19.3
Sales & Use	300.0	219.7	(80.3)	393.3
Fuel	-	1.9	1.9	1.8
Penalties & Interest	-	8.8	8.8	9.6
Total	$1,167.0	$1,445.4	278.4	1,345.8
Licenses/Permits	23.0	32.8	9.8	27.5
Intergovernmental Revenue				
Federal Grants	320.0	-	(320.0)	-
Federal Shared Revenue	169.6	93.4	(76.2)	340.1
Federal Payment in-Lieu of Taxes	200.0	517.0	317.0	430.6
State Grants	10.5	56.3	45.8	23.5
State Shared Revenue	235.0	425.0	190.0	262.1
State Payment in Lieu of Taxes	-	2.6	2.6	0.6
Grants from Other Units	14.0	122.6	108.6	183.4
Total	$ 949.1	$1,216.9	$ 267.8	$1,240.3
Charges for Services	263.5	194.8	(68.7)	182.3
Fines & Forfeitures	90.0	135.0	45.0	90.7
Miscellaneous	225.8	378.3	152.5	280.5
Contributions & Transfers	726.1	-	(726.1)	15.0
TOTAL REVENUE	$3,444.5	$3,403.2	$ (41.3)	$3,182.1

TABLE 4.1-13 (cont.)

EXPENDITURES	Budget	1979 Actual	Over (Under) Budget	1978 Actual
General Government				
Commission	$ 66.0	$ 59.0	$ (7.0)	$ 53[illegible]
District Court	9.5	9.1	(0.5)	4.3
Justice Court	45.7	45.0	(0.7)	50.2
Circuit Court	35.0	31.7	(3.3)	23.7
Juvenile Court	4.1	2.9	(1.2)	3.3
Jury & Witness	9.0	7.9	(1.1)	5.9
Clerk--Auditor	79.7	69.1	(10.6)	64.5
Treasurer	54.1	51.0	(3.1)	45.1
Recorder	49.2	49.2	-	45.2
Attorney	42.9	42.8	(0.1)	39.2
Assessor	75.7	62.8	(12.9)	56.7
Surveyor	12.0	8.5	(3.5)	11.3
Non-Departmental	128.0	108.7	(19.3)	59.8
Buildings & Grounds	128.0	113.1	(14.9)	72.8
Elections	1.0	0.1	(0.9)	18.8
Planning & Zoning	30.4	25.3	(5.1)	18.1
Education & Community Promotion	14.0	9.3	(4.7)	12.5
Tort Insurance	30.0	21.4	(8.6)	27.1
Total	$ 814.3	$ 716.7	$ (97.6)	$ 612.4
Public Safety				
Sheriff	212.8	191.9	(20.9)	150.6
Fire Department	50.8	29.8	(21.0)	29.3
Correction	31.3	31.3	-	20.8
Other Protection	98.1	85.5	(12.6)	84.6
Total	$ 393.1	$ 338.5	$ (54.6)	$ 285.3
Public Health				
Health Services	117.5	112.2	(5.3)	90.4
Hospital	385.0	312.7	(72.3)	196.7
Total	$ 502.5	$ 424.9	$ (77.6)	$ 287.1
Highways & Public Improvements				
Highways	1,000.0	650.6	(349.5)	633.8
Sanitation	21.0	10.0	(11.0	20.6
Shop & Garage	100.0	99.7	(0.3)	115.0
Airport	169.9	169.8	(0.1)	75.5
Total	$1,290.9	$ 930.0	$(360.9)	$ 844.0

TABLE 4.1-13 (cont.)

	Budget	1979 Actual	Over (Under) Budget	1978 Actual
EXPENDITURES (cont.)				
Parks, Recreation & Public Property				
Recreation	$ 156.7	$ 155.1	$ (1.6)	$ 126.1
Libraries	67.5	67.2	(0.3)	59.7
Cemeteries	95.5	87.7	(7.8)	20.5
Total	319.7	310.1	(9.6)	206.3
Conservation & Economic Development	123.9	88.8	(35.1)	147.2
TOTAL EXPENDITURES	$3,444.5	$2,809.0	$(635.5)	$2,383.3
Excess (Deficiency) of Revenue over Expenditures	-0-	594.2	594.2	799.8

Source: County of Uintah Report of Audit, December 31, 1979.

TABLE 4.1-14

CITY OF VERNAL, UTAH
STATEMENT OF REVENUES AND EXPENDITURES
FOR YEAR ENDING JUNE 30, 1979
($000)

	Budget	1979 Actual	Over (Under) Budget	1978 Actual
REVENUES				
Taxes				
Property	$ 45.0	$ 39.7	$ (5.3)	$ 40.4
Delinquent	-	-	-	1.9
Sales & Use	897.5	908.6	11.1	440.5
Penalties & Interest	30.0	48.4	18.4	25.2
Total	$ 972.5	$ 996.8	$ 24.3	508.0
Licenses/Permits	37.4	37.4	-	$ 44.5
Intergovernmental Revenue				
Federal Revenue Sharing	70.0	68.8	(1.2)	82.8
Road Fund Allotment	39.2	39.2	-	26.3
Liquor Fund	8.0	7.4	(0.6)	7.4
State Anti-recession	-	-	-	6.5
Housing Allotment	6.0	16.9	10.9	-
State Grants	50.2	40.7	(9.5)	3.9
Total	$ 103.4	$ 104.1	$ 0.6	$ 65.0
Contributions from Local Units	69.5	58.6	(10.9)	62.7
Charges for Services	51.9	53.2	1.2	67.6
Fines	36.5	35.6	(0.9)	36.2
Miscellaneous	22.1	23.9	1.8	14.8
Contributions & Transfers	41.1	18.3	(22.8)	2.4
TOTAL REVENUES	$1,404.4	$1,396.6	$ (7.8)	$ 868.3

TABLE 4.1-14 (cont.)

EXPENDITURES	Budget	1979 Actual	Over (Under) Budget	1978 Actual
General Government				
City Council	$ 40.0	$ 37.1	$ (2.9)	$ 99.7
Executive Staff	52.0	48.9	(3.1)	12.3
Administrative Agencies	84.2	81.6	(2.6)	1.8
City Hall Buildings	21.8	22.4	0.6	17.0
Total	$ 198.0	$ 190.0	$ (8.0)	$ 130.8
Public Safety				
Police Department	340.5	340.0	(0.5)	286.6
Fire Department	40.8	40.4	(0.4)	24.3
Preventive Inspection	28.3	27.1	(1.1)	25.4
Animal Control	9.8	8.8	(1.0)	-
Total	$ 419.4	$ 416.4	$ (3.0)	$ 336.3
Highways & Public Improvements				
Streets & Highways	153.3	147.4	(6.9)	139.6
Airport	10.1	9.8	(0.3)	10.0
Engineering	0.9	0.9	-	-
Parking	-	-	-	-
Total	$ 165.3	$ 158.1	$ (7.2)	$ 149.6
Parks, Recreation & Public Property				
Parks & Recreation	32.7	33.1	0.4	25.4
Golf Course	52.9	52.1	(0.8)	44.4
Swimming Pool	50.6	50.5	(0.1)	65.2
Cemetery	44.0	43.6	(0.4)	39.1
Total	$ 180.2	$ 179.3	$ (0.9)	$ 174.1
Community & Economic Development	53.8	49.3	(4.5)	0.1
Contributions to Other Funds	237.4	232.4	(5.0)	-
TOTAL EXPENDITURES	$1,254.1	$1,225.5	$ (28.6)	$7,909
Excess of Revenues Over Expenditures	$ 150.3	$ 171.2	$ 20.8	$ 72.3

Source: City of Vernal, Utah, Financial Statements, Year Ending June 30, 1979.

State Parks are about five miles from Vernal. Big Sand Lake State Park is outside the County and about 30 miles west of Vernal.

For purposes of cataloguing the State's recreational resources, Utah has been divided into nine regions. The project area and the City of Vernal are within the Dinosaurland Region, with ready access to Dinosaur National Monument about 20 miles east of Vernal, and Flaming Gorge National Recreation Area located about 60 miles to the north in the State of Wyoming.

Other major recreation opportunities in the region include Capitol Reef, Arches and Canyonlands National Parks all located in Utah. Major winter skiing and recreation areas are located in the vicinity of Salt Lake City, about 150 miles to the west, and near Denver, Colorado, about 350 miles to the east of Vernal.

4.1.2.8 Community Attitudes

Citizens in Uintah County, generally recognize that mineral production in the area is essential for their economic well-being, so the majority favor some growth. The Vernal Area Chamber of Commerce, the Uintah Basin Planning Council and Commissioners, the women's organizations, and all other civic organizations in the area are very supportive of the proposed energy and resource development (Henderson, 1980). Other major companies in the area also in favor of mineral production are Stauffer Chemical in Vernal and American Gilsonite in Bonanza. The main concern of Uintah Basin residents seems to be the likelihood of an increase in recreation users, especially hunters and fishermen.

In addition to recreation and sports activities, Uintah has many cultural opportunities for its residents. The Uintah Potter's Guild and Little Gallery of Arts cater to the artistic community members. Other educational and cultural clubs include Beaux Arts, Cultural Arts, Current Topics, Progressive Arts, State Poetry Society, Vernal

Journalism Club and the Historical Society (Vernal Area Chamber of Commerce, 1980).

The County has churches representing 10 denominations. The L.D.S (Mormon) Church has chapels in every ward in the County. Other denominations with churches in Vernal are Catholic, United Church of Christ, Christian, Assembly of God, First Baptist, Episcopal, Jehovah's Witnesses, Lutheran and Kingsbury Community.

4.1.3 Political Profile

The City of Vernal is governed by five councilmen and a mayor who are elected to four-year terms. Three are elected one year, with the other two council positions and the mayor being voted on two years later. A city manager is employed to carry out council policy and administrate city functions.

Uintah County's governmental structure is comprised of three commissioners who are the elected officials. Every two years two commissioners are elected to office, one for a two-year term, one for four years. There are seven other county officials, each elected to a four-year term: sheriff, clerk, assessor, treasurer, recorder, engineer, and attorney.

Uintah County has a planning commission which is responsible for making recommendations to the County Commission on policy matters regarding the County's future developments, as well as enforcing the Zoning Ordinance.

The State has established a three-county planning district, the Uintah Basin Association of Governments (UBAG), which includes Daggett, Duchesne, and Uintah County. Representatives are appointed from each county, city and major town in the Basin. A representative is elected by the officials of his jurisdiction, from within his own ranks. The

Association was established to deal with issues relevant to an entire region, where city or county actions would be too limited.

The State of Utah allocates funds which have been collected through various taxes for schools, roads and other improvements.

4.1.4 Transportation

4.1.4.1 Roads

Uintah County is served by two major highways. U.S. Highway 40 provides east/west access to Salt Lake City, to the Rocky Mountain areas of Colorado, and ultimately into Denver. State Highway 44 provides north/south access from Vernal to the Flaming Gorge National Recreation area in southern Wyoming. The county is also served by State Highway 121, which provides access to Neola and Cedarview in Duchesne County.

Access to the project area is provided by U.S 40 and State Highway 45 to the town of Bonanza. State Highway 45 runs south of U.S. 40 and ends in the town of Bonanza. The remaining road between Bonanza and the project site, approximately three miles, is a county unimproved road which is currently used for project-related and limited recreational purposes.

Data on traffic volumes in the area are developed by the Utah Department of Transportation. These data for 1978, the latest available information, indicate the highest volume, 9,100 average daily traffic (ADT) in the County occurs on U.S. 40 west of Vernal. Other significant data include 7,020 ADT on U.S. 40 in the center of Vernal, and 3,500 ADT east of the city. State Highway 45 in Bonanza had a volume of 285 ADT in 1978. Figure 4.4-1 shows average daily traffic counts for 1978 in Uintah County.

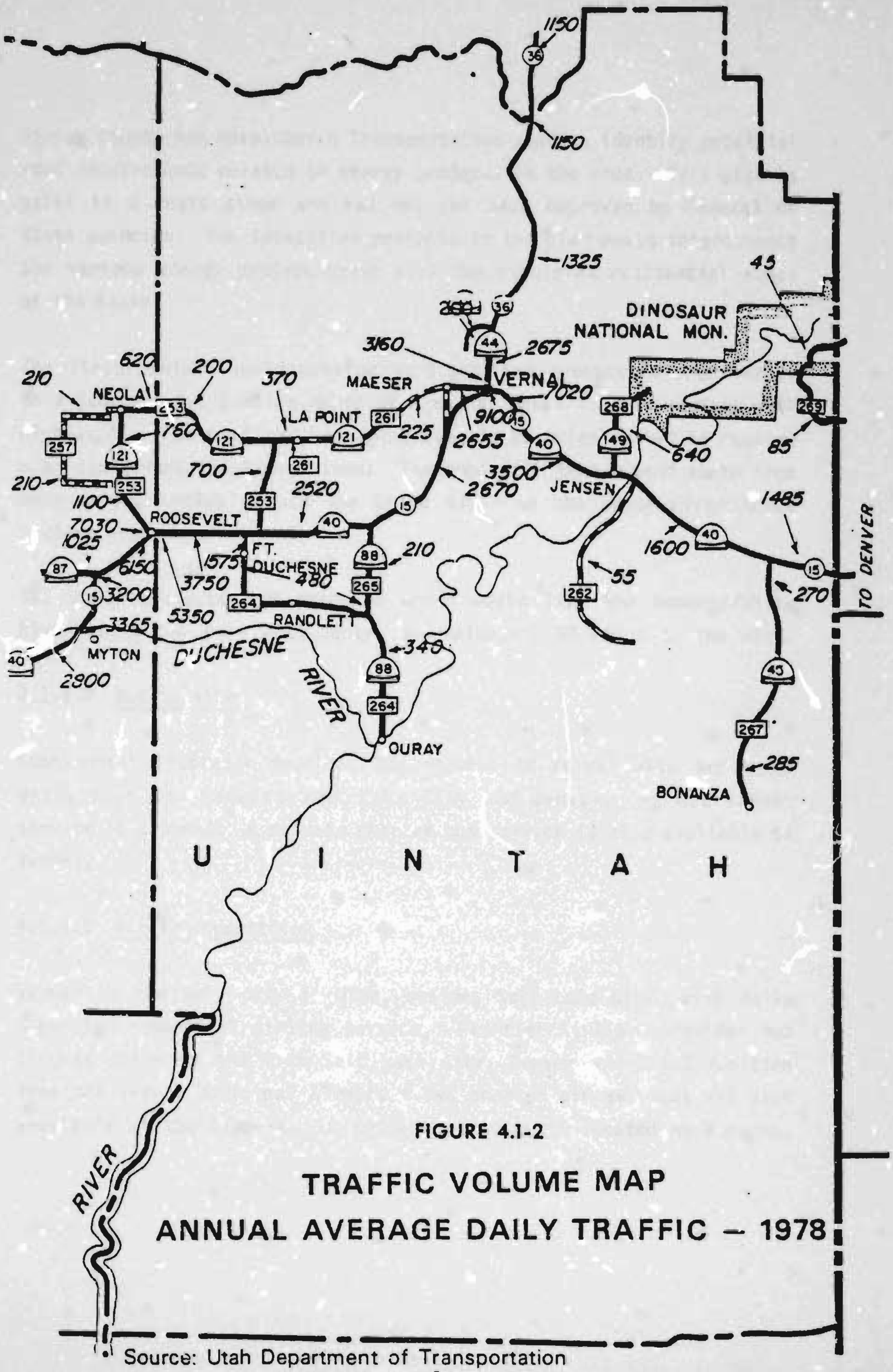


FIGURE 4.1-2

TRAFFIC VOLUME MAP

ANNUAL AVERAGE DAILY TRAFFIC – 1978

Source: Utah Department of Transportation

Uintah County has developed a Transportation Plan to identify potential road requirements related to energy projects in the area. This plan is still in a draft stage and has not yet been approved by Federal or state agencies. The identified projects in the plan would interconnect the various energy project areas with the populated residential areas of the Basin.

The first project would provide straight-line connection from Vernal to a junction 5-1/2 miles north of Bonanza, where it will connect with Highway 45. The road would be approximately 25 miles and would require a bridge across the Green River. The road will then extend south from Bonanza four miles across the White River to the White River Shale Project area.

Two other projects are proposed which would link the Bonanza/White River shale oil area with Ouray, approximately 30 miles to the west.

4.1.4.2 Bus Service

Continental Trailways provides bus service to Vernal with two buses daily each way between Salt Lake City and Denver. No additional service is planned. A private charter bus service is also available in Vernal.

4.1.4.3 Air Transportation

Vernal is the only city in Utah, besides Salt Lake City, with daily scheduled commercial airline service. Frontier Airlines provides two flights daily to and from Salt Lake City, Denver and Grand Junction from the Vernal Municipal Airport. Two charter air services are also available at the airport. A private airstrip is located at Bonanza.

4.1.4.4 Rail Service

Rail service is not provided in Uintah County. The nearest rail service is available at Green River, Wyoming, approximately 112 miles north of Vernal. In addition, a rail service is provided from Price, Utah, approximately 120 miles to the southeast.

4.1.4.5 Pipelines

Two major pipeline systems cross Uintah County. A natural gas pipeline linking New Mexico and the northwest is located east of Vernal. Chevron Oil Company operates an oil pipeline which originates near Rangely, Colorado, and extends to Salt Lake City. This pipeline traverses the County approximately 20 miles south of Vernal.

4.1.5 Native American Culture

The Ute Tribe is located in the Uintah Valley in Uintah, Duchesne, Wasatch, and Grand Counties. The tribal offices, plus the Uintah Ouray Agency, are located at Fort Duchesne in Uintah County, 23 miles west of Vernal, and seven miles east of Roosevelt. The agency is the Bureau of Indian Affairs headquarters, which is charged with carrying out the trust responsibilities of the U.S. Government to the Ute Tribe.

In 1864 Congress enacted legislation establishing the Uintah Reservation. President Chester A. Arthur established the Uncompahgre Reservation by an executive order which was combined with the Uintah Reservation in 1886 to form an area of 4,470,914 acres. Today it is known as the Uintah and Ouray Reservation (Western Environmental Associates, Inc., 1975).

Through the years, the size of the Reservation has been reduced considerably. In 1905 it was opened to homesteading. The Uinta National Forest was also created in 1905 by withdrawing 1,100,000 acres from the

Reservation. Because of this, in 1933 each tribal member was paid $1,100 in damages. Due to the Taylor Grazing Act in 1933, an additional 429,000 acres were removed into public domain; some of the loss has been recovered, both monetarily and in land recovery (Western Environmental Association, Inc., 1975).

4.1.5.1 Physical Description of the Reservation

The Uintah and Ouray Reservation presently consists of approximately 1,012,12? acres within the "bowl" of the Uinta Valley. The Ute tribe owns an additional 430,000 acres of mineral or subsurface rights within the valley (BIA, 1975).

The "bowl" is a natural depression of a former lake associated with the Green River which flows across the Basin. The Duchesne and White Rivers enter the Green River from the east and west near Ouray, located approximately 28 miles west of the proposed project site.

The landscape is very dissected due to the many tributaries in the Basin. Landscapes vary, with forested mountains and hills, grassy or barren benchlands, rolling hills and valleys, semi-desert areas, plateaus, and barren canyonlands (BIA, 1975). The predominent vegetation on the reservation consists of sagebrush, pinyon-juniper, pine, fir, aspen, and grasses.

The pattern of land ownership of Indian and non-Indian lands forms a checkerboard pattern in the northern portion of the Reservation. U.S. Highway 40 traverses east-west through the most heavily populated northern part of the Reservation. The southern limit is approximately the 9,000 foot level of the Roan Cliffs. It is bounded on the west by Desolation Canyon of the Green River and on the east by Willow Creek. The southern portion, known as the Hill Creek Extension is in sharp contrast to the northern portion, as it contains no roads or settlements.

4.1.5.2 Indian Population

The Ute Indian Tribe is comprised of three bands: the Uncompahgre, the White River, and the Uintah. As of 1975. the total population was 1,640 persons, 457 in the Uintah Band, 797 in the Uncompahgre Band, and 386 in the White River Band. The Utes are members of the desert-plateau Indians, an anthropological grouping (BIA, 1975).

There are five established Indian communities within the reservation. Myton is the only community in Duchesne County. Fort Duchesne, Randlett, White Rocks and Ouray are all in the northwestern section of Uintah County. Ouray is the farthest south, located on the Green River.

4.1.5.3 Socioeconomic Conditions

The 1970 Census, the latest information, indicated an unemployment rate of 26.6% among Indians on the Reservation. Only 276 persons out of the 376 person labor force were employed (BIA, 1975). The major employers are the tribal offices, Bureau of Indian Affairs, and the many Tribal enterprises.

The Tribe has established various enterprises to provide jobs for the Indian population and investments for the Tribe. In 1965 the Tribe began operation and maintenance of a water system which serves the non-Indian population of the area as well as the reservation. The Ute Tribal Livestock Enterprise was established in 1963 so the Indians could utilize their range more economically. The Ute Trails and Rivers Enterprise provides employment and income through the sale of hunting and fishing permits, campground and cabin rentals, sale of hunting trip packages, boating, and wild horse chases. In 1969 FabUte Corporation was formed and now employs 60 people in manufacturing laminated furniture.

Ute Bottle Hollow Resort at Fort Duchesne on U.S. Highway 40 was opened in July, 1971. The resort is located next to Bottle Hollow Reservoir and employs approximately 50 people. There is a hotel, convention center, Ute museum, Ute craft shop, and restaurant. The reservoir is utilized for water sports including boating, water skiing, swimming, and fishing.

Even with all of the employment opportunities mentioned, regional Indian income is much lower than the non-Indian sector of the population. In 1975, 53% of the Indian families on the Reservation had annual incomes less than $4,000; less than 5% of non-Indian families in the County had incomes that low (BIA, 1974)

The housing conditions on the Reservation have been greatly improved since the Housing Authority was established in 1964. As of June, 1974, 168 new homes had been constructed through the Department of Housing and Urban Development. A total of 368 units were on the Reservation in 1975, with an additional 20 units needed (BIA, 1975).

Children living on the Reservation attend public schools at Fort Duchesne and Roosevelt. Special programs have been established to increase Indian education levels, which are low (BIA, 1975).

Health care is provided through a medical and dental clinic run by the Indian Health Service. The major cause of death among the Indian population is accidents. Alcoholism is a major problem, with rehabilitation programs to combat it, although drug abuse is seen as minimal (BIA, 1974). A suicide prevention program has also been established.

4.1.5.4 Resources

The major physical resources on the Uintah and Ouray Reservation are agricultural and grazing land, minerals, and limited supplies of water. There are presently 30,000 acres of irrigated land. Approximately 930,000 acres of grazing land support 6,700 head of cattle (BIA, 1975).

Although agriculture is the primary economic activity, oil and gas are the Tribe's most valuable resources. In 1975 there were 104 oil and gas wells, plus shared revenues from an additional 57 wells on lands adjacent to the Reservation.

4.1.6 Aesthetics

The 582-acre project area lies in the east-central portion of Uintah County and is characteristic of high desert regions. It is vast, treeless and dry, and there is virtually unlimited visibility in all directions from areas of elevated topography. It is characterized by gently sloping, hummocky terrain, with minimal variety provided primarily by layered shale-sandstone outcroppings. The arid land is sparsely vegetated (30% cover), due to both lack of precipitation and shallow, severely eroded soils. The primary land uses in the region are mineral development (oil, gas, gilsonite), and livestock grazing. The land for many miles in all directions from the proposed project has been designated for oil shale development.

Located on state land, the project area is in the extreme southern portion of the Bonanza Planning Unit, which lies within the River Resource Area of the BLM's Vernal District. This resource area extends from the Colorado border on the east to the Green River and Ouray Indian Reservation on the west, and from the Blue Mountain escarpment on the north to the White River on the south, which cuts through the southeast corner of the project area.

The aesthetic character of the Bonanza Planning Unit is determined by its arid climate, shallow, rocky soils, and general absence of water bodies and human habitation. Vegetation is almost exclusively sage scrub, with occasional occurrences of pinyon-juniper and tall grasses along ephemeral streambeds and the White River. The sage scrub ground cover has a seasonal color range from brown to grayish green, and the eroded shale sandstone outcroppings range from gray-brown to ochre.

Within the Bonanza Planning Unit, the largest scenic area is the Blue Mountain region, about 25 miles south of the project area, and classified by the BLM as Category B, having excellent variety. However, it is neither visible from the project, nor is the project area visible from the Blue Mountain region.

With the exception of the linear configuration of the White River in the southeast corner of the project area, land from which the project area can be viewed has been classified by the BLM as Category D, having only slight variety and/or occurrence of color, landform, water, vegetation, uniqueness, and intrusions. Within the project area, the White River flows through a steep-sided, V-notched gorge, with walls rising about 300 to 500 feet above the river. The canyon bottom ranges from river width in steeper terrain to about one-quarter mile over more level terrain. Trees and shrubs grow along the flatter river bottom lands. The project area is otherwise lacking in properties of visual variety. It is typical of the larger region, with minimal topographic variation, sparse sage-scrub ground cover, shale sandstone outcroppings, and gravelly ephemeral streambeds which are dry except during and immediately after periods of rainfall. Other than along the White River, there are virtually no trees in the project area.

Utilizing the BLM Quality Evaluation Chart for Sightseeing-Scenery, where A is the highest and C the lowest value, both the project area and surrounding region would receive a C rating. Of the six key factors of landform, color, water, vegetation, uniqueness, and intrusions, the project area would rate low on the first five and receive a high rating for the sixth, as the area is "free from aesthetically undesirable or discordant sights and influences" (BLM, 1973). According to the BLM scoring criteria, ranging from 1 to 24 points, where A = 15-24, B = 10-14 and C = 1-9, the project area would receive a score of 7 too small an entity for its own line.

4.1.7 Cultural and Paleontological Resources

Cultural resources investigations have been conducted by Nickens and Associates under the direction of Dr. Paul R. Nickens. Paleontological resources investigations were conducted by the Antiquities Section, Utah Division of State History (UDSH), under the direction of Mr. James B. Madsen. Their reports will be submitted to BLM and UDSH as required by Federal and State antiquities permits.

No historic or prehistoric sites eligible for the National Register of Historic Places (NRHP) were located during the archaeological investigation (Tucker, 1980); however, two localities consisting of historic Euro-American artifacts have been located along the proposed powerline corridor in Section 18, approximately three miles north of the project site.

The paleontological investigation located several vertebrate, invertebrate and paleobotanical fossil specimens in outcrops of the Uinta and Green River formations (Madsen and Nelson, 1980). The fossils are not of scientific interest because they are poorly preserved and commonplace. Their presence, however, indicates that other, more important fossils may exist subsurface.

4.1.7.1 Cultural Resources

The history and prehistory of the project area have been previously described by the UDSH (VTN, 1976). One historic artifact locality was found during the field investigation for this project, and a second was found during an investigation for the BLM (Larralde and Nickens, 1980). The first locality consists of one glass medicine bottle, three evaporated milk cans, two tobacco cans, and one broken screw top glass container. The cultural affiliation of this locality was attributed by the investigators to either gilsonite exploration or sheepherding activities. The second locality consisted of two purple glass fragments. Neither locality has any further heritage value beyond that recorded by the investigation.

Three other recent campsites were noted during the investigation. They were of no heritage value, however, as the artifacts were less than 50 years old.

The lack of evidence for prehistoric sites or artifacts during this investigation is consistent with previous studies conducted in the region (VTN, 1976). These studies found that the majority of sites (26 of 32) occurred along the White River, and most of the project area is located in the desert shrub ecozone which has a very low site density. That portion of the project area along the White River was not found to contain any prehistoric cultural resources (Tucker, 1980).

4.1.7.2 <u>Paleontological Resources</u>

The majority of the fossil specimens located during the UDSH investigation (Madsen and Nelson, 1980) were exposed in outcrops of the lower Uinta Formation (mammals, turtles and petrified wood) along the powerline corridor and in the fissile shales of the Green River Formation (insects and plants) in the cliffs and canyons adjacent to the White River. All the specimens, with the exception of the plant leaves and insect fossils, were fragmented and poorly preserved.

Fossiliferous horizons are exposed throughout the study area; however, no concentrations of fossils were found. While the exposed fossils are of limited scientific interest, they do indicate a good probability of finding subsurface fossils in better conditions of preservation and in greater variety.

4.2 Geology and Soils

4.2.1 Geology

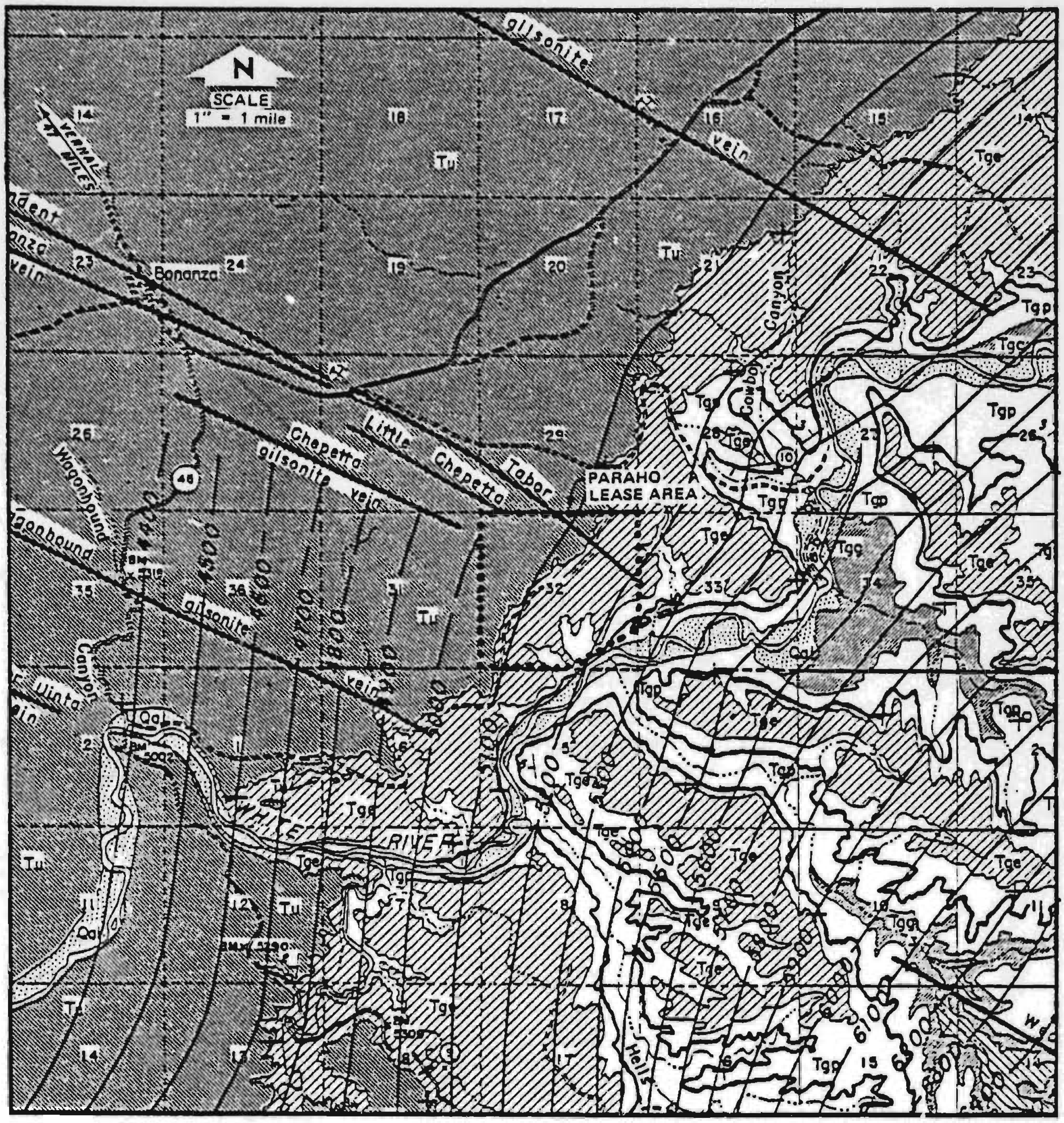
The project site is located within the structural, depositional and topographic region called the Uinta Basin. The basin is bounded by the Uinta Mountains to the north and the Roan Cliffs to the south. The area has relatively even to slightly hilly topography, except for the very steep slopes created by the White River Canyon and dry washes draining south into the White River. Elevations of the land surface range from approximately 5,000 to 5,729 feet above sea level.

4.2.1.1 Stratigraphy

The principal rock units for the area of study (see Figure 4.2-1) are the Green River and Uinta Formations of Eocene age and Quarternary alluvium located in stream valleys. Each of these units is described in the following paragraphs.

Green River Formation - The Green River Formation is subdivided into three members, the Douglas Creek, Garden Gulch and Parachute Creek (see Table 4.2-1). The Douglas Creek Member is primarily composed of interbedded shale, fine- to medium-grained quartz sandstone, siltstone, and limestone. The Garden Gulch Member consists primarily of gray and brown marlstone strata with minor amounts of siltstone, sandstone, and thin beds of oil shale. These units are approximately 870 and 300 feet thick, respectively, near the project area (White River Shale Project, 1980).

The Parachute Creek Member includes the uppermost strata of the Green River Formation, and contains the most economically important sequences of oil shale strata within the Uinta Basin. Its lithology is predominantly marlstone and dolomite interbedded with minor amounts of siltstone, sandstone and altered volcanic tuff beds. Near the study area



LEGEND

Qal	QUATERNARY ALLUVIUM
Tu	UINTA FORMATION
	GREEN RIVER FORMATION
Tge	EVACUATION CREEK MEMBER
Tgp	PARACHUTE CREEK MEMBER
Tgg	GARDEN GULCH MEMBER
	GEOLOGIC CONTACT
	OUTCROP OF MAHOGANY BED
	GILSONITE VEIN
—5000—	STRUCTURAL CONTOURS DRAWN ON MAHOGANY MARKER

NOTE: THE NAME EVACUATION CREEK MEMBER HAS BEEN ABANDONED. THIS UNIT IS RENAMED AND INCLUDED AS A PART OF THE PARACHUTE CREEK MEMBER (CASHION & DONNEL 1974).

Adapted from: Cashion & Brown, Jr., 1956.

GEOLOGIC MAP OF PROJECT VICINITY

FIGURE 4.2-1

TABLE 4.2-1

GENERALIZED GEOLOGIC COLUMN
PARAHO OIL SHALE MODULE PROJECT VICINITY

STRATIGRAPHIC UNIT		APPROXIMATE THICKNESS AND CHARACTER OF ROCKS
ALLUVIUM		0–50' SILT, FINE SAND
UINTA FORMATION		0–500' MASSIVE TUFFACEOUS SANDSTONE & CLAYSTONE
GREEN RIVER FORMATION	PARACHUTE* CREEK MEMBER	0–55' HORSE BENCH SANDSTONE
		0–200' BIRD'S NEST ZONE SILTSTONE, MARLSTONE WITH CAVITIES
		MARLSTONE
		100' MAHOGANY ZONE KEROGEN-RICH MARLSTONE
		MARLSTONE
	GARDEN GULCH MEMBER	300' MARLSTONE, SILTSTONE, SANDSTONE
	DOUGLAS CREEK MEMBER	870' INTERBEDDED SHALE, SANDSTONE, SILSTONE, LIMESTONE
WASATCH FORMATION		1500'–2500' SHALE WITH INTERBEDDED SANDSTONE

* Total thickness of 730' Adapted from White River Shale Project, 1980, Draft Update, Detailed Development Plan, Federal Lease Tracts U-a and U-b.

NOTE: Drawing not to scale.

the unit is approximately 730 feet thick. An important stratigraphic bed within this member is the Mahogany Marker, a persistent and widespread volcanic tuff bed (about 6 inches in thickness) located about 9 to 15 feet above the Mahogany bed. The Mahogany zone is about 100 feet in thickness in this area and contains the richest oil shale deposits in the basin.

A remarkably distinctive zone lies near the top of the Parachute Creek Member and is known informally as the "Bird's Nest Zone" because of its many ellipsoidal cavities formed by leaching out of nahcolite, a soluble sodium-bicarbonate mineral, from a matrix of predominantly siltstone and marlstone. This zone is the principal aquifer above the Mahogany Zone in the lease area.

A prominent ledge-forming light-brown sandstone unit that lies immediately above the Bird's Nest Zone is believed to be, according to Cashion (1967), the "Horse Bench Sandstone."

Uinta Formation - The Uinta Formation is composed of massive tuffaceous sandstone alternating with claystone. It is divided into "a" and "b" units by a distinctive bed of tuffaceous sandstone two to six feet thick located at the base of the "b," or upper unit.

Quarternary Alluvium - Quarternary alluvium occurs along most of the canyons in the study area. The alluvium consists primarily of silt and fine sand. The greatest thickness occurs along the White River and is approximately 35 to 50 feet.

4.2.1.2 Structural Geology

The structure of the Mahogany Marker characterizes the general structure of the study area. The remaining beds of the Green River Formation lie parallel to the Mahogany Marker, with a dip of less than 5 degrees to the north or northwest. This orientation is typical of the regional structure.

384 PARAHO DEVELOP CORP

SURFACE OIL SHALE RETORTING MODULE PHASE I ENVIRONMENTAL IMPACT STA

No faults have been mapped on the lease area. A large number of near-vertical joints occur throughout the area. The major joint set is oriented north 62 degrees west and dips 86 degrees toward the southwest.

4.2.1.3 Mineral Resources of the Area

Oil shale is the primary mineral resource in the region. The U.S. Geological Survey estimates that more than 80 billion barrels of shale oil deposits are contained in a 1,000 square mile area in this part of the basin (Western Oil Shale Corporation, 1976). Gilsonite veins occur within and in surrounding areas of the lease area. The Tabor gilsonite vein that transects the lease area has a maximum thickness of 14 feet and extends a combined length of 7 miles (connects with the Little Bonanza and Independent veins to the northwest). Additional smaller gilsonite veins occur within 0.5 miles of the lease area. The depths to which the veins extend are unknown, but prospecting has indicated that they extend to as much as 1,500 feet (Cashion and Brown, 1956).

The Uinta Basin is an also area of significant oil and gas development. No oil or gas production is located in the immediate vicinity of the site although significant fields are located within 10 miles of the site.

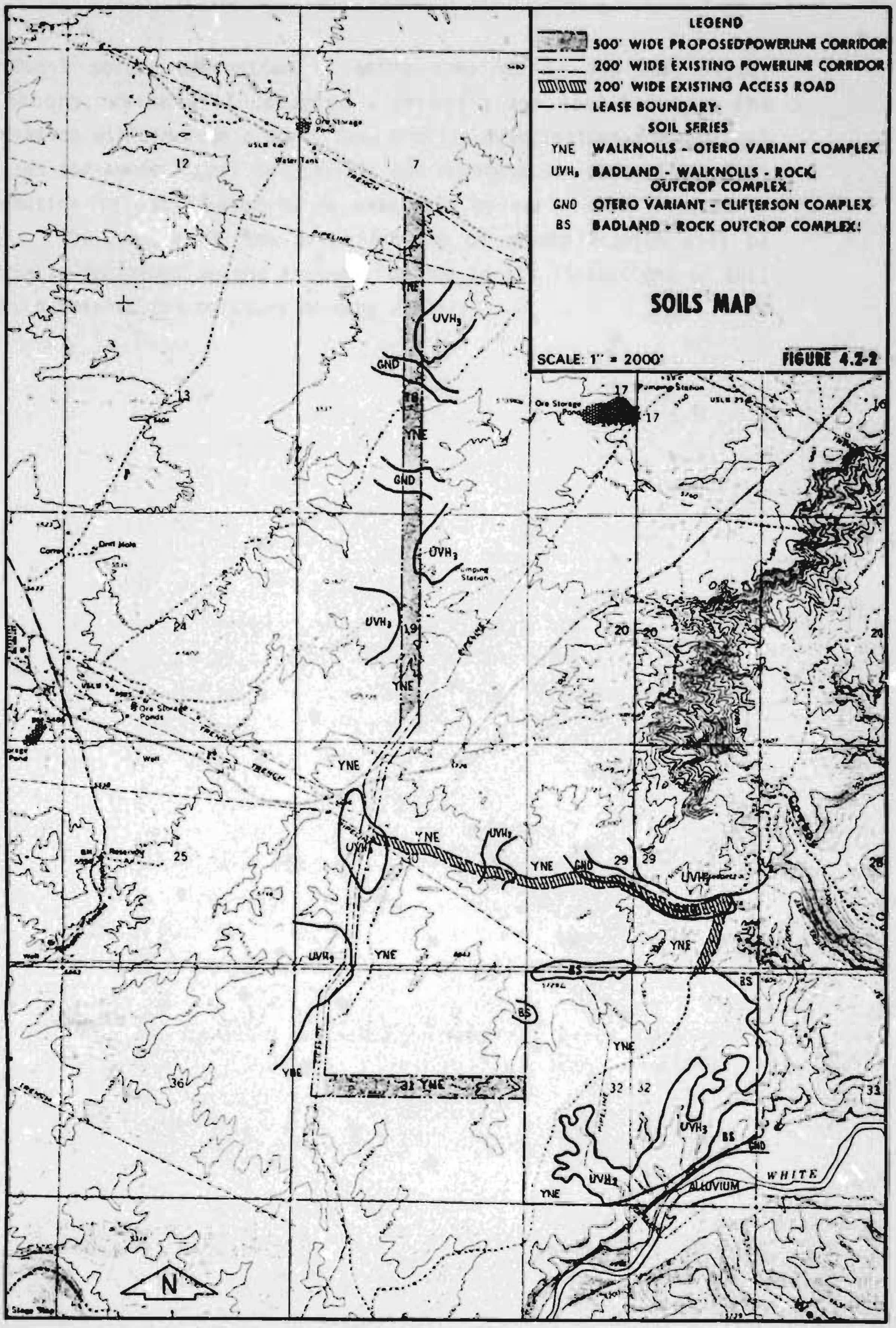
4.2.1.4 Geologic Hazards

Of the three zones of seismic risk established by NOAA (1973), based on historic earthquake occurrence, the project site is located within the lowest risk zone. No active surface faults are known to occur through the vicinity of the project area. Landslides and debris flows that occur along the steep-cut banks of the White River are primarily the result of severe thunderstorms and flash floods.

4.2.2 Soils

The soils of the project area are coarse textured and shallow with a parent material of sandstone and marlstone that outcrops on the site. The southeast third of Section 32 is a complex of badland topography with rock outcrops and shallow soil development exposed by the downward cutting of the White River (50-90 percent slopes). Sandstone outcrops also appear along the proposed transmission line corridor Sections 31, 30, 19, 18 and 7 (see Figure 4.2-2). Most of the lease area is dominated by variants of Walknolls series which are largely differentiated by depth to bedrock and topographic position. Figure 4.2-2 presents a soils map for the project area. The Soil Conservation Service (SCS) has recently identified the Walknolls series as a loamy-skeletal, mesic, Lithic Torriorthent (2-25 percent slopes) (Chapman, 1980). In other words it is a typical coarse textured soil; recently formed in an arid climate with a minimal profile development; and associated with rock outcrops. The series is strongly alkaline with a pH of 8.2 to 8.4; has high base saturation and deposits of calcium carbonate. It is moderately to severly eroded, tends to be droughty and is relatively low in nutrients. It is typically 5-20 inches deep at the project site. On about five percent of the area it is even shallower, which severly limits plant growth.

The Otero variant occurs as a complex with the Walknolls series in Section 32. It is much deeper (2-5 feet) and has not been formally described by the SCS. These soils are found in the northwest part of the parcel on relatively level, low-lying areas between the ridges and hills (less than 10 percent slopes). These soils are typical Torriorthents and are associated with the shadscale vegetation type described in section 4.6.1.2. From the standpoint of revegetation and soil erosion, these soils are much easier to manage than the soils of the ridges and upper slopes.


LEGEND
500' WIDE PROPOSED POWERLINE CORRIDOR
200' WIDE EXISTING POWERLINE CORRIDOR
200' WIDE EXISTING ACCESS ROAD
LEASE BOUNDARY
SOIL SERIES
YNE WALKNOLLS - OTERO VARIANT COMPLEX
UVH3 BADLAND - WALKNOLLS - ROCK OUTCROP COMPLEX
GND OTERO VARIANT - CLIFTERSON COMPLEX
BS BADLAND - ROCK OUTCROP COMPLEX
SOILS MAP
SCALE: 1" = 2000'
FIGURE 4.2-2
Ore Storage Pond
Water Tank
TRENCH
PIPELINE
Ore Storage Ponds
Drill Hole
Pumping Station
ALLUVIUM
WHITE
N

Additional soils information is being compiled by the SCS, Vernal and others, which will comprise a second order soil survey. The information will include a soils map, profile descriptions and chemical analyses for agricultural suitability and revegetation potential. This information is anticipated to be available by early 1981 (Broadbent, 1980). The impact of the soil resource on rehabilitation will be especially important on the Paraho site due to its limitations of soil depth, nutrients and moisture holding ability.

4.3 Water Use and Availability

Water use in the State of Utah is determined by appropriation doctrine. The same State laws apply to surface and groundwater use. The primary source of water in the project vicinity is the White River. Runoff of the White River varies considerably. During low flow periods, it is unlikely that there will be there is sufficient runoff to satisfy senior water rights of the Ute Indians and meet the water requirements for large commercal-scale oil shale development. Therefore, to assure adequate amounts of water throughout the year, periods of high runoff need to be stored for later use, the State of Utah has prepared plans to contruct the White River Dam approximately six miles southwest of the project site. Approximately 100,000 acre-feet/year of water from the proposed reservoir would be available for purchase from the State by developers of oil shale and other energy resources. The primary surface water use is presently agricultural.

The bedrock formations underlying the area do not contain any aquifers that are permeable enough to support large (more than 500 gallons per minute) sustained withdrawals (Price and Miller, 1974).

Groundwater use is somewhat restricted by its quality. Springs and shallow alluvial wells supply users in the southern Uinta Basin with most of their groundwater, which is used mostly for stock watering and alternate domestic supplies (Price and Miller, 1974). The American Gilsonite Company has drilled wells in the alluvium of the White River south of Bonanza, Utah. The wells supply water for the gilsonite mining operation and for the residents of Bonanza. A few deep wells located in Asphalt Wash, which produce water from the Douglas Creek Member, are used for stock watering.

4.4 Hydrology, Water Quality, and Water Regulations

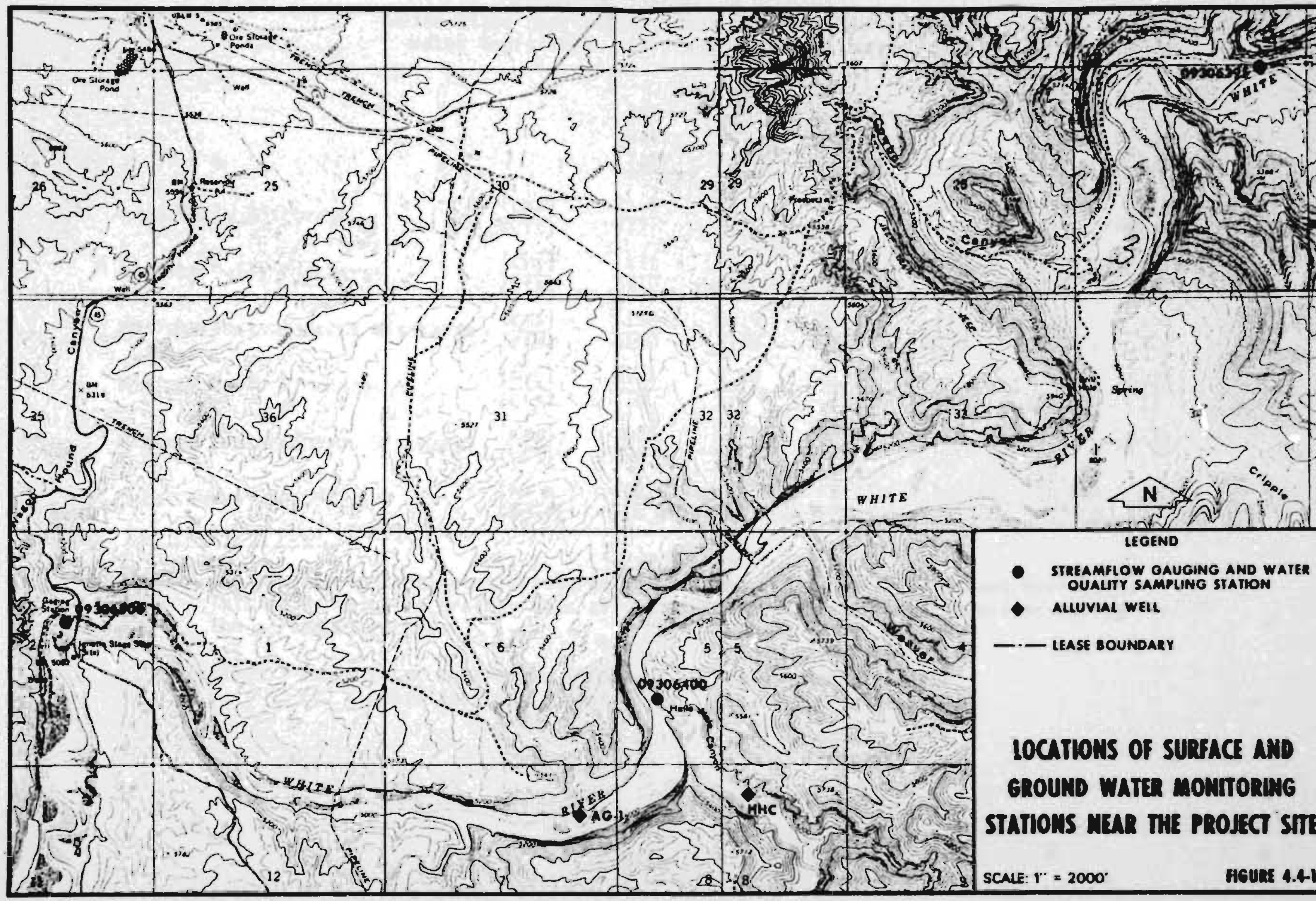
4.4.1 Surface Water

The streams in the vicinity of the project site are part of the White River Basin, which is a major sub-basin of the Green River. Most of the flow of the White River originates from the mountainous area in western Colorado above Meeker, called the Flat Tops. As the river flows westward only minor additions are made in the lower 80% of the drainage area between the headwaters in the mountains and the confluence with the Green River. The drainages from the project site are ephemeral and flow only in response to snowmelt or rainfall events. The flow and water quality of the White River in the vicinity of the project site have been investigated in detail during recent years (1974 to present) as part of the baseline study for the Federal Prototype Oil Shale Lease Tracts U-a and U-b, and through other studies by the U.S. Geological Survey (USGS) in the southeastern Uinta Basin. The surface water monitoring locations on the White River are shown in Figure 4.4-1. At the present time, surface water data are being collected only at station 09306395.

4.4.1.1 Description and Quantity

White River. The White River has a drainage area of about 3,700 square miles upstream of the project site. At the USGS gauging station 09306500 (near the White River bridge south of Bonanza) the mean annual flow was 695 cubic feet per second (cfs) during the 1923-1979 period.

Table 4.4-1 summarizes the streamflow records for water years 1975-1979 and the period of record at station 09306500. During most of the year, streamflow is sustained by a relatively stable baseflow (200-500 cfs). Peak flow usually occurs from mid-May through mid-July due to snowmelt runoff in the upper watershed. Since little flow is contributed to White River from the drainages near the project site, peak flows are



LOCATIONS OF SURFACE AND GROUND WATER MONITORING STATIONS NEAR THE PROJECT SITE

SCALE: 1" = 2000'

FIGURE 4.4-1

TABLE 4.4-1

SUMMARY OF STREAMFLOW RECORDS
White River near Watson, Utah (Station 09306500)
Water Years 1975 - 1979 vs. Period of Record

		1975 Water Year	1976 Water Year	1977 Water Year	1978 Water Year	1979 Water Year	Period of Record
Mean Daily Discharge	(cms)	21.8	15.5	8.72	20.8	21.7	19.7
	(cfs)	772	546	308	735	767	695
Maximum Daily Discharge	(cms)	111	58.0	17.0	108	108	231*
	(cfs)	3910	2050	602	3800	3820	8160*
Maximum Instantaneous Discharge	(cms)	118	60.9	37.1	111	110	--*
	(cfs)	4150	2150	1310	3910	3900	--*
Minimum Daily Discharge	(cms)	4.81	4.90	0.37	2.72	5.38	0.37
	(cfs)	170	173	13	96	190	13
Minimum Instantaneous Discharge	(cms)	3.06	4.73	0.34	2.69	--	0.31
	(cfs)	108	167	12	95	--	11
Total Annual Runoff	(ha-m)	68,930	48,930	27,530	65,660	68,460	62,100
	(ac-ft)	558,800	396,700	223,300	532,300	555,000	503,500

*Note: The maximum instantaneous discharge on this day (July 15, 1929) is not available. This daily value is greater than all other instantaneous discharge values during the period of record.

Abbreviations: cms = cubic meters per second; cfs = cubic feet per second; ha-m = hectare-meter; ac-ft = acre-feet generated primarily by either rapid snowmelt in the upper watershed or relatively wide-spread intense convective storms. The 100-year, one-day high flow is estimated to be 5,180 cfs, and the 10-year, 7-day low flow is estimated to be 125 cfs, based on the period of record at station 09306500 through the 1979 water year. A drought in 1977 resulted in very low streamflow during the summer months, reaching a mean daily flow of only 13 cfs on July 4.

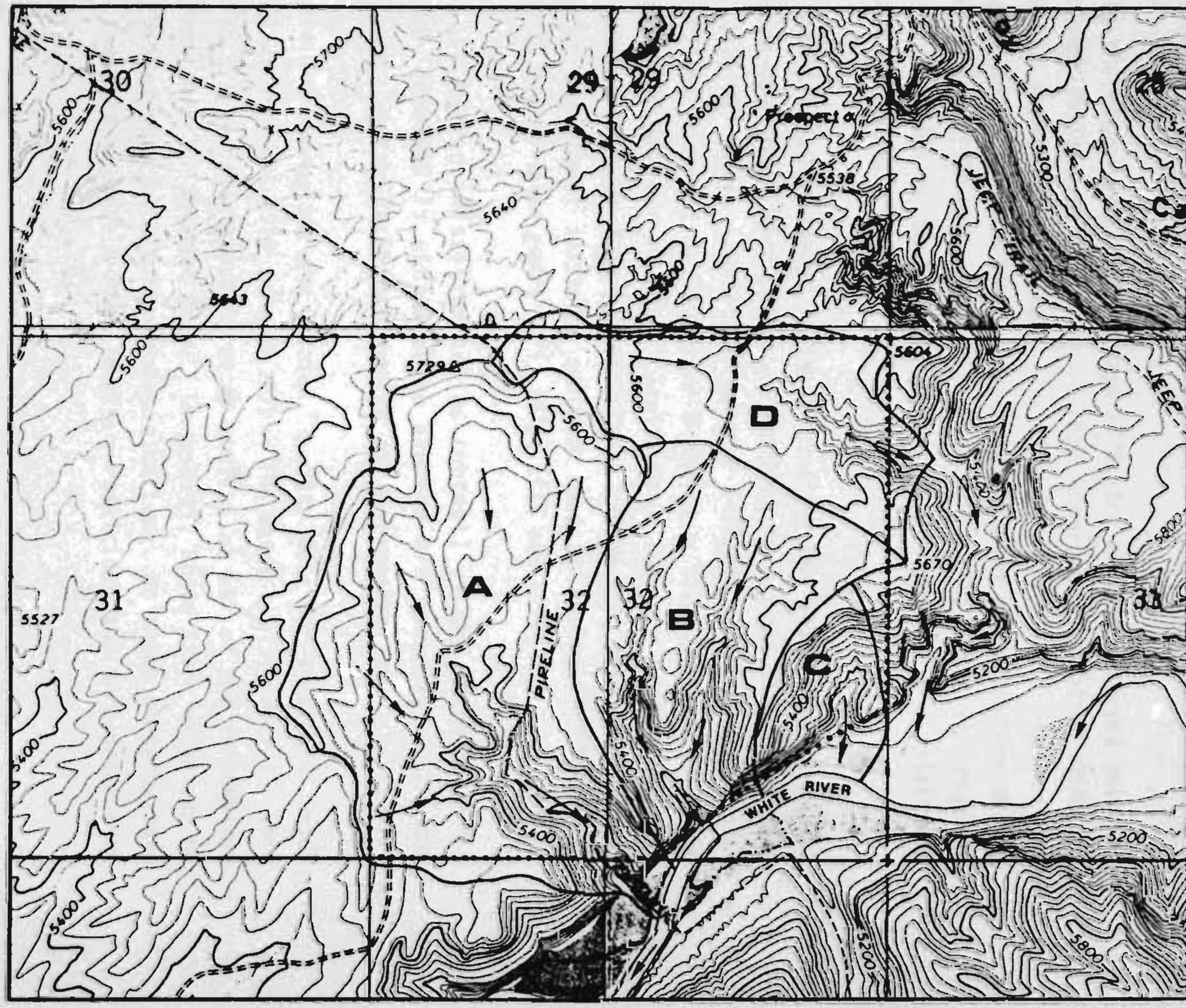
Project Site Drainages. The project site is drained primarily by four small ephemeral tributaries to the White River. These drainages are shown in Figure 4.4-2. (Drainage basin D is a tributary to a larger dry wash which reaches the White River immediately east of the project site.) The approximate drainage areas of these four basins are as follows:

Drainage Basin	Drainage Area
A	320 acres
B	170 acres
C	50 acres
D	120 acres

The general flow directions for surface runoff are also shown in Figure 4.4-2. Flow events are normally of short duration and occur in response to rapid snowmelt or intense rainfall.

4.4.1.2 Quality

White River. During March and April, a significant portion of the flow of the White River is composed of snowmelt from the lower tributaries of the White River Basin. The quality of this water is somewhat variable, but generally has moderate concentrations of dissolved solids (500 mg/l to 700 mg/l) and high concentrations of suspended sediment (600 mg/l to 3,000 mg/l). From May through July, most of the flow of the White River is composed of snowmelt runoff from the uppermost reaches of the White River drainage. This water typically has low



PROJECT SITE DRAINAGES AND DIRECTION OF SURFACE WATER FLOW

FIGURE 4.4-2

concentrations of dissolved solids (200 mg/l to 400 mg/l) but has high concentrations of suspended sediment (800 mg/l to 7,000 mg/l). During the remainder of the year, the flow is sustained primarily by ground water discharge. This water, referred to as baseflow, also has moderate concentrations of dissolved solids (450 mgl to 650 mg/l), but has lower concentrations of suspended sediment (100 mg/l to 500 mg/l).

During the water years 1975 through 1979, the maximum observed value of dissolved solids was 924 mg/l. This occurred at station 09306395 during a period of extremely low flow in July 1977. The maximum observed value of mean daily suspended sediment concentration during water years 1975 through 1979 was 61,000 mg/l. This occurred at station 09306395 on September 8, 1978 and was caused by a relatively large flash flood.

The total annual suspended sediment load for the White River near the Colorado-Utah state line (station 09306395) during the 1978 water year was 1,415,067 tons. Almost 30 percent (412,000 tons) of this total annual load occurred on September 8 during a flash flood. About 50 percent (735,080 tons) of the total annual load occurred in May and June during the peak flow period. There are no data available at this time for the annual suspended sediment load at stations 09306395 and 09306500 during water years 1975, 1976, 1977 and 1979.

The salt burden (dissolved solids content) of the White River at station 09306500 is estimated to average 876 tons/day or 320,000 tons/year (Uintah Basin Association of Governments, et. al., 1977).

Table 4.4-2 summarizes the chemical quality data for station 09306500 during water years 1975 through 1979. The water quality data for this station are representative of water quality at all of the White River stations near the project site. In general, White River water can be regarded as very hard and somewhat alkaline. No trace elements have been found at unusually high levels. Pesticides and herbicides were

TABLE 4.4-2

SUMMARY OF THE WATER QUALITY OF THE WHITE RIVER (STATION 09306500)

OCTOBER 1974 – SEPTEMBER 1979

	PARAMETERS		Number of Samples	Mean	Standard Deviation	Maximum	Minimum
GENERAL CHARACTERISTICS	Total Alkalinity as $CaCO_3$	(mg/l)	67	181	32.0	250	107
	Dissolved Solids	(mg/l)	66	491	128	913	213
	Total Hardness as $CaCO_3$	(mg/l)	67	270	54.1	440	140
	Noncarbonate Hardness as $CaCO_3$	(mg/l)	66	89.5	29.1	190	30
	Oil and Grease	(mg/l)	29	1.55	1.96	6	0
	pH	(units)	56	8.14	0.374	8.8	7.2
	Specific Conductance at 25°C	(umhos/cm)	76	751	183	1,290	290
	Streamflow, Instantaneous	(cfs)	127	649	728	3,980	42
	Temperature	(°C)	122	10.3	8.73	26.0	0.0
	Turbidity	(JTU)	38	170	246	1,000	5
	Color	(PCU)	29	11.4	10.7	40	3
MAJOR CATIONS	Calcium, dissolved	(mg/l)	67	66.3	11.8	94	35
	Magnesium, dissolved	(mg/l)	67	25.4	6.64	49	12
	Potassium, dissolved	(mg/l)	67	2.25	0.785	5.4	1.0
	Sodium, dissolved	(mg/l)	67	64.7	24.4	150	17
	Sodium Adsorption Ratio		67	1.68	0.504	3.1	0.6
	Percent Sodium		67	33.1	4.87	43	21
	Strontium, dissolved	(ug/l)	24	815	201	1,200	60
MAJOR ANIONS	Bicarbonate	(mg/l)	60	223	36.7	300	131
	Carbonate	(mg/l)	54	0.630	1.89	9	0
	Chloride, dissolved	(mg/l)	67	35.6	13.9	89	7.5
	Sulfate, dissolved	(mg/l)	67	173	50.4	360	59
	Sulfide as S, dissolved	(mg/l)	31	0.148	0.361	1.9	0.0
	Sulfide as S, total	(mg/l)	3	0.100	0.100	0.2	0.0
	Fluoride, dissolved	(mg/l)	67	0.273	0.0687	0.4	0.1
	Bromide, dissolved	(mg/l)	34	0.100	0.0551	0.3	0.0
BIOCHEMICAL CONSTITUENTS	Carbon Dioxide	(mg/l)	46	3.21	3.53	20	0.6
	Dissolved Oxygen	(mg/l)	47	9.01	1.95	15.0	6.4
	Chemical Oxygen Demand, Low Level	(mg/l)	9	33.6	23.4	90	15
	Chemical Oxygen Demand, High Level	(mg/l)	28	16.3	18.0	81	0
	Organic Carbon, Dissolved	(mg/l)	11	5.57	2.35	9.9	2.9
	Organic Carbon, Suspended	(mg/l)	6	1.57	1.23	3.7	0.2
	Organic Carbon, Total	(mg/l)	6	7.02	5.06	14	3.1
	Inorganic Carbon, Total	(mg/l)	7	48	6.06	58	40
	Chlorophyll A, Periphyton, Spec.	(mg/sq. m)	2	3.88	5.20	7.56	0.200
	Chlorophyll B, Periphyton, Spec.	(mg/sq. m)	2	0.000	0.000	0.000	0.000
	Chlorophyll A, Periphyton, Chrom.-Spec.	(mg/sq. m)	3	1.24	1.28	2.61	0.079
	Chlorophyll B, Periphyton, Chrom.-Spec.	(mg/sq. m)	3	0.287	0.259	0.545	0.027
	Chlorophyll A, Phytoplankton, Spec.	(ug/l)	17	2.49	3.27	13.5	0.000
	Chlorophyll B, Phytoplankton, Spec.	(ug/l)	17	1.07	1.82	7.35	0.000
	Chlorophyll A, Phytoplankton, Chrom.-Fluor.	(ug/l)	3	0.184	0.319	0.552	0.000
	Chlorophyll B, Phytoplankton, Chrom.-Fluor.	(ug/l)	3	0.0213	0.0370	0.064	0.000

TABLE 4.4-2 (CONTINUED)

SUMMARY OF THE WATER QUALITY OF THE WHITE RIVER (STATION 09306500)

OCTOBER 1974 – SEPTEMBER 1979

	PARAMETERS		Number of Samples	Mean	Standard Deviation	Maximum	Minimum
MICRO-NUTRIENTS	Ammonia as N, dissolved	(mg/l)	41	0.0298	0.0405	0.19	0.00
	Nitrite as N, dissolved	(mg/l)	41	0.00315	0.00468	0.01	0.00
	Nitrate as N, dissolved	(mg/l)	41	0.103	0.112	0.39	0.00
	Nitrite plus Nitrate as N, dissolved	(mg/l)	63	0.217	0.559	4.3	0.00
	Ammonia plus Organic Nitrogen as N, total	(mg/l)	42	0.666	0.696	3.3	0.10
	Ortho-Phosphorus as P, dissolved	(mg/l)	60	0.0173	0.0246	0.17	0.00
	Phosphorus as P, total	(mg/l)	42	0.165	0.230	1.1	0.00
MACRO-NUTRIENTS	Boron, dissolved	(ug/l)	55	73.1	26.5	150	30
	Copper, dissolved	(ug/l)	23	2.65	2.21	8	0
	Iron, dissolved	(ug/l)	34	39.4	54.8	270	0
	Manganese, dissolved	(ug/l)	34	4.97	7.79	30	0
	Zinc, dissolved	(ug/l)	22	14.0	23.0	110	0
	Molybdenum, dissolved	(ug/l)	22	2.14	1.17	4	0
	Cobalt, dissolved	(ug/l)	17	< 2.12	-	< 11	0
	Silica as SiO_2, dissolved	(mg/l)	67	12.9	2.20	18	6.6
TRACE METALS	Aluminum, dissolved	(ug/l)	31	20.0	22.9	120	0
	Barium, dissolved	(ug/l)	22	63.5	109	500	0
	Beryllium, dissolved	(ug/l)	8	< 4.00	-	10	0
	Bismuth, dissolved	(ug/l)	8	< 9.00	-	< 17	< 2
	Cadmium, dissolved	(ug/l)	22	< 0.136	-	1	0
	Chromium, dissolved	(ug/l)	22	< 3.14	-	10	0
	Gallium, dissolved	(ug/l)	8	< 3.75	-	< 6	0
	Germanium, dissolved	(ug/l)	8	< 10.7	-	< 20	< 2
	Lead, dissolved	(ug/l)	22	0.636	1.22	5	0
	Lithium, dissolved	(ug/l)	26	< 12.6	-	30	0
	Mercury, dissolved	(ug/l)	22	0.0318	0.078	0.3	0.0
	Nickel, dissolved	(ug/l)	17	< 3.47	-	12	0
	Selenium, dissolved	(ug/l)	22	1.14	0.710	3	0
	Silver, dissolved	(ug/l)	8	< 0.625	-	< 2	0
	Tin, dissolved	(ug/l)	8	< 9.00	-	< 17	< 2
	Titanium, dissolved	(ug/l)	8	< 5.37	-	6	< 2
	Vanadium, dissolved	(ug/l)	22	1.65	0.946	4.2	0.0
	Zirconium, dissolved	(ug/l)	8	< 15.5	-	< 30	< 3
TRACE NON-METALS	Arsenic, dissolved	(ug/l)	26	1.12	1.03	4	0
	Cyanide, total	(mg/l)	21	0.000476	0.00218	0.01	0.00
	Methylene Blue Active Substances	(mg/l)	9	0.0222	0.0441	0.10	0.00
	Phenols	(ug/l)	37	3.43	2.41	11	0
	Pesticides and Herbicides	(ug/l)	3	0.00	0.00	0.00	0.00
RADIOACTIVE CONSTITUENTS	Gross Alpha as U-nat., dissolved	(ug/l)	22	< 10.9	-	35	< 4.3
	Gross Alpha as U-nat., suspended total	(ug/l)	5	9.16	5.86	17	1.5
	Gross Beta as Sr 90/Y 90, dissolved	(PC/l)	22	< 3.62	-	9.9	< 1.3
	Gross Beta as Sr 90/Y 90, suspended total	(PC/l)	5	4.72	3.67	10	1.0
	Gross Beta as Cs 137, dissolved	(PC/l)	22	< 4.23	-	12	< 1.5
	Gross Beta as Cs 137, suspended total	(PC/l)	5	5.36	4.03	11	1.0
	Cesium 137, dissolved	(PC/l)	4	< 1.00	-	< 1.0	< 1.0
	Radium 226, dissolved	(PC/l)	1	0.150	-	0.15	0.15
	Uranium, dissolved, dir. fluor.	(PC/l)	1	0.200	-	0.2	0.2

below detection limits. At stations 09306400 and 09306500 during the 1975 and 1976 water years, the total coliform counts ranged from 0 per 100 ml to 760 per 100 ml, while fecal coliform counts ranged from 0 per 100 ml to 1,395 per 100 ml. The coliform counts were highest during peak flow periods. The apparent cause of the high levels of coliforms was attributed to grazing in the upstream drainage in Colorado (Uintah Basin Association of Governments, et. al., 1977). Dissolved oxygen concentrations have usually been near saturation and above 6 mg/l.

Project Site Drainages. There are no water quality data available for surface water within the project area. However, there are water quality data available for three dry washes near the project site (Hell's Hole Canyon, Southam Canyon, and Asphalt Wash) during the 1975 through 1979 water years. These data indicate that surface water runoff in the area typically has moderate levels of dissolved solids (approximately 800 mg/l) and high levels of suspended sediment (up to 300,000-400,000 mg/l). The water would be classified as a sodium-sulfate type. The water quality of these dry washes has illustrated considerable variation between different drainages and also between different flow events on the same drainage.

4.4.1.3 Stream Classifications and Water Quality Standards

The State of Utah Department of Health has classified the White River and its tributaries from the confluence with the Green River to the Colorado-Utah state line for the following beneficial uses: 1) protected for non-game fish and other aquatic life, including the necessary aquatic organisms in their food chain (Class 3C); and 2) protected for agricultural uses including irrigation of crops and stock watering (Class 4). The Utah numerical water quality standards for these two beneficial uses of the White River segment are shown in Tables 4.4-3 and 4.4-4. Also, the Utah narrative water quality standards apply to the White River and its tributaries. These standards state that:

TABLE 4.4-3

STATE OF UTAH
NUMERICAL WATER QUALITY STANDARDS FOR THE PROTECTION OF BENEFICIAL USES OF WATER

	CLASSES											
	Domestic Source			Recreation & Aesthetics		Aquatic Wildlife				Agri-culture	Indus-try	Special
Constituent	1A	1B	1C	2A	2B	3A	3B	3C	3D	4	5	6
Bacteriological (No./100 ml)								STANDARDS WILL BE DETERMINED ON A CASE-BY-CASE BASIS (SEE TABLE 4.4-4)			STANDARDS WILL BE DETERMINED ON A CASE-BY-CASE BASIS	STANDARDS WILL BE DETERMINED ON A CASE-BY-CASE BASIS
(30-day Geometric Mean)												
Maximum Total Coliforms	1	50	5,000	1,000	5,000	*	*		*	*		
Maximum Fecal Coliforms	*	*	2,000	200	2,000	*	*		*	*		
Physical												
Total Dissolved Gasses	*	*	*	*	*	(b)	(b)		*	*		
Minimum DO (mg/l) (a)	*	*	5.5	5.5	5.5	6.0	5.5		5.5	*		
Maximum Temperature	*	*	*	*	*	20°C	27°C		*	*		
Maximum Temp. Change	*	*	*	*	*	2°C	4°C		*	*		
pH	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0		6.5-9.0	6.5-9.0		
Turbidity increase (c)	*	*	*	10 NTU	10 NTU	10 NTU	10 NTU		15 NTU	*		
Chemical (Maximum mg/l)												
Arsenic, dissolved	.05	.05	.05	*	*	*	*		*	.1		
Barium, dissolved	1	1	1	*	*	*	*		*	*		
Cadmium, dissolved	.010	.010	.010	*	*	.0004(d)	.004(d)		*	.01		
Chromium, dissolved	.05	.05	.05	*	*	.10	.10		.10	.10		
Copper, dissolved	*	*	*	*	*	.01	.01		*	.2		
Cyanide	*	*	*	*	*	.005	.005		*	*		
Iron, dissolved	*	*	*	*	*	1.0	1.0		1.0	*		
Lead, dissolved	.05	.05	.05	*	*	.05	.05		*	.1		
Mercury, total	.002	.002	.002	*	*	.00005	.00005		.00005	*		
Phenol	*	*	*	*	*	.01	.01		*	*		
Selenium, dissolved	.01	.01	.01	*	*	.05	.05		*	.05		
Silver, dissolved	.05	.05	.05	*	*	.01	.01		*	*		
Zinc, dissolved	*	*	*	*	*	.05	.05		*	*		
NH_3 as N (un-ionized)	*	*	*	*	*	.02	.02		*	*		
Chlorine	*	*	*	*	*	.002	.01		*	*		
Fluoride, dissolved (e)	1.4-2.4	1.4-2.4	1.4-2.4	*	*	*	*		*	*		
NO_3 as N	10	10	10									
Boron, dissolved	*	*	*	*	*	*	*		*	.75		
H_2S	*	*	*	*	*	.002	.002		*	*		
TDS (f)	*	*	*	*	*	*	*		*	1200		
Radiological (Maximum pCi/l)												
Gross Alpha	15	15	15	*	*	15(g)	15(g)		15(g)	15(g)		
Radium 226, 228 combined	5	5	5	*	*	*	*		*	*		
Strontium 90	8	8	8	*	*	*	*		*	*		
Tritium	20,000	20,000	20,000	*	*	*	*		*	*		
Pesticides (Maximum ug/l)												
Endrin	.2	.2	.2	*	*	.004	.004		.004	*		
Lindane	4	4	4	*	*	.01	.01		.01	*		
Methoxychlor	100	100	100	*	*	.03	.03		.03	*		
Toxaphene	5	5	5	*	*	.005	.005		.005	*		
2, 4-D	100	100	100	*	*	*	*		*	*		
2, 4, 5-TP	10	10	10	*	*	*	*		*	*		
Pollution Indicators (g)												
Gross Beta (pCi/l)	50	50	50	*	*	50	50		50	50		
BOD (mg/l)	*	*	5	5	5	5	5		5	5		
NO_3 as N (mg/l)				4	4	4	4		*	*		
PO4 as P (mg/l)(h)	*	*	*	.05	.05	.05	.05		*	*		

* Insufficient evidence to warrant the establishment of numerical standard. Limits assigned on case-by-case basis.

(a) These limits are not applicable to lower water levels in deep impoundments.

(b) Not to exceed 110% of saturation.

(c) For Classes 2A, 2B, 3A, and 3B at background levels of 100 NTUs or greater, a 10% increase limit will be used instead of the numeric values listed. For Class 3D at background levels of 150 NTUs or greater, a 10% increase limit will be used instead of the numeric value listed. Short term variances may be considered on a case-by-case basis.

(d) Limit shall be increased threefold if $CaCO_3$ hardness in water exceeds 150 mg/l.

(e) Maximum concentration varies according to the daily maximum mean air temperature.

Temp. °C	mg/l
12.0 and below	2.4
12.1 to 14.6	2.2
14.7 to 17.6	2.0
17.7 to 21.4	1.8
21.5 to 26.2	1.6
26.3 to 32.5	1.4

(f) Total dissolved solids (TDS) limit may be adjusted on a case-by-case basis.

(g) Investigations should be conducted to develop more information where these pollution indicator levels are exceeded.

(h) PO4 as P(mg/l) limit for lakes and reservoirs shall be .025.

TABLE 4.4-4

NUMERICAL STANDARDS FOR PROTECTION OF CLASS 3C WATER USE APPLICABLE TO THE WHITE RIVER AND TRIBUTARIES FROM THE CONFLUENCE WITH THE GREEN RIVER TO THE STATE LINE

Physical	
Minimum D.O. (mg/l)	5
Maximum Temperature	27°C
Maximum Temperature Change	4°C
pH	6.5-9.0
Turbidity Increase (NTU)	15[b]
Chemical (Maximum mg/l)	
Cadmium, dissolved	0.004
Chromium, dissolved	0.1
Copper, dissolved	0.01
Cyanide	0.005
Iron, dissolved	1.0
Lead, dissolved	0.05
Mercury, total	0.0005
Phenol	0.01
Selenium, dissolved	0.05
Silver, dissolved	0.01
Zinc, dissolved	0.05
Chlorine	0.2
H_2S	0.02
Radiological (Maximum pCi/l)	
Gross Alpha	15
Gross Beta	30
Pesticides (Maximum mg/l)	
Endrin	0.004
Lindane	0.01
Methoxychlor	0.03
Toxaphene	0.005
Pollution Indicators[a]	
BOD (mg/l)	5.0
NO_3 as N (mg/l)	4.0

(a) Investigations should be conducted to develop more information where these pollution indicator levels are exceeded.

(b) At background levels of 150 NTU's or greater, a 10% increase limit will be used instead of the numeric values. Short term variances may be considered on a case-by-case basis.

Source: State of Utah, Department of Social Services, Division of Health; 1978.

It shall be unlawful, and a violation of these regulations, for any person to discharge or place any waste or other substance in such a way as will be or may become offensive such as unnatural deposits, floating debris, oil, scum or other nuisances such as color, odor or taste; or conditions which produce undesirable aquatic life or which produce objectionable tastes in edible aquatic organisms; or concentrations or combinations of substances which produce undesirable physiological responses in desirable resident fish, or other desirable aquatic life, as determined by bio-assay or other tests performed in accordance with standard procedures determined by the Committee.

The Colorado River and its tributaries, which includes the White River, are also protected by the requirements of "Proposed Water Quality Standards for Salinity Including Numeric Criteria and Plan of Implementation for Salinity Control, Colorado River System, June 1975" and a supplement dated August 26, 1975, entitled "Supplement, Including Modifications to Proposed Water Quality Standards for Salinity Including Numeric Criteria and Plan of Implementation for Salinity Control, Colorado River System, June 1975," as approved by the seven Colorado River Basin States and the U.S. Environmental Protection Agency.

On February 28, 1977, the Colorado River Basin Salinity Control Forum proposed a policy for implementation of the Colorado River Salinity Standards through the NPDES program. This policy is applicable to discharges that would have an impact, either direct or indirect, on the lower mainstem of the Colorado River System, which is defined as that portion of the main river from Hoover Dam to Imperial Dam. The salinity standards state that "the objective for discharges shall be a no-salt return policy whenever practicable." The numerical salinity standards are as follows:

Location	Salinity in mg/l
Below Hoover Dam	723
Below Parker Dam	747
Imperial Dam	879

4.4.2 Groundwater

4.4.2.1 Description and Quantity

Groundwater occurs throughout the region in the alluvial deposits along major stream courses, and within portions of the Uinta Green River, Wasatch, and Mesa Verde Formations. Small, isolated aquifers are found in the Uinta and Green River Formations throughout the region. The deep Wasatch and Mesa Verde Formations may contain significant aquifers, but no water wells are known to have been drilled below the Green River Formation. The principle aquifer in the region is the Bird's Nest Zone in the Parachute Creek Member of the Green River Formation. The Douglas Creek Member of the Green River Formation is the only other formation known to contain significant amounts of groundwater in the area.

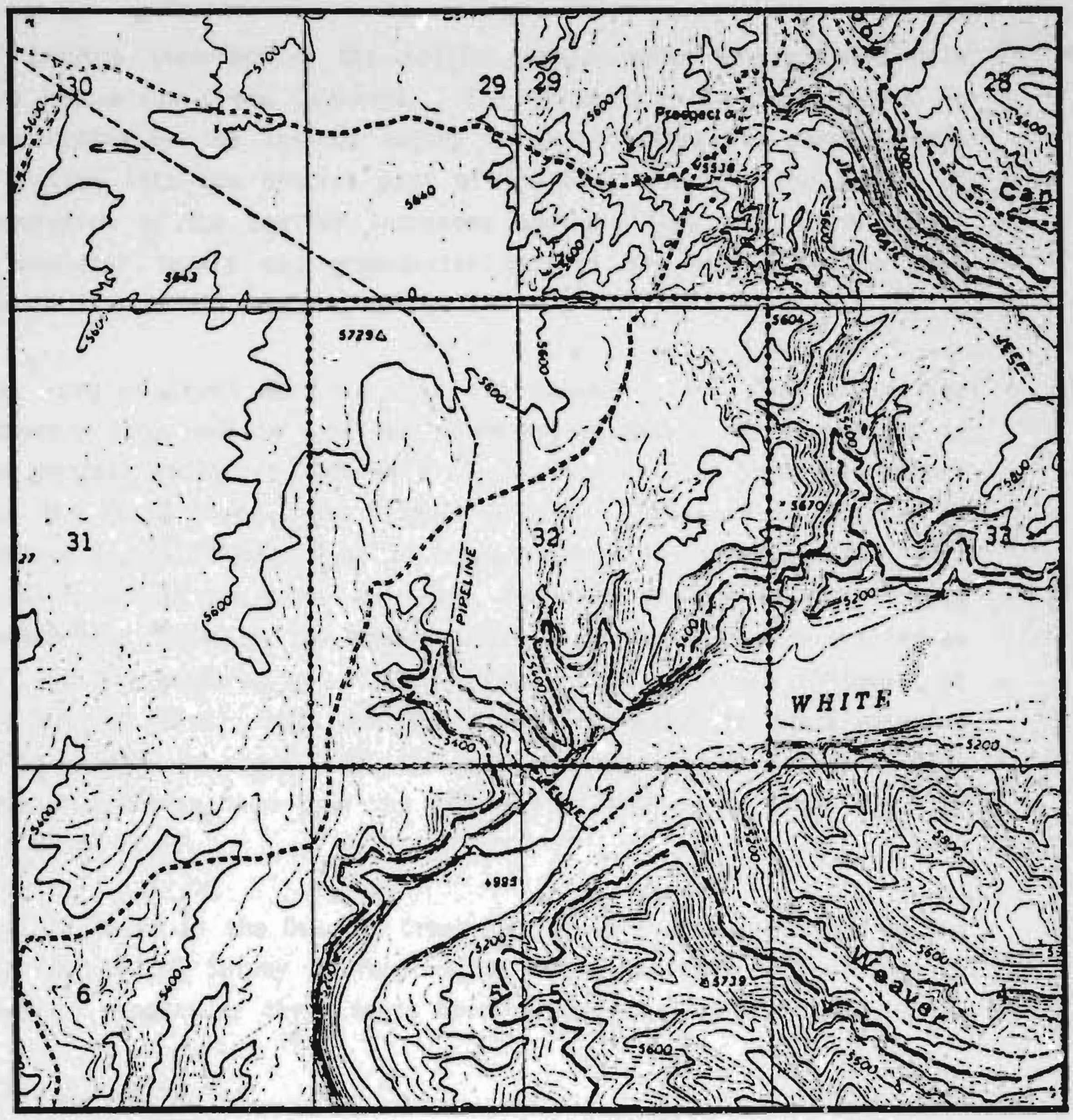
The Bird's Nest Aquifer, previously described by Cashion and Brown (1956), consists predominantly of cavities formed by the leaching of nahcolite from marlstone strata. The aquifer is very persistent laterally and vertically throughout the general project area. The thickness of the aquifer ranges from 90 to over 200 feet and averages about 115 feet. The upper surface of the aquifer slopes to the northwest uniformly at approximately 250 feet per mile. The stratigraphic position of the aquifer is very consistent, typically occurring in the top 50 to 125 feet of the Green River Formation, and at an average of 430 feet above the Mahogany Marker (White River Shale Project, 1980). The Bird's Nest Aquifer outcrops along the north rim of the White River Canyon in the project area. It also outcrops along some of the canyons that enter into the White River from the south. Springs and seepage from the aquifer are common throughout this area.

The properties of the Bird's Nest Aquifer vary with location throughout the area. Near its outcrop the aquifer is dry or only partially saturated. The aquifer becomes increasingly saturated towards the northwest, which is generally the direction of groundwater flow in the area. Flow direction is determined by: 1) the structural dip of the formation to the northwest, and 2) fracture patterns oriented northwest-southeast. Intraformational or interformational leakage is not expected to be significant since the major aquifer zones (Bird's Nest and Douglas Creek) appear to be well shielded from each other by an extensive thickness of shaly material.

Four geohydrologic tests conducted at Tracts U-a and U-b indicate that the aquifer is very heterogeneous. Transmissivity values ranged from 15 to 75,000 gallons per day per foot (gpd/ft). An artesian head of up to 375 feet was measured in Tract U-a about 5 miles southeast of the project site. The highest rate of water production (700 gallons per minute) was measured at the northern border of Tract U-a. Three holes drilled in Section 33 adjacent to the project site did not encounter water within the Bird's Nest (Dana, 1980). Another test about three miles to the north of the lease site indicated a transmissivity of 18.9 gpd/ft (Western Oil Shale Corporation, 1976). At this well location two additional permeable zones were encountered below the Bird's Nest (depth 600-650 feet). These tests indicated a transmissivity of 3.8 gpd/ft for an interval at a depth of 850-900 feet (upper oil shale zone), and 28.3 gpd/ft for an interval at a depth of 1,050-1,100 feet (Mahogany Zone).

Groundwater recharge to the Bird's Nest Aquifer is primarily by interception of precipitation and runoff along the aquifer's outcrop. The primary area of recharge for the project site is along the outcrop in White River Canyon (see Figure 4.4-3). The relatively small surface area of outcrop exposed at this location and the relatively low structural gradient of the aquifer (about 300 feet/mile) limit the rate at which recharge can occur (White Rive Shale Project, 1980).

Discharge from the Bird's Nest Aquifer is common along the down-dip portions of the aquifer. Regions of discharge include the east wall



SCALE 1" = 2000'

LEGEND

PARAHO LEASE AREA

TOP OF BIRD'S NEST AQUIFER OUTCROP

APPROXIMATE LOCATION OF BIRD'S NEST AQUIFER OUTCROP

FIGURE 4.4-3

of canyons intersecting the aquifer (e.g., White River, Hells Hole and Evacuation Creek Canyons). The groundwater in these areas is interrupted by the canyons before it can continue its northwesterly migration into the central part of the Uinta basin. The amount of saturation of the aquifer increases down-dip from the canyon areas. Groundwater levels and groundwater storage are stable in the area (White River Shale Project, 1980).

The Douglas Creek Aquifer lies approximately 500 feet below the Mahogany Zone, and is expected to be approximately 800 feet thick in the project vicinity. One well (6-16A) was drilled into this member for the White River Shale Project (1976). This well is located in Section 21, T11S,R25E, about 10 miles south of the project site. Well 6-16A flowed at the ground surface. Two other wells drilled into this member also flowed at the ground surface. These wells were drilled as oil and gas exploration wells in Asphalt Wash (10 miles southwest of the project site), but have since been converted to stock-watering wells. Based on these data, the Douglas Creek Aquifer apears to have greater artesian head than the Bird's Nest Aquifer in areas south of the White River.

Aquifer tests in the Douglas Creek member were also conducted by the U.S. Geological Survey on four wells in the vicinity of the project; however, results of these tests have not been released (Holms, 1980).

4.4.2.2 Quality

Regional studies of the groundwater quality for the Uinta Basin have been performed by Feltis (1966) and Austin and Skogerboe (1970). The available data for groundwater quality from the Uinta, Green River, Wasatch and Mesa Verde Formations suggest that groundwater from the Green River Formation consistently has the lowest concentration of total dissolved solids (TDS). In general, the best water quality occurs in the Book Cliffs area far south of the lease area.

A considerable amount of water quality information was obtained from wells used for a monitoring program at Tracts U-a and U-b (VTN, 1979). The water quality of the Bird's Nest Aquifer in this area ranges from fresh (878 mg/l TDS) to moderately brackish (6,000 mg/l TDS). The group of wells in the northeastern portion of the Tracts had an average TDS concentration of 4,030 mg/l, and the group of wells in the southwestern portion had an average value of 1,760 mg/l. The improvement of water quality in this area may be due to larger amounts of recharge from areas to the southeast. The groundwater of the Douglas Creek Aquifer had an average TDS concentration of 919 mg/l, and is classified as fresh water (Hem, 1970).

Alluvial water quality was monitored in the vicinity of Tracts U-a and U-b. Water quality remained stable throughout the monitoring program (except for one well location). The water quality of the nearest White River alluvial monitor wells (AG-1 Upper and Lower) located approximately 1-1/2 miles southwest of the lease area (see Figure 4.4-1) had average TDS values of 633 mg/l and 951 mg/l. Wells located in the alluvium of Hells Hole Canyon near its confluence with the White River had average values of 1,626 mg/l and 1,718 mg/l. These data indicate that the water quality of the alluvial aquifers in the vicinity of the project ranges from fresh to slightly brackish.

4.4.2.3 Applicable Standards

Standards of quality for groundwater use are the same as described for surface water in Section 4.4.1.3.

4.5 CLIMATE, METEOROLOGY, AND AIR QUALITY

This section describes the climate, meteorology, and air quality of the Paraho project-tract area. The characterization of these parameters on the Paraho tract will be done using the data from Tracts Ua - Ub, which are two to ten miles southwest of the Paraho tract. Because of the proximity and the similarity of the topography at the Paraho and Ua - Ub Tracts, there should be no significant deviations of meteorology or air quality. Figure 4.5-1 shows the general location and topography of the study area, as well as the locations where meteorological and air quality data were collected.

4.5.1 Summary of Climatology

4.5.1.1 Regional Climate

This section describes the climate of the general area of the Paraho project. The lease, located in the east-northeast section of Utah, has complex topography where climatic conditions can vary with altitude changes. The Paraho tract is in the Uinta Drainage Basin along the White River. The basic climate type (Trewartha, 1961) is (1) semiarid and (2) undifferentiated highlands. Temperatures are cold in winter and, except for higher elevations, warm in summer. Precipitation falls from air masses of Pacific origin and occurs most frequently in the winter half of the year. Variations in weather are related to synoptic-scale high and low pressure systems that move with the mid-latitude westerlies.

The horizontal transport of an air mass is a consequence of large-scale differences in air pressure. The determining factor in Utah's weather during the winter months is the location and strength of the intermountain region high pressure cell. Figure 4.5-2a shows the normal January sea-level pressure and temperature. Storm tracks during mid-winter tend to pass north through Montana and south through Colorado. After February, storm tracks become more prevalent over Utah as the strength of the basin high wanes. This weakening of the high pressure system causes higher precipitation during the spring months in northeastern Utah.

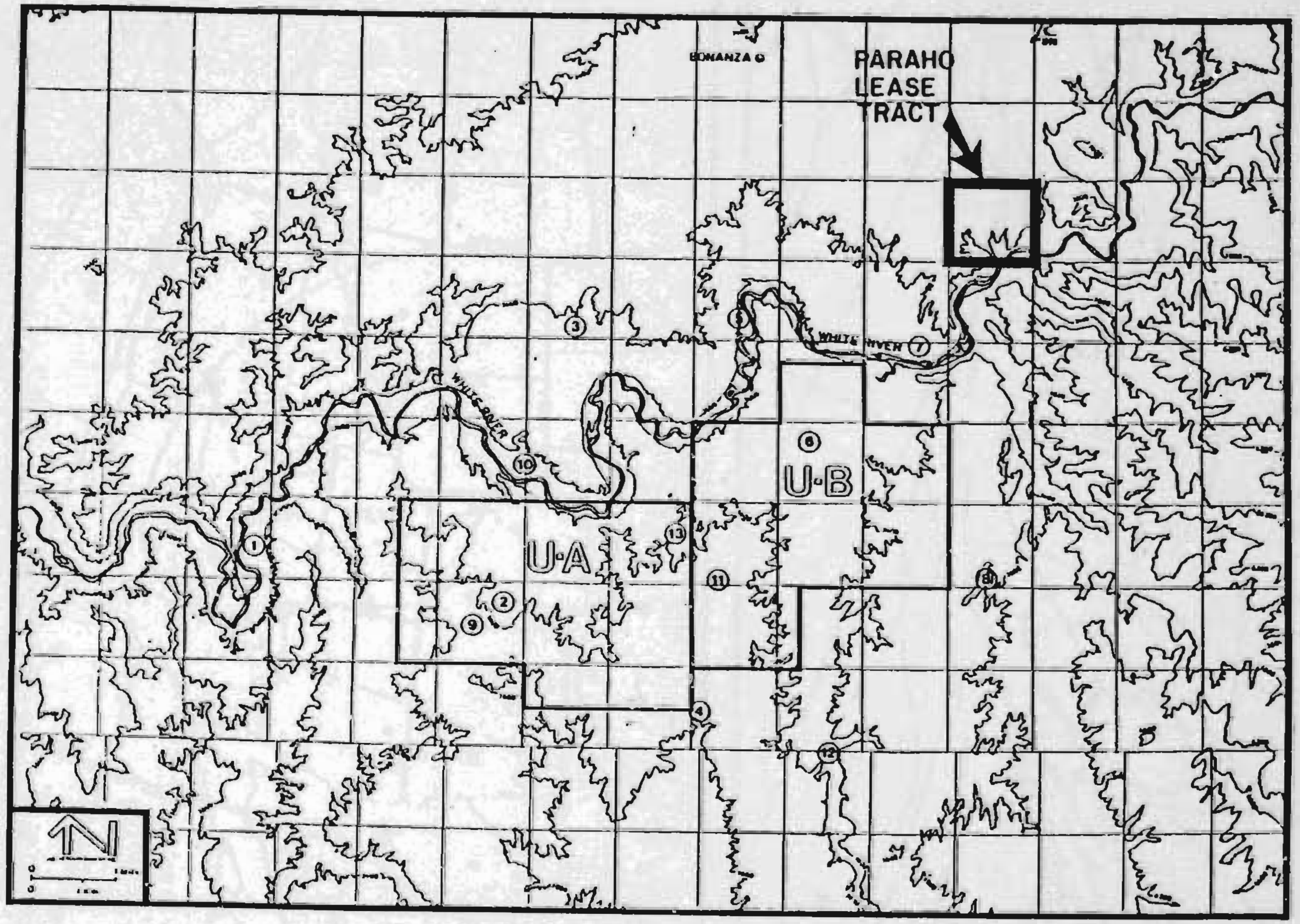
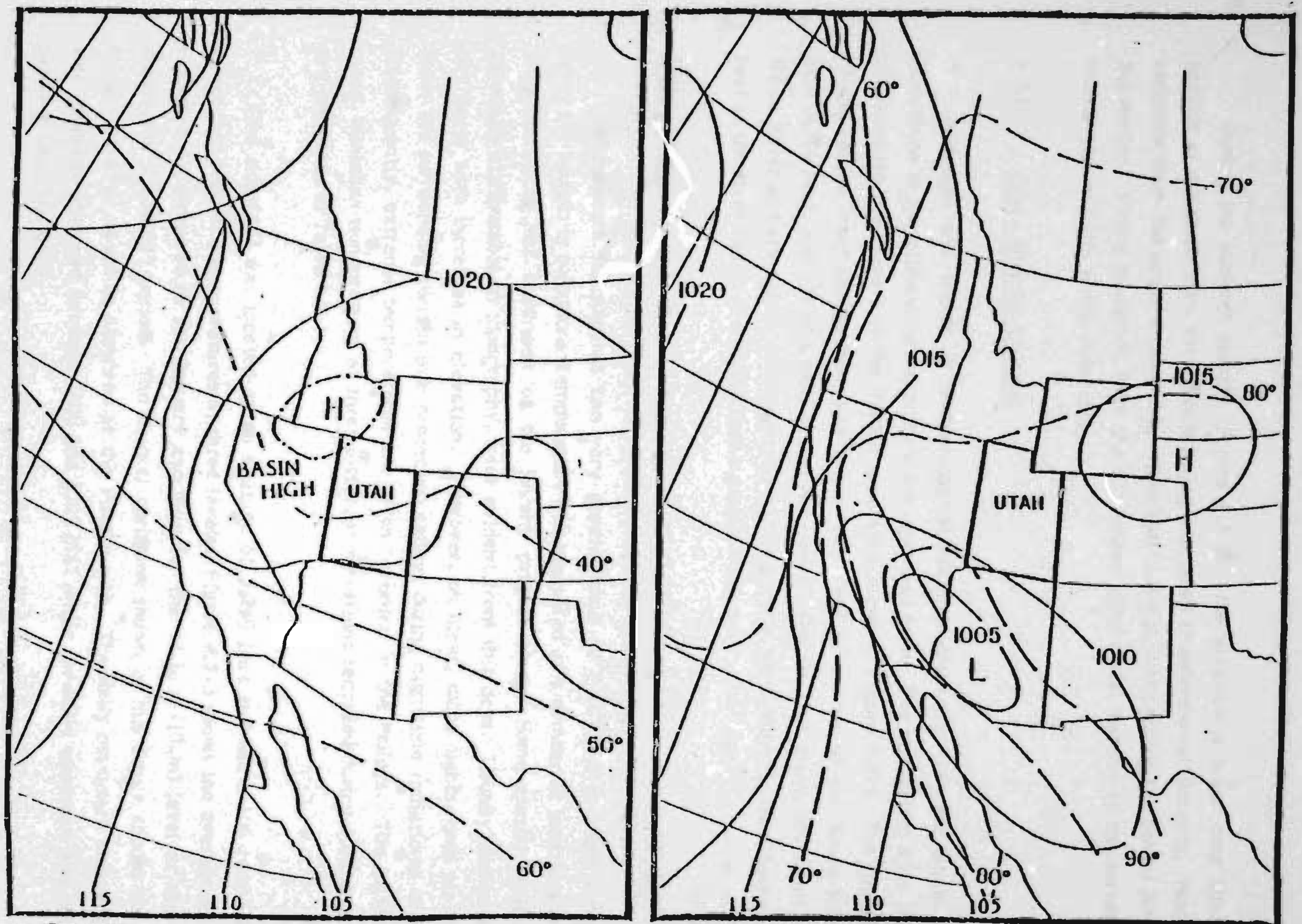


FIGURE 4.5-1. General location of the Paraho lease tract and study area.



a. January

b. July

FIGURE 4.5-2. Normal January and July sea level pressure (solid lines) in mb and temperature in °F (dashed lines).

Source: U.S. Weather Bureau, 1952.

During the summer months (Figure 4.5-2b), the pressure is lower over Utah with periods of moisture from the south bringing scattered thundershower activity. Normally, moisture from the south is carried by winds aloft several times during the period June into September. Strong insolation from the sun causes differential heating of the surface and thunderstorms form in the moist air.

4.5.1.2 Site - Specific Climate

Averages and trends of meteorological readings from the Ua - Ub tracts which contribute to the climatological picture are discussed here. The monitoring sites used to characterize the climate in the Paraho area were shown in Figure 4.5-1. The topography of the Paraho tract ranges from just below 5,000 feet at the bed of the White River to over 5,700 feet, just 3/4 of a mile to the northwest. The Ua - Ub tracts are south of the White River and are similar in topography to the Paraho tract, running from below 5,000 feet at the river bed to over 5,800 feet a couple miles south.

Temperature

Temperature fluctuations can vary greater than 10°F (6°C) over short distances when the terrain is complex. Temperature was measured at a number of locations on the Ua - Ub tracts just southwest of the Paraho project area. Some spatial variations, generally attributable to topography, were evident from this data. Usually, temperature decreases with increases in elevation. However, on clear, calm nights, cold air drains from the surrounding terrain into protected valleys during nighttime radiational cooling. Consequently, extreme temperatures are often recorded in the valleys. The maximum, mean, minimum temperatures at three different elevations recorded during 1975 and 1976 are presented in Table 4.5-1.

One site (A6) was located at an altitude of 5,240 feet and had a 100-foot (30-m) tower that recorded temperatures at three levels. Figure 4.5-3 shows the average diurnal variation in temperature for January and July for the 33-foot (10-m) level at this site during the 1975-1979 period. The diurnal variation shown in this figure should be very similar to what would be observed at the Paraho site. The daily maximum temperature was generally observed between 1400 and 1500 MST while the daily minimum was usually between 0400 and 0500.

TABLE 4.5-1. The maximums, means, and minimum temperatures measured at these different altitudes during 1975 and 1976 in °C.

Altitude (feet)	Maximum		Mean		Minimum	
	1975	1976	1975	1976	1975	1976
5,880	33	36	9.3	9.8	-16	-20
5,240	34	36	7.3	8.1	-20	-26
4,850	35	42	2.5	9.8	-31	-27

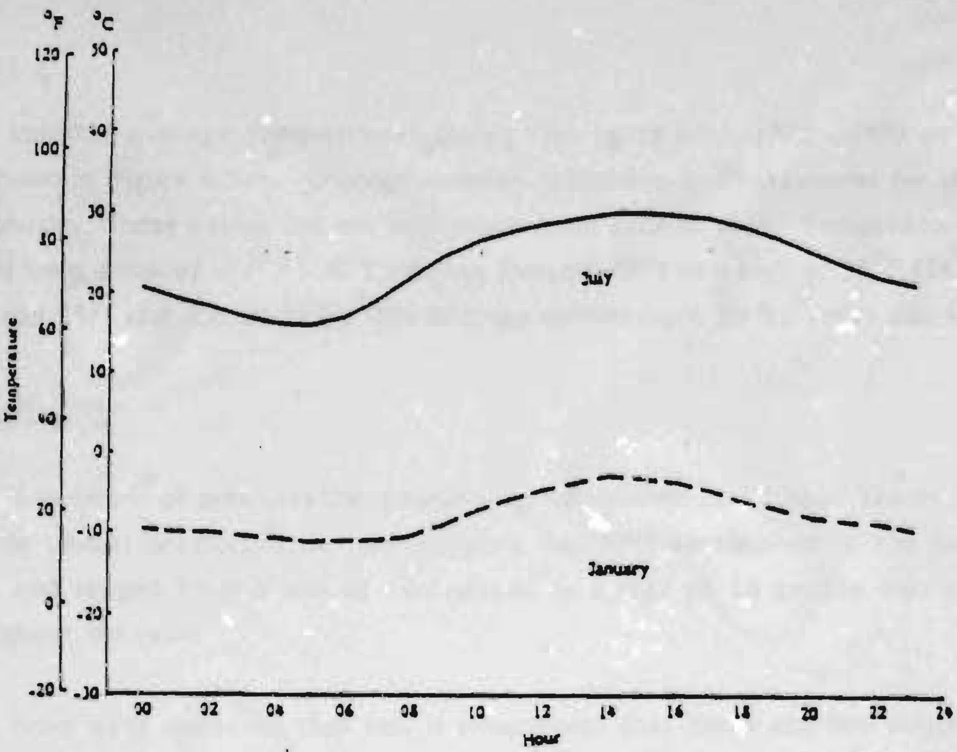


FIGURE 4.5-3. Diurnal variation of mean temperatures at Site A6 during 1975 - 1979.

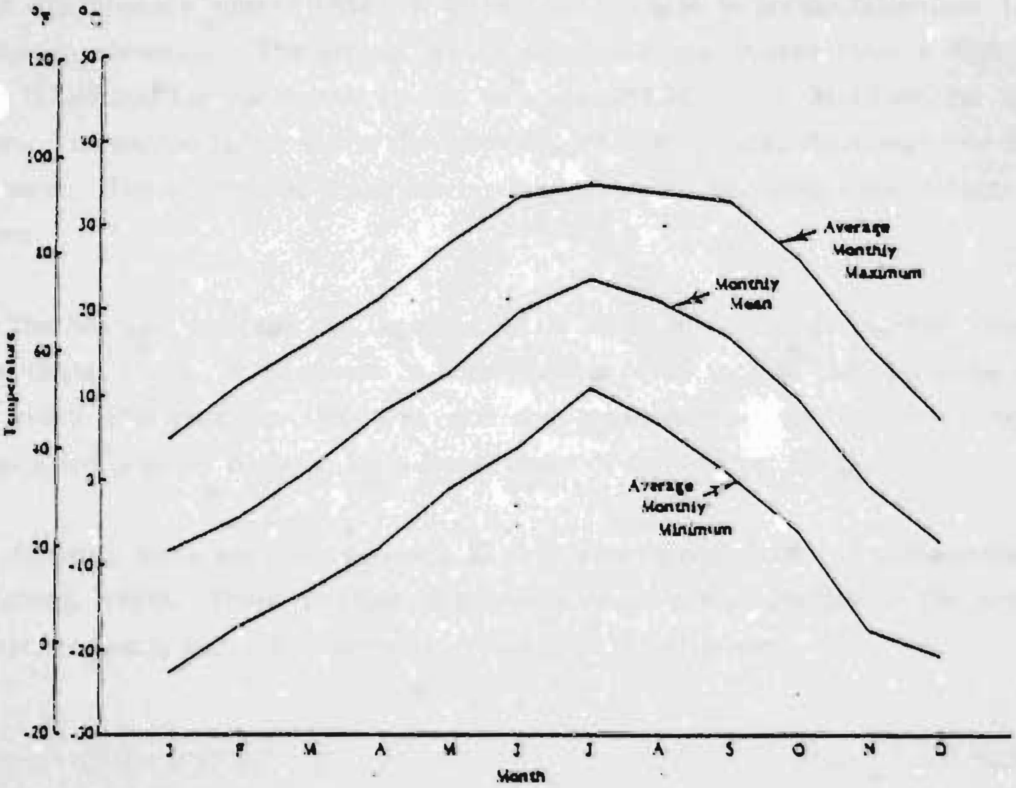


FIGURE 4.5-4. Average monthly maximum and minimum and monthly mean temperature at Site A6 during 1975 - 1979.

Monthly average temperatures during five years from 1975 - 1979 at this site (A6) are shown in Figure 4.5-4. Average monthly minimums and maximums for this period are also shown. These values did not vary much from year to year. Temperatures at this site varied from a low of -22°F (-30°C) during January 1979 to a high of 97°F (36°C) in July of 1976 and 1978 and August 1979. The average temperature for all years was 45°F (8°C).

Precipitation

A network of precipitation gauges was established on or near Tracts Ua and Ub to monitor annual precipitation. The network was first established in the last quarter of 1974, and ranged from a low of two gauges to a high of 13 gauges that were operated throughout the year.

From data collected thus far, it is apparent that there are two major factors that account for the variations in precipitation amounts from station to station. The primary factor is the variation in terrain. In general, monitoring indicated that precipitation was heavier on ridgetops and lighter in valleys. It has been determined that this orographic effect will produce approximately a three-inch increase in precipitation per 1,000-foot increase in elevation. The annual precipitation average ranged from a high of 10.90 inches (27.69 cm) for the highest station to a low of 8.36 inches (21.13 cm) for the lowest station. The second factor is the slow-moving, intense, isolated thunderstorms that cross the tracts. The effects of these storms may override the orographic effects at some stations.

The heaviest rainfalls can be expected to occur in August during the thunderstorm season (BLM, 1977). A maximum 24-hour rainfall of up to 3.30 inches can be expected once every 100 years in this area and the mean number of days with measurable precipitation is about 80 days. (U.S. Department of Commerce, 1968).

Annually there are approximately 35 days with thunderstorms in east-northeast Utah (Landsberg, 1969). These weather phenomena occur predominantly in the late spring, summer, and early fall. They are most frequent in the afternoon.

Annual snowfall is highly dependent on terrain elevation and on the orientation of mountains and mountain ranges. Elevations in the Paraho area range from a little less than 5,000 feet at the White River bed tc 5,730 feet. Annual snowfall in this area ranges between 20 and 30 inches, and generally falls between October and May (McKee, 1972).

Most of the water that runs into the White River system comes from snowmelt at higher elevations. No general flooding occurs during normal snowfall and normal springtime temperatures. However, during heavy snow-cover years or sudden spring warming (or both), flooding can occur. Local flash floods can also occur during heavy rains from intense thunderstorms during the summer months.

Air Moisture

Relative humidity has been measured for five years at Site A6 on tracts Ua - Ub. In general, the air on the tracts is drier in summer than in the winter. The highest readings are found in the winter from 0400 through 0800 MST and average above 80%. The lowest readings occur from 1400 - 1700 MST in the summer, with values around 25%.

The diurnal variation of relative humidity is approximately the reciprocal of temperature, indicating that the amount of moisture in the air remains fairly constant during a typical day in this region. Figure 4.5-5 shows the average diurnal variation in relative humidity in January and July during 1975-1979.

Elevation differences can be responsible for considerable variation in the relative humidity from one location to another. Relative humidity tends to decrease with an increase of altitude. The average annual humidity at Site A6 is 52 percent.

Evaporation from ground pans was measured from 1975 through 1979. Evaporation data collected for the freeze-free period, approximately May through September, indicated an average total pan evaporation of approximately 38 inches (97 cm).

Heat Flux

Heat flux was determined by measuring the net thermal radiation at Site A6. This parameter is the amount of heat received by the sun minus the amount lost by the earth

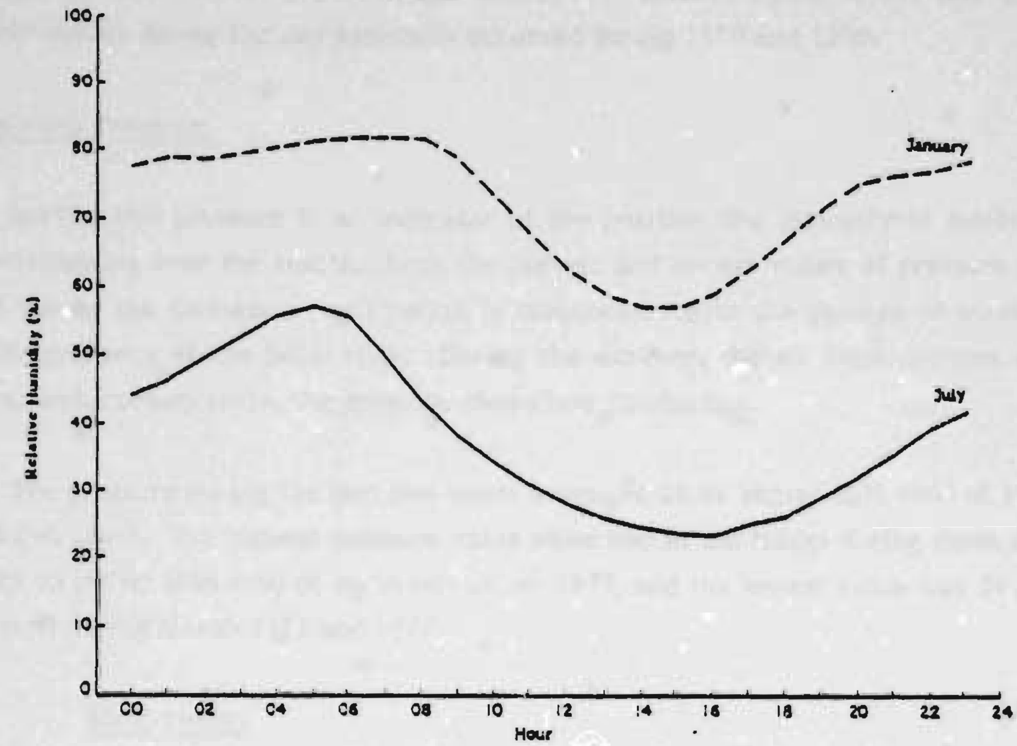


FIGURE 4.5-5. Diurnal variation of mean relative humidity at Site A6 during January and July 1975 - 1979.

during radiative cooling. Heat flux affects the stability of the atmosphere and the solar radiation influences the rate of various photochemical processes.

Figure 4.5-6 shows the average hourly net solar radiation on the tracts during January and July for 1975-1979. As should be expected, the solar radiation is higher in the summer than winter due to longer days, more intense sunlight, and less cloudiness. Highest values during the day generally occurred during 1100 and 1200.

Barometric Pressure

Barometric pressure is an indicator of the position and intensity of major weather systems passing over the tracts. Both the highest and lowest values of pressure generally occur during the October - April period in conjunction with the passage of winter storms and the presence of the Basin High. During the summer, the air mass systems are much weaker and, consequently, the pressure shows less fluctuation.

The pressure during the last five years averaged 24.84 inches (631 mm) of Hg at Site A6 (5,246 feet). The highest pressure value observed on the tracts during these five years was 25.43 inches (646 mm) of Hg in November 1975, and the lowest value was 24.17 inches (614 mm) during March 1975 and 1977.

4.5.2 Meteorology

Unlike climatology, which deals with general atmospheric conditions and averages over the long-term, meteorology is concerned with the specifics of motion in the atmosphere, and the diffusion of the materials in it. Therefore, this section will address the topics of surface flow, synoptic or upper air meteorology, and diffusivity.

4.5.2.1 Surface Flow

Surface winds have been measured at the Ua - Ub tracts at a number of sites during the last five years (1975-1979). The rugged terrain features in the area complicate the airflow pattern. Table 4.5-2 lists the prevailing direction and average speed by month for four of these wind sites. This table shows some spatial variation in wind speed on the

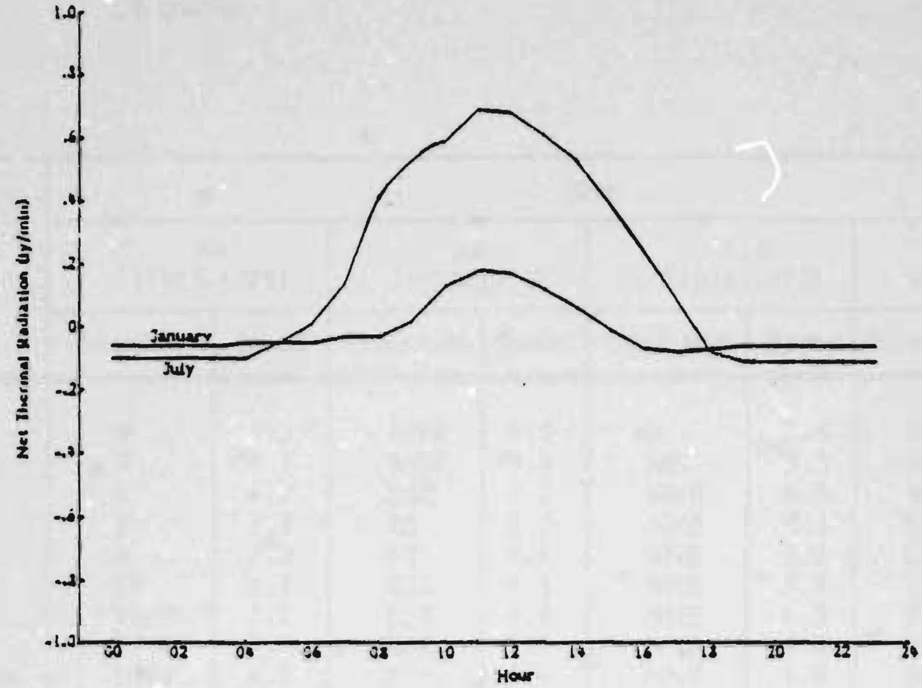


FIGURE 4.5-6. Diurnal variation of the mean net thermal radiation during 1975 - 1979 at Site A6.

TABLE 4.5-2. Average monthly wind speeds (mph) and prevailing direction on the Ua - Ub tracts.

Month	Site							
	A4 (1975-1979)		A6 (1975-1979)		A10 (1974-1977)		A7 (1975-1977)	
	Direction	Speed	Direction	Speed	Direction	Speed	Direction	Speed
January	W	4.5	WSW	4.3	N	2.8	NE	3.5
February	W	5.1	WSW	5.4	NE	3.5	WNW	4.8
March	W	6.7	ESE	7.2	NNE	4.8	W	6.8
April	W	7.8	SE	8.7	NNE	5.5	SSW	8.0
May	W	7.8	SE	9.4	NNE	5.0	SSW	7.3
June	SW	8.5	ESE	9.8	NNE	5.5	VAR	8.5
July	WNW	7.2	ESE	7.8	NNE	4.5	VAR	6.8
August	WNW	7.4	ESE	8.1	NNE	5.0	SSW	7.5
September	WNW	6.7	ESE	7.4	NNE	4.0	NE	6.0
October	WNW	5.8	ESE	6.7	NNE	3.8	NE	5.5
November	W	5.1	ESE	5.8	N	3.3	NE	4.2
December	W	5.4	ESE	4.9	N	2.8	NE	3.5
Annual	W	6.5	ESE	7.2	NNE	4.2	NE	6.0

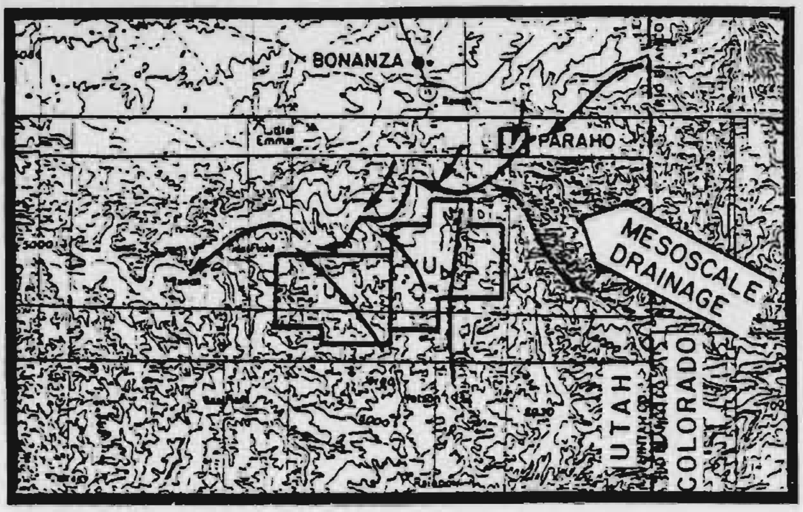
tracts. Site A10 is a riverbed site, Site A4 is the highest site on the tracts, Site A6 represents mid-altitude level in the area, and Site A7 was north of the river bed and closest to the Paraho tract. The prevailing directions at Sites A6, A10, and A7 represent drainage flows. The prevailing flow at Site A4 was synoptic.

Generally, nighttime drainage flow is prevalent throughout the year. Figure 4.5-7a shows the typical airflow streamlines for the early morning drainage pattern. The solid lines are estimated flow streamlines. The large open arrow depicts the mesoscale flow direction in the greater White River drainage basin. The drainage pattern does not deviate significantly and is always from higher to lower terrain.

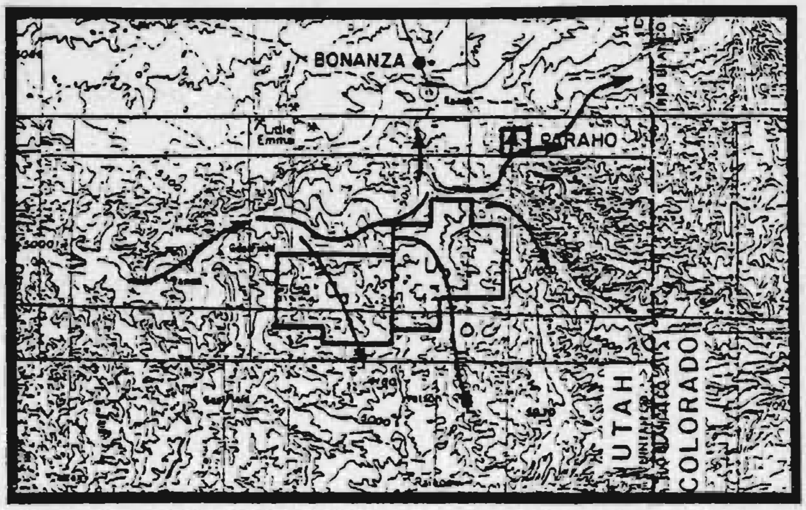
Figure 4.5-7b shows an upslope pattern that is transitional between drainage and synoptic flow. The surface-based inversion that results from strong radiative cooling begins to lose some of its strength shortly after sunrise. As the morning progresses, the heat gained by the surface from solar radiation exceeds that lost by terrestrial radiation to the sky and the soil temperature rises, warming the air above. This creates a pressure difference resulting in upslope flow. This pattern is transitional and generally lasts less than an hour, but is important to the understanding of dispersion of pollutants since plume fumigation (mixing of an elevated plume to the ground) would occur under this condition. Because of its brevity, this pattern is lost in hourly-average wind direction tabulation. This pattern begins earlier during the summer months than during the winter when the sun rises later.

Figure 4.5-7c shows afternoon streamlines on the tracts. Very little directional difference is noted from site to site but the average speeds are higher during the summer. This is the average synoptically-induced westerly flow that is encountered in this portion of Utah throughout the year.

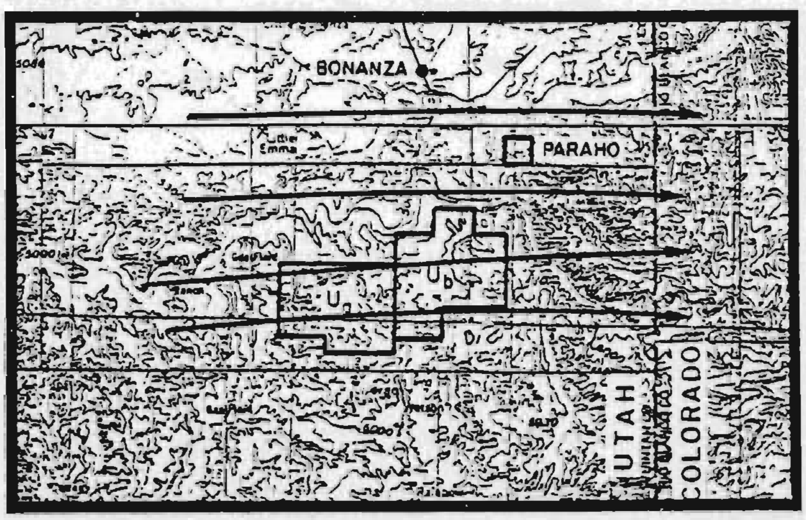
Figure 4.5-8 displays the five-year average hourly wind speeds for January and July at Site A7 (closest to the Paraho tract). The January speeds are practically the same throughout the day. The wind speeds reach an average peak of about 11 mph between 1400 and 1600 hours during July.



a. drainage



b. transitional



c. synoptic

FIGURE 4.5-7. Typical flow patterns in the study area.

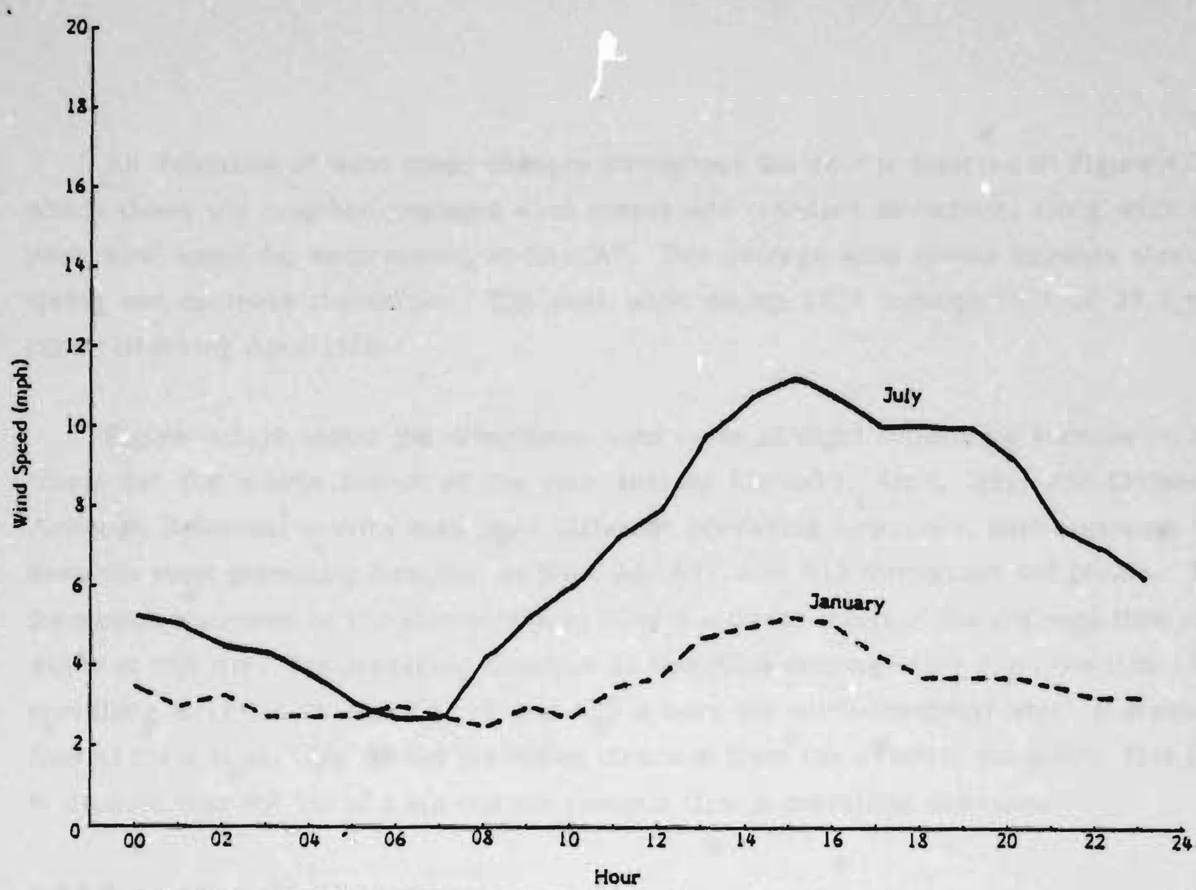


FIGURE 4.5-8. Diurnal variation of mean wind speed during January and July 1975-1976 at Site A7.

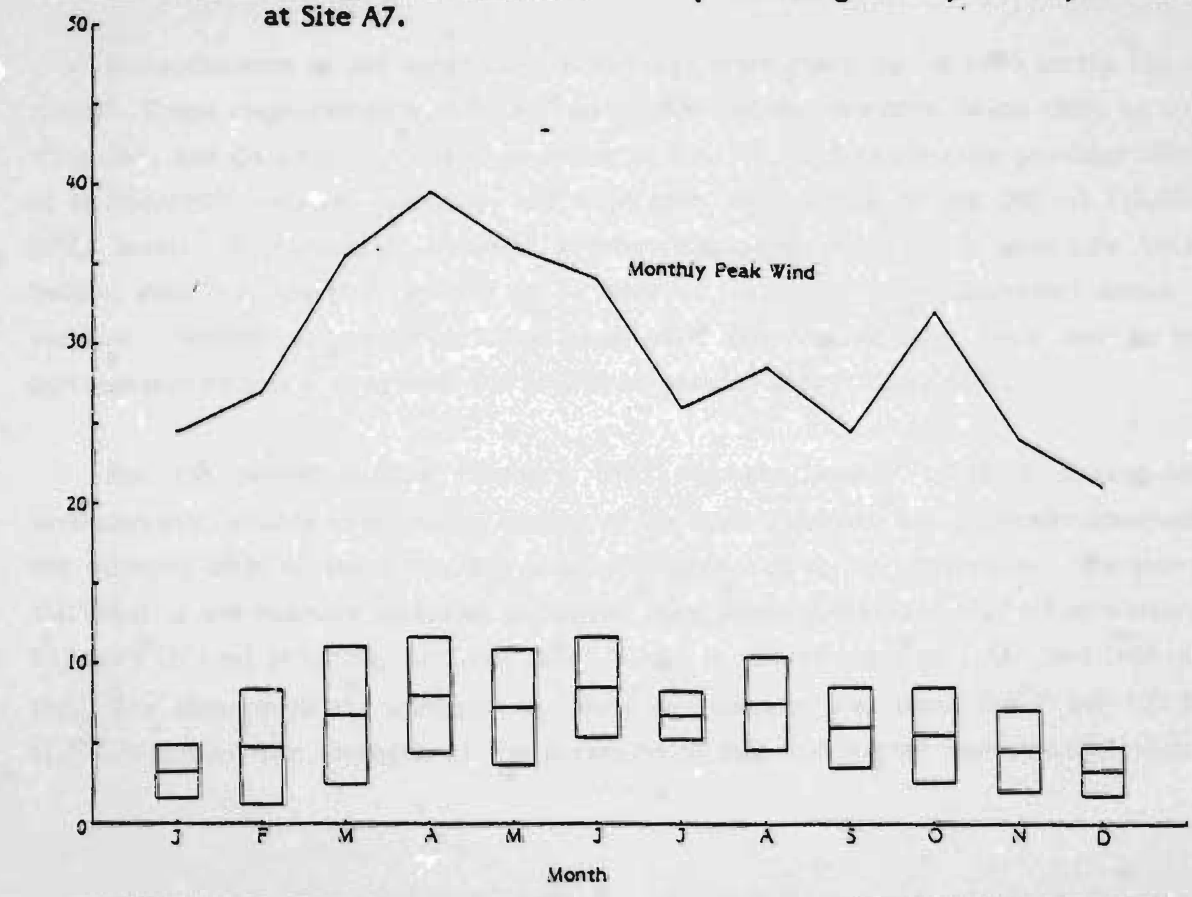


FIGURE 4.5-9. Monthly mean and peak winds speeds at Site A7 during 1975-1976.

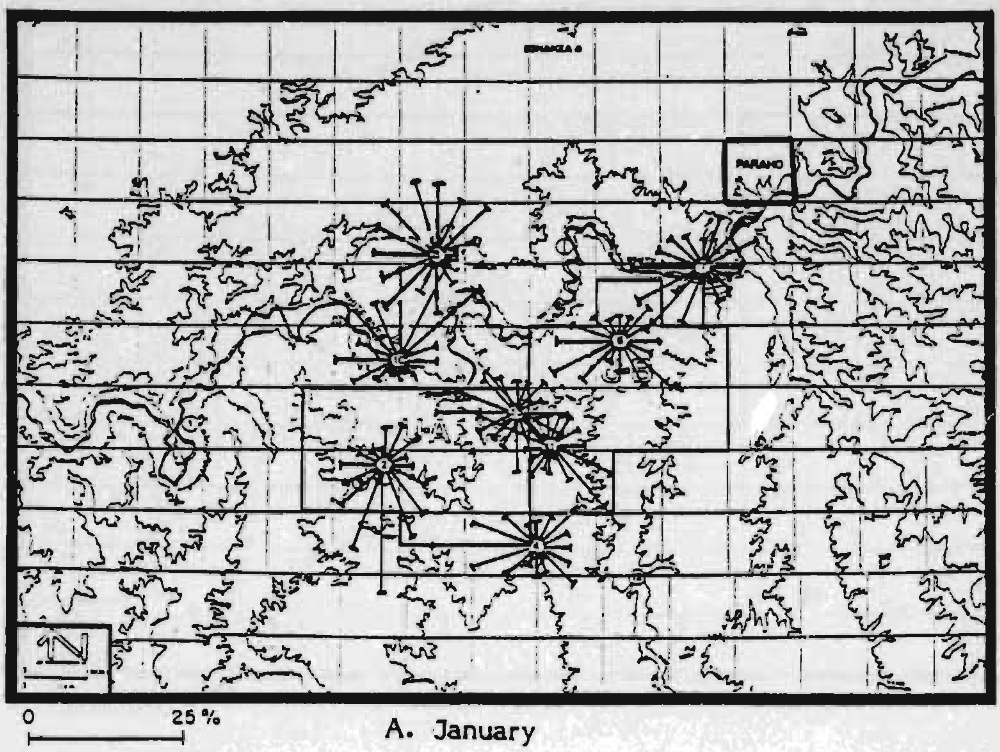
An indication of wind speed changes throughout the year is depicted on Figure 4.5-9 which shows the monthly-averaged wind speeds and standard deviations, along with the peak wind speed for each month, at Site. A7. The average wind speeds increase through spring and decrease thereafter. The peak wind during 1975 through 1979 of 39.5 mph occurred during April 1976.

Figure 4.5-10 shows the directional wind roses at eight monitoring stations on the tracts for the middle month of the four seasons (January, April, July, and October). Although individual months may show different prevailing directions, east-southeast has been the most prevailing direction at Sites A6, A11, and A13 throughout the period. The frequent occurrence of the east-southeast wind is a direct result of the drainage flow that exists at this site. The prevailing direction at Site A2 is drainage flow from the site. The prevailing direction at sites A7, A3, and A10 is from the north-northeast which is drainage flow at these sites. Site A4 has prevailing direction from the westerly quadrant. This site is situated near the top of a hill and the synoptic flow is prevailing direction.

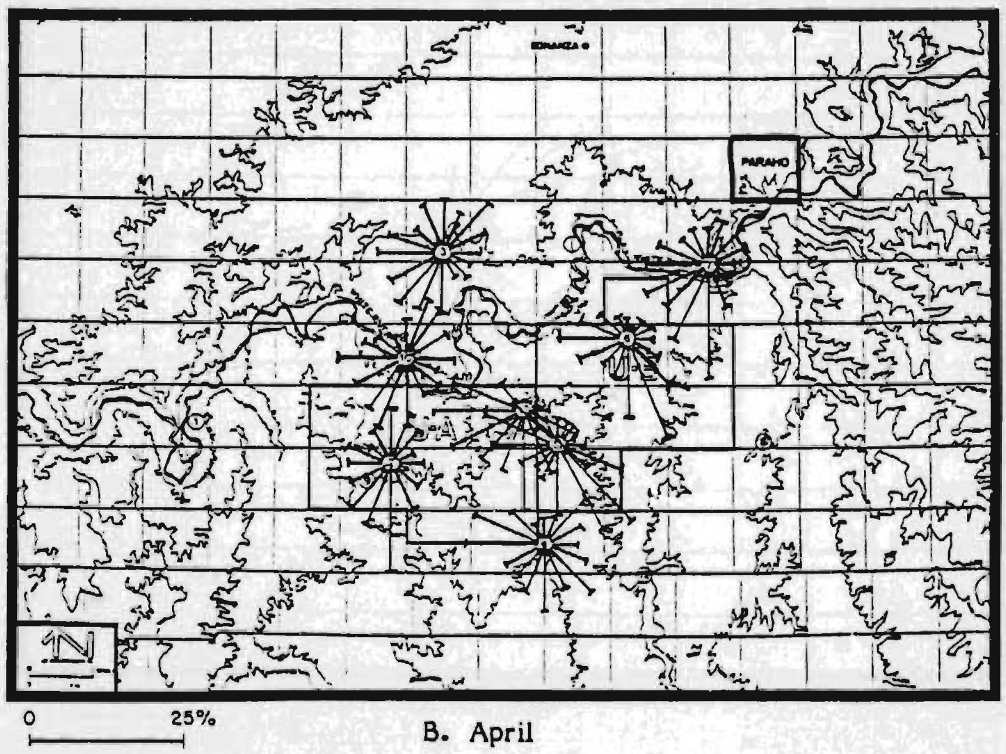
4.5.2.2 Upper Air Meteorology

Measurements of the upper air meteorology were made during 1975 on the Ua - Ub tracts. These measurements included rawinsonde balloon launches twice daily on every sixth day, and continuous acoustic sounding at Site A6. The rawinsonde provided records of temperature, relative humidity, and wind from the surface to the 500 mb (18,000 ft MSL) level. A monostatic acoustic sounder displayed atmospheric structure (mixing height, stability, thermal plumes) up to about a half-mile (one kilometer) above the surface. Additional bistatic records taken on a less regular basis were used to show atmospheric turbulence between 650 ft (200 m) and 1,500 ft (450 m) AGL.

For the period studied (January 1975 through January 1976), a surface-based inversion attributable to nocturnal cooling of the earth's surface was generally observed in the morning 94% of the time, and usually disappeared in the afternoon. The average thickness of the morning inversion increased from about 1,696 feet (517 m) in winter, to 912 feet (278 m) in spring, to 1,187 feet (362 m) in summer, and to 1,587 feet (484 m) in fall. The strength of the inversion in spring and summer was about 0.8°F per 100 feet (1.5°C/100 m). The strength of the inversion in fall and winter was stronger with an

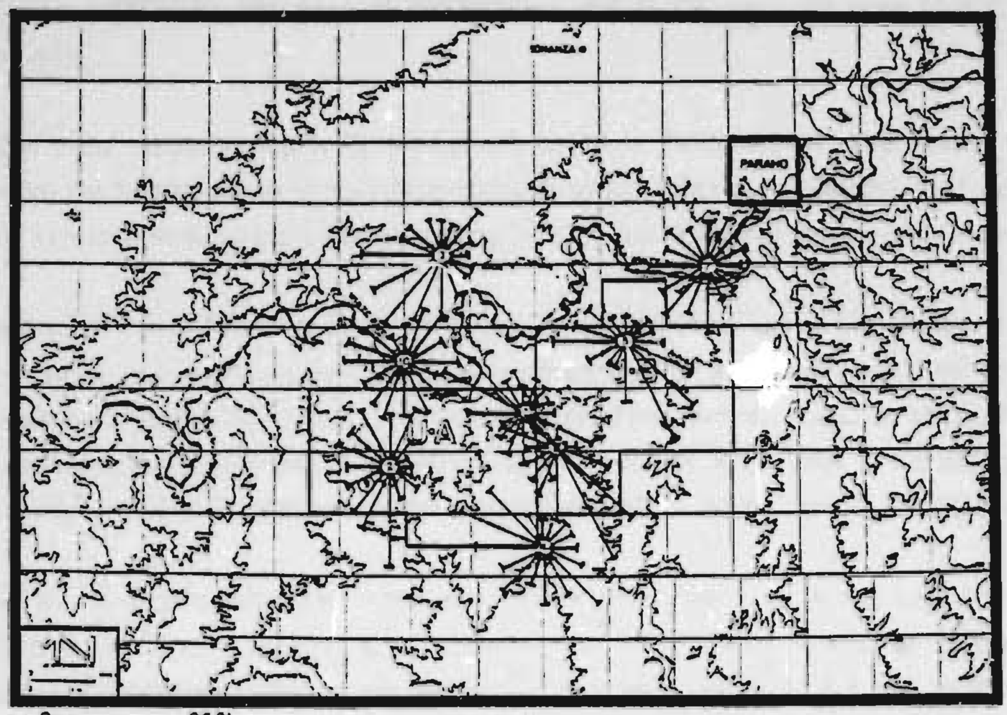


A. January



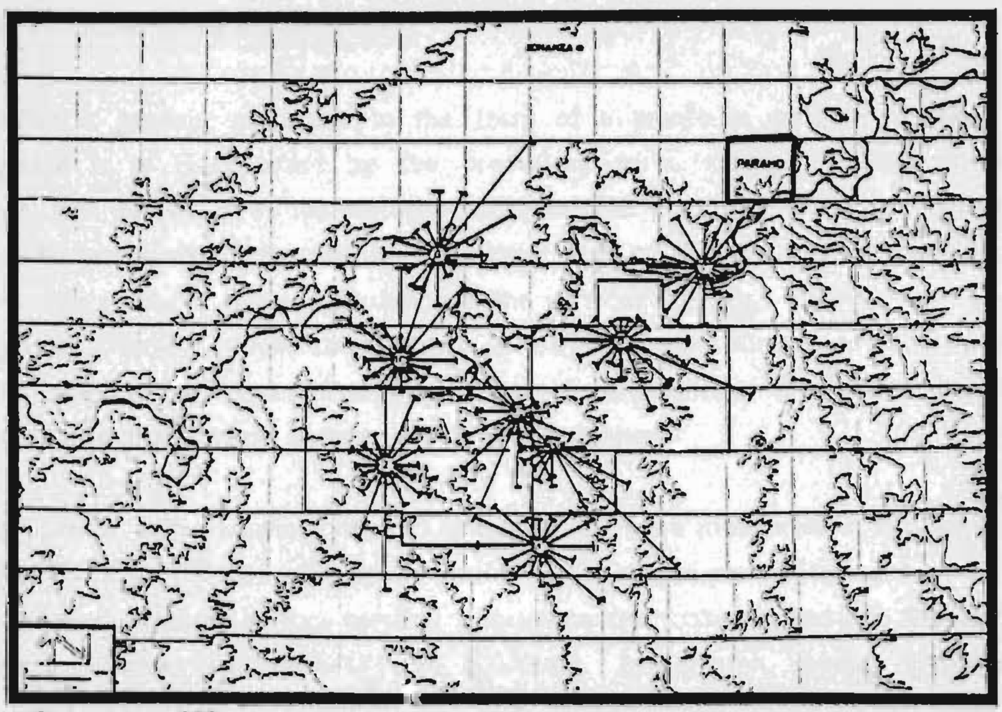
B. April

FIGURE 4.5-10. Directional wind roses. The length of each bar represents the frequency of winds from the direction toward which the bar points.



0 25%

C. July



0 25%

D. October

FIGURE 4.5-10. (Continued)

average of 1.0°F per 100 feet (3.1°C/100 m) and 0.9°F per 100 feet (0.9°C/100 m), respectively.

The mean mixing heights by season are listed in Table 4.5-3. The mixing height is defined as the height above the surface through which relatively vigorous vertical mixing occurs. The lowest day-long average mixing heights occur during the winter season.

Relative humidity in the lower half-mile (one kilometer) above the ground was about 70 percent in the morning and about 50 percent in the afternoon, with no significant change from February to April. In July, the relative humidity in the lower half-mile decreased to about 50 percent in the morning and to about 30 percent in the afternoon. In October, it was about 40 percent in the morning and about 35 percent in the afternoon.

In the first half-mile above the ground, the winds were quite variable from day to day. Above this first half-mile, winds were usually from the west, with an average speed of about 17.9 mph during the winter and spring quarters and about 8.9 mph in the summer and fall.

4.5.2.3 Dispersion Characteristics

When a gaseous pollutant in the form of a plume or puff is released into the atmosphere it is transported by the prevailing wind. As it travels downwind its concentration decreases as the pollutant diffuses into the surrounding air. The growth of the volume occupied by the pollutant is determined by the strength of the turbulence in the air. The strength of the turbulence in the vertical direction is governed mainly by the atmospheric stability, while its strength in the horizontal direction depends upon both stability and on the mechanical generation of turbulence. Mechanical turbulence is defined as irregular airflow induced by surface roughness.

A number of parameters related to diffusivity were measured on the Ua - Ub tracts during 1975-1979. Besides wind speed and direction, these parameters are σ_θ, a measure of the lateral turbulence; σ_ω, vertical turbulence fluctuations; and ΔT, the temperature difference between two levels (33 and 100-feet). In addition, special diffusion experiments were performed in February and June 1975 in which smoke plumes were released from 300 ft (90 m), and actual diffusion measured by aircraft probing.

TABLE 4.5-3. Mean mixing heights (feet) over the Paraho tract.

Season	Morning	Afternoon
Winter	1,050	3,542
Spring	1,800	9,500
Summer	985	12,790
Fall	820	6,750
Annual	1,164	8,145

Source: Holzworth, 1972

Using σ_θ data at Site A6, the frequency distribution of different "diffusion" classes (often called "stability" classes) has been computed and is presented in Table 4.5-4. During each of the years analyzed (1975-1979), diffusion Classes D and E were the most prevalent on the tracts.

A complete dispersion picture must also include the effect of plume rise. The meteorological parameters that most greatly influence the height of a plume are atmospheric stability and wind speed. Vertical atmospheric stability can be best defined by ΔT data. Figure 4.5-11 presents the average diurnal variation of ΔT at Site A6 during January and July for 1977-1979. Very stable or slightly stable atmospheric conditions prevailed in early morning and evening hours during January and July, with stability lasting into the late morning in January. In the afternoon, neutral or unstable conditions were a general rule.

The frequency distribution of stabilities during 1977-1979 based on ΔT appears in Table 4.5-5. This table shows that unstable or neutral conditions are the most frequent conditions during all seasons, especially spring. Very stable conditions occurred least often during spring and more often in the fall and winter.

4.5.3 Air Quality

Factors which reduce the quality of the air include gaseous and particulate air contaminants. Standards, referred to as the National Ambient Air Quality Standards (NAAQS), to protect health have been developed for a number of pollutants. These standards are given in Table 4.5-6. The state of Utah has adopted these standards, so no different state standards exist. Recently a new Federal 1-hour standard for CO of 25 mg/m^3 was proposed and is presently in draft stages. Also, a 1-hour Federal standard for NO_2 is being considered and legislation is pending.

Other values, such as aesthetics, can also be important. The main effect air contaminants have on aesthetics is in their impact on visibility. Although no standards currently exist in Utah for visibility, the Environmental Protection Agency (EPA) has promulgated proposed regulations for Visibility Protection for Federal Class I Areas (45FR101, pp 34762-34779, 22 May 1980). These proposed regulations would require the State of Utah to address visibility protection in its State Implementation Plan (SIP).

TABLE 4.5-4. Relative frequency distribution (%) of diffusion classes at Site A6, using σ_θ to define the class.

Period	Season	Diffusion Classes						
		Unstable			Neutral	Slightly Stable	Very Stable	Total Number of Observations
		A	B	C	D	E	F	
June 1975	Winter	0.4	1.3	6.7	27.6	48.9	15.1	8,378
through	Spring	0.4	2.2	10.1	28.8	50.2	8.3	8,829
Dec. 1979	Summer	0.8	3.1	12.2	37.2	41.3	5.4	10,239
	Fall	0.5	1.7	10.3	32.3	40.9	14.3	10,294

* Basis: Atomic Energy Commission (1972): Safety guides for water cooled nuclear power plants. NRC Regulatory Guide 1.23.

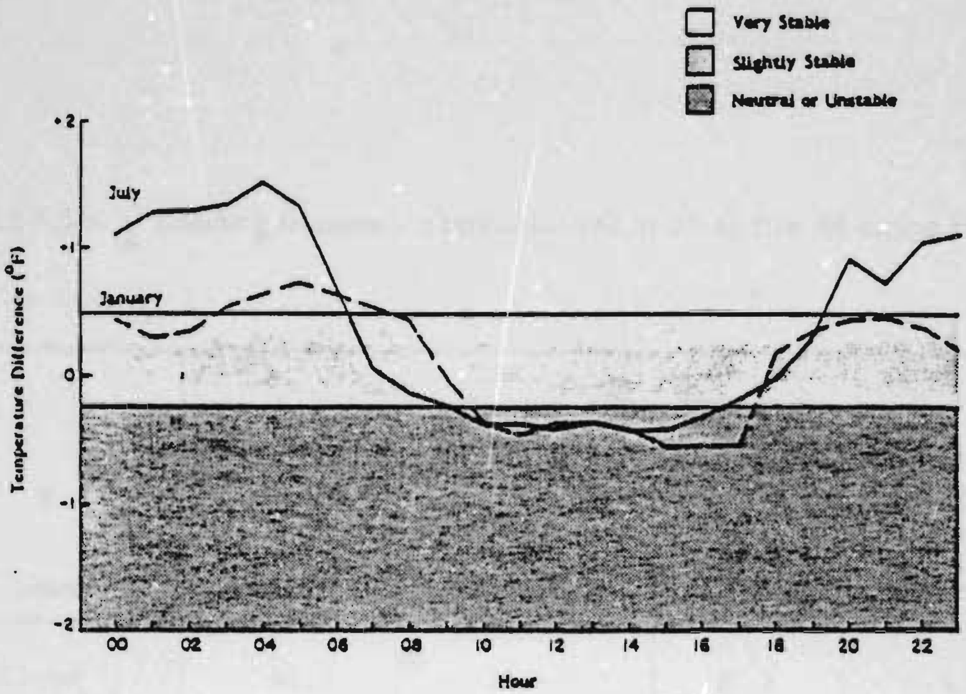


FIGURE 4.5-11. Diurnal variation of the mean ΔT at Site A6 in January and July from 1977 through 1979.

TABLE 4.5-5. Relative frequency distribution (%) of ΔT at Site A6 during 1977-1979.

Season	Stability (ΔT in °F/1000-ft) Unstable or Neutral (<-2.74)	Slightly Stable (-2.74 to 8.22)	Very Stable (>8.22)	Total Number of Observations
Winter	41.3	21.4	37.3	6,404
Spring	46.3	28.0	25.7	6,210
Summer	37.7	26.3	36.0	6,542
Fall	43.3	18.0	38.7	6,552
All Year	42.1	23.5	34.4	25,708

TABLE 4.5-6. National ambient air quality standards for gaseous pollutants. (State standards for Utah are the same.)

Pollutant	Averaging Time	Primary Standards	Secondary Standards
Ozone (O_3)	1-hour *	240 µg/m^3 (0.12 ppm)	Same as primary
Carbon Monoxide (CO)	8-hour *	10 mg/m^3 (9 ppm)	Same as primary
	1-hour *	40 mg/m^3 ** (35 ppm)	Same as primary
Sulfur Dioxide (SO_2)	annual	80 µg/m^3 (0.03 ppm)	-
	24-hour *	365 µg/m^3 (0.14 ppm)	-
	3-hour *	-	1300 µg/m^3 (0.5 ppm)
Nitrogen Dioxide (NO_2)	annual average	100 µg/m^3 (0.05 ppm)	Same as primary
Hydrocarbons (corrected for methane - NMHC)	3-hour (6-9 a.m.)	160 µg/m^3 (0.24 ppm)	Same as primary
Suspended Particulate Matter	annual geometric mean	75 µg/m^3	60 µg/m^3
	24-hour *	260 µg/m^3	150 µg/m^3

* Not to be exceeded more than once per year.

Concentration expressed first in units in which it was promulgated. Equivalent units given in parentheses are based upon a reference temperature of 25°C and a reference pressure of 760 mm of mercury. All measurements of air quality are to be corrected to these references. ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas.

** A new 1-hour federal CO standard of 25 mg/m^3 was recently proposed.

These topics will be discussed in this section as they relate to concentrations measured in the Ua - Ub tracts area. Because of the proximity of the Ua - Ub tracts to the Paraho tract, the remoteness of these tracts from any significant air pollutant emitting source, and the homogeneity of air pollutants in a pristine environment, data collected on the Ua - Ub tracts should be representative of the air quality on the Paraho tract.

4.5.3.1 Gaseous Pollutants

Like the meteorological parameters, air quality was measured at a number of locations during 1975-1979 in this northeastern region of Utah. A brief description of the general air quality in the area is discussed here. Gaseous air quality parameters measured included sulfur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3), hydrocarbons (HC) and carbon monoxide (CO). Concentrations for most of these pollutants were generally very low and were fairly uniform over the entire area.

Non-Methane Hydrocarbons

The only one of these pollutants which exceeded any of the NAAQS was non-methane hydrocarbons (NMHC). However, this standard was developed as a guideline for the control of ozone pollution in urban areas, and not as a health standard. High NMHC values are frequently observed in remote areas, and the high levels in this region are not uncommon.

Ozone

The only other gaseous pollutant found in significant amounts was ozone. The highest amount of O_3 measured in this area was 190 $\mu g/m^3$ in the spring of 1975 at a site which was operated during 1975 and 1976. The peaks and averages for the one site with a complete five-year data set is given in Table 4.5-7. These values are below the Federal Standard of 240 $\mu g/m^3$.

The monthly average ozone trend during the five years is shown in Figure 4.5-12. The highest monthly average of 97 $\mu g/m^3$ occurred in February 1979. In general, the

TABLE 4.5-7. Highest, second highest, and average one-hour O_3 readings ($\mu g/m^3$) for each season at Site A6 (1975-1979) (standard - 240 $\mu g/m^3$).

Season	Highest Concentration	2nd Highest Concentration	Average
Winter	150	150	67
Spring	160	160	75
Summer	160	160	75
Fall	150	140	57

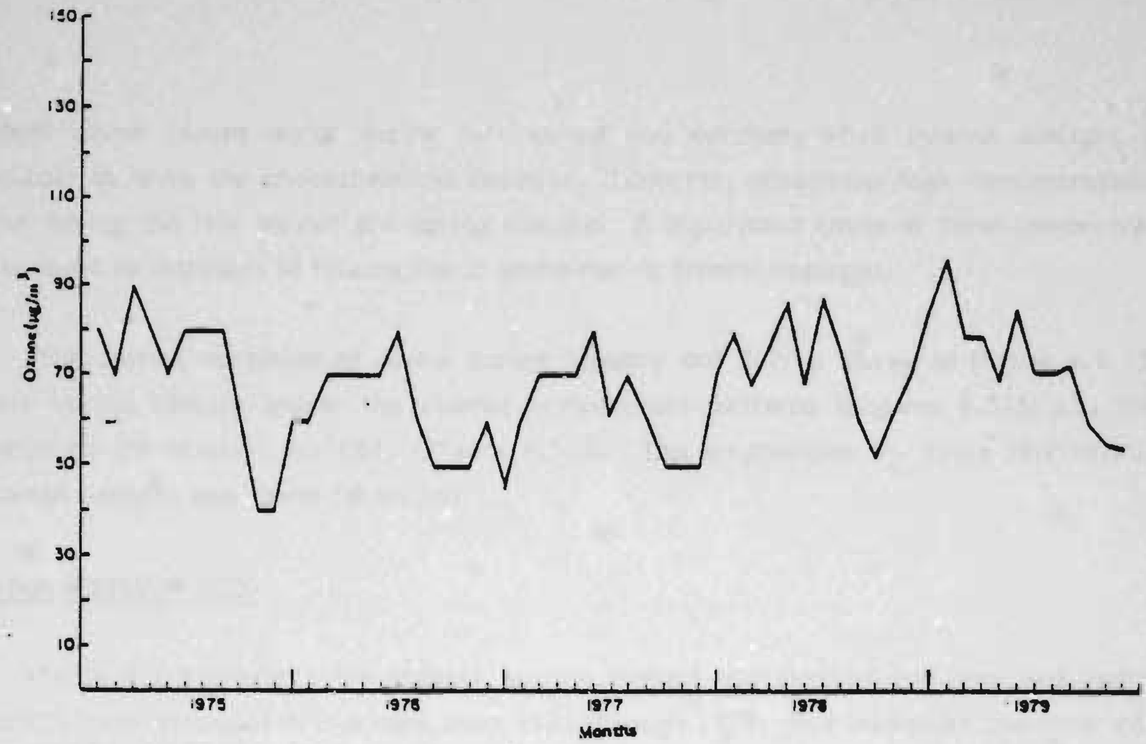


FIGURE 4.5-12. Trend of monthly average ozone at Site A6 from February 1975 - December 1979.

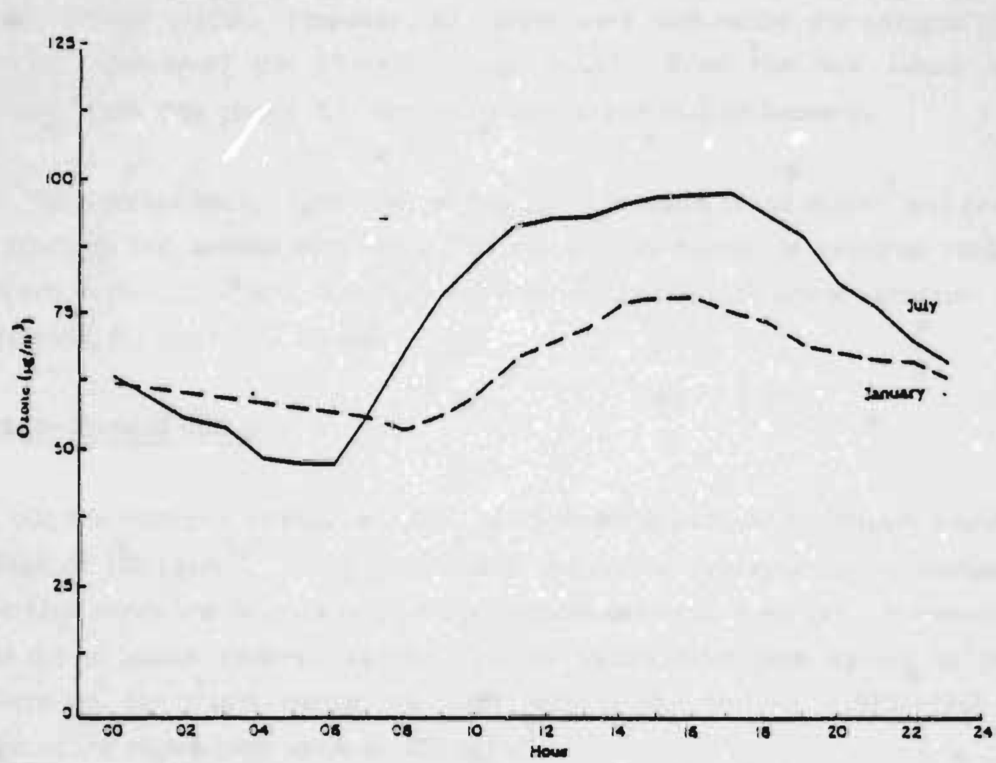


FIGURE 4.5-13. Diurnal variation of mean ozone concentrations at Site A6 during January and July 1975 - 1979.

highest ozone values occur during late spring and summer, when intense sunlight is available to drive the photochemical reaction. However, occasional high concentrations occur during the late winter and spring months. A significant cause of these concentrations could be intrusion of stratospheric ozone during frontal passages.

The diurnal variation of ozone during January and July is shown in Figure 4.5-13. These curves closely follow the diurnal temperature patterns (Figures 4.5-3) and the inverse of the relative humidity (Figure 4.5-5). This emphasizes the close relationship between sunlight and ozone formation.

Carbon Monoxide (CO)

Table 4.5-8 presents the highest, second highest and average one-hour and eight-hour CO concentrations in this area from 1975 through 1979. The maximum one-hour was 3.0 mg/m^3 in 1975 and the maximum eight-hour reading was 1.8 mg/m^3 in 1976. These values occurred early in the monitoring program when there was considerably more activity on the tracts. However, all values were well-below the national standards of 40 mg/m^3 (one-hour) and 10 mg/m^3 (eight-hour). When the new 1-hour standard of 25 mg/m^3 goes into effect, CO concentrations should still be below it.

The average background level on the Ua - Ub tracts is 0.2 mg/m^3 and practically all the readings fall around and below this value. No diurnal or seasonal variations were observed in the CO levels. Readings were generally near the lower detection limit of the instrument, 0.1 mg/m^3 (0.1 ppm).

Nitrogen Dioxide (NO_2)

Of the nitrogen oxides, only NO_2 has a Federal ambient air quality standard (annual average of 100 $\mu g/m^3$). Table 4.5-9 shows the annual averages during monitoring. This table also shows the highest and second highest one-hour averages. Proposals have been made for a 1-hour Federal standard, but no values have been agreed to yet. Again, activity on the tracts during the first part of the program (1975-1976) could have produced the high 1-hour value of 100 $\mu g/m^3$.

TABLE 4.5-8. Highest, second highest, and average 1-hour and 8-hour CO reading (mg/m^3) for the years 1975-1979 at Site A6 (standards 40 mg/m^3 for 1-hour and 10 mg/m^3 for 8-hour.

		1975	1976	1977	1978	1979
1-hour	Highest	3.0	3.0	1.0	0.7	1.8
	Second Highest	2.0	2.7	0.9	0.6	0.9
	Average	0.2	0.2	0.2	0.1	0.1
8-hour	Highest	1.3	1.8	0.6	0.4	0.4
	Second Highest	0.7	1.7	0.6	0.4	0.4
	Average	0.2	0.2	0.2	0.1	0.1

TABLE 4.5-9. Highest and second highest 1-hour NO_2 readings and annual averages ($\mu g/m^3$) for the years 1975-1979 at Site A6 (annual standard = 100 $\mu g/m^3$).

	1975	1976	1977	1978	1979
Highest	100	70	10	15	30
Second Highest	80	50	10	13	26
Annual Averages	6	5	0	1	2

The precision of the instrument is around 20 μg/m^3 and readings are generally near the lower detection limit of this instrument (4 μg/m^3).

Sulfur Dioxide (SO_2)

Table 4.5-10 gives the highest, second highest, and average of both the three-hour and 24-hour readings of SO_2 from 1975 through 1979. No seasonal or diurnal trend has been evident and most values are less than 10 μg/m^3 (4 ppb). The highest three-hour SO_2 reading of 94 μg/m^3 was recorded during the fall of 1979. The standard for a three-hour averaging time is 1,300 μg/m^3. The highest 24-hour SO_2 reading was 14 μg/m^3 and was recorded during the fall 1978. Again, this reading is well below the 24-hour standard of 365 μg/m^3. The annual average on the tracts is from 1 μg/m^3 to 2 μg/m^3 as compared to the annual standard of 80 μg/m^3. Most values have been near or below the detection limit of the instrument (25 μg/m^3).

Summary

Most gaseous pollutant concentrations were very low, often near the detection threshold of the instrument, and well-below any applicable standards. To show comparison with standards, the peak pollutant readings for the various time averages are given in Table 4.5-11. Although some of the peaks were measured at sites which only operated during the first two years, the peak concentrations measured at A6 (which operated all five years) were either nearly the same or much lower during the last three years than concentrations at that location during the first two. Also, activity on the tracts was much greater during the first two years, so most of the peak concentrations occurred during this period. Therefore, these concentrations probably represent the peaks for all sites during the five years.

Annual averages at A6 for each of the five years for each pollutant are given in Table 4.5-12. The background air quality at the Paraho site can best be represented by the five-year averaged pollutant concentrations measured at Site A6. Thus, the background values for O_3, CO, NO_2, and SO_2 are 66 μg/m^3, 0.2 mg/m^3, 3 μg/m^3, and 1 μg/m^3 respectively. Generally, the annual averages of all pollutants, except ozone, have decreased since the 1975-1976 period when on-tract activities were higher than

TABLE 4.5-10. Highest, second highest, and average 3-hour and 24-hour SO_2 readings ($\mu g/m^3$) for the years 1975-1979 at Site A6 (standards = 3-hour, 1300 $\mu g/m^3$; 24-hour, 365 $\mu g/m^3$; annual, 80 $\mu g/m^3$).

		1975	1976	1977	1978	1979
3-hour	Highest	15	5	15	27	94
	Second Highest	15	5	10	19	57
	Average	3	0	1	7	2
24-hour	Highest	10	0	10	14	12
	Second Highest	10	0	5	13	7
	Average	3	0	1	6	1

TABLE 4.5-11. Peak concentration values for all sites measured on the tracts during 1975 - 1979 for each of the pollutants and averaging times.

Pollutant	Averaging Time	Peak	Standard ($\mu g/m^3$)
SO_2	3-hour	94 $\mu g/m^3$	1300*
	24-hour	25 $\mu g/m^3$	365
CO	1-hour	5.2 mg/m^3	40
	8-hour	3.9 mg/m^3	10
NO_2	Annual	6 $\mu g/m^3$	100
O_3	1-hour	190 $\mu g/m^3$	240

*Secondary Standard

TABLE 4.5-12 The annual averages ($\mu g/m^3$) for the gaseous pollutants during the entire period of 1975 - 1979 at Site A6.

Pollutant	Annual Averages					Five Year Average
	1975	1976	1977	1978	1979	
O_3	75	63	61	58	74	66
CO (mg/m^3)	.3	.2	.2	.1	.1	.2
NO_2	6	5	0	1	2	3
SO_2	3	0	0	3	1	1

during the last three years. The variability of ozone from year to year is mainly due to changes in meteorological conditions and not to changes in activity on the tract.

4.5.3.2 Particulates

Particulates were measured for 24 hours every sixth day at a number of sites in the vicinity of the Paraho property during 1975-1979. Also, size-fractionated particulate samples were collected every month during the first two years at A2 and analyzed for trace elements. The trace constituents can be a valuable indication of the source of the particulates measured, since soil particles and combustion particles have different chemical make-up.

Table 4.5-13 shows the geometric means and maximum particulate concentrations measured at A6. The highest 24-hour average particulate concentration observed on the tracts was 127.4 $\mu g/m^3$ at a site on the riverbed in the fall of 1975. The highest annual geometric mean was 24.5 $\mu g/m^3$ at Site A6, also for 1975. These peaks are most likely due to the more frequent human activity (drilling, driving, monitoring, etc.) in the area during the initial years. None of these values exceeded even the secondary standards for annual (60 $\mu g/m^3$) or daily (150 $\mu g/m^3$) averaging times.

In general, particulate concentrations were lower in the winter due to snow cover and moisture, and higher in the summer and fall. The main sources were most likely wind erosion and fugitive dust from dirt roads. The particulate trend over this period shows a decrease with the annual mean in 1979 being almost one half of the 1975 value. This is most likely due to decreased activity on the tracts, decreased mining activities nearby, and increased winter storminess during the last two years.

Trace element analysis showed that, except for the normal soil constituents, most elements were at very low concentrations (<10 ng/m^2). Concentrations of the typical anthropogenic aerosol constituents usually found in cities were very low, showing that the source of the particulate is generally natural.

Background TSP value at the Paraho property can best be represented by the five-year average measured at Site A6 which is 19.5 $\mu g/m^3$.

TABLE 4.5-13. Geometric Means and Maximum Daily Averages for particulates at Site A6 during 1975 - 1979.

Season	Geometric Means				
	1975	1976	1977	1978	1979
Winter	-	14.2	13.2	7.2	9.2
Spring	17.2	17.2	22.2	14.2	8.1
Summer	39.2	34.8	27.6	27.2	19.0
Fall	17.2	37.1	22.9	21.3	16.4
Annual	24.5	23.5	22.2	15.0	12.5
	Maximum 24-hour Averages				
Winter	-	51.9	32.6	13.0	19.6
Spring	52.0	45.1	58.3	47.7	34.3
Summer	74.7	63.9	47.2	45.2	[illegible]
Fall	52.8	101.2	51.4	62.7	52.9

4.5.3.3 Visibility

Visibility was measured on the Ua - Ub tracts by photographs and the scattering of light by airborne particles. The latter measurement was at a wavelength of light of approximately 500 nm.

Diurnally, the lowest visibilities (highest scattering) were generally observed during the stable night and early morning hours. During the afternoon, when wind and human activities would tend to increase the dust emisssions into the air, better ventilation and mixing tended to counteract any visibility degradation.

Seasonally, the best visibilities were observed during the winter, when snow cover suppressed the dust. The lowest scattering (best visibility) observed in 1975-1976 was $b_s = 0.02 \times 10^{-3} m^{-1}$, which roughly corresponds to a local visual range of 150 miles (235 km). The minimum visual range of 18 miles (29 km) was measured in the spring ($b_s = 0.10 \times 10^{-3} m^{-1}$). The average visual range in 1975 was much lower than in 1976, with averages of 64 miles (103 km) and 81 miles (131 km), respectively. Since very small increases in atmospheric fine particulate matter concentrations have a strong impact on the visibility in clean areas, this large difference is most probably a consequence of human activity near the monitoring station during the first year of monitoring. Seasonal visual ranges are given in Table 4.5-14. In general, these readings correspond to very good visibility, with a lack of human-caused haze in the area.

TABLE 4.5-14. Maximum, minimum, and average local visual range values (in miles) on the Ua - Ub tracts during 1975-1976.

	Maximum	Minimum	Average	No. of Observations
Winter	150	29	70	3,778
Spring	150	18	78	3,805
Summer	150	27	65	3,807
Fall	150	31	89	4,345

4.6 Ecology

4.6.1 Terrestrial

4.6.1.1 General Ecology of the Region

The proposed project and associated corridors lie within the eastern portion of the Uinta Basin which is located in northeast Utah. The topography of the area is characterized by generally flat plains, broken by occasional ridges and dissected by steep-sided streambeds. The project area itself (Section 32) is on a gently sloping plain that extends from the northwest to the project area where it is cut by the White River. The project area, access road and powerline corridors lie between 5,400 and 5,600 feet elevation with the exception of the southeastern edge of the project site which drops from 5,400 to 5,000 feet along the steep bank of the White River.

Vegetation in the region can be characterized as a salt desert shrub typical of the Uinta Basin. Four major vegetation types that occur within this region are riparian, juniper, sagebrush and shadscale. The riparian community is restricted to areas along permanent water, notably the White River. The juniper community occurs in higher elevations where soils are generally thin and poorly formed. The sagebrush and shadscale associations occur in areas of relatively low relief.

The wildlife resources found in the region are typical of those found in salt desert shrub lands throughout the Uinta Basin. The wildlife diversity is somewhat limited due to relatively sparse vegetation cover, lack of water, and domestic livestock use. Mammals found in the Uinta Basin include carnivores such as cougar, bobcat and coyote; large herbivores including elk, pronghorn and mule deer; as well as numerous smaller mammals such as desert cottontail rabbit, whitetail prairie dog and smaller rodents. The avian species in the Uinta

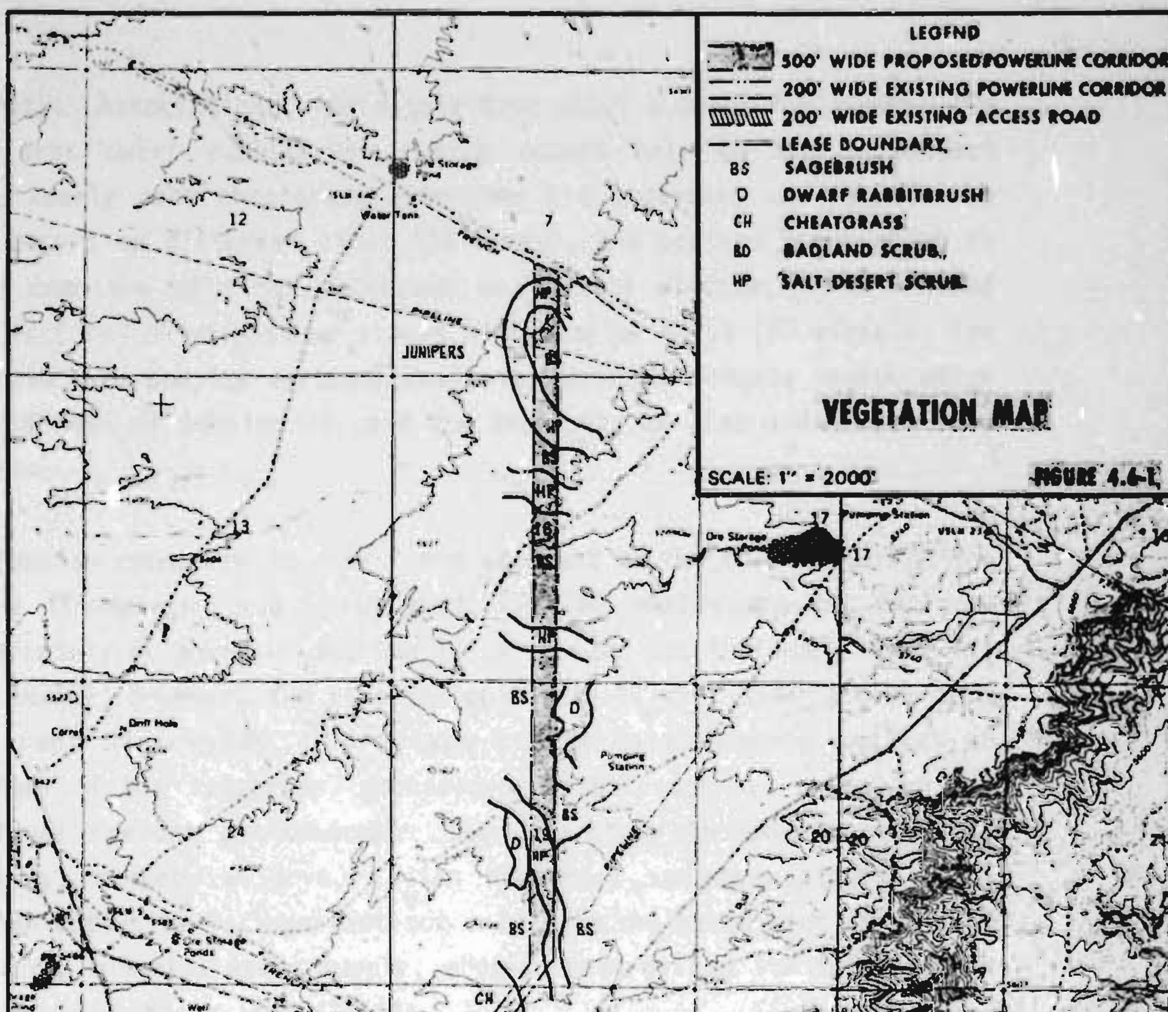
Basin include several raptor species such as golden eagle, bald eagle, prairie falcon, and red-tailed hawk; gamebirds such as Canada geese, sage grouse, and mourning doves; and a variety of smaller non-game birds. Amphibians and reptiles that are found throughout the Uinta Basin in suitable habitats include the leopard frog, the midget faded rattlesnake and the sagebrush lizard.

4.6.1.2 Vegetation of the Project Area

The major vegetational communities that occur on the Paraho site and nearby areas are shadscale shrub, sagebrush and riparian types. These are roughly equivalent, though not identical to the sagebrush/greasewood, shadscale and riparian community types identified on the Federal Prototype Oil Shale Lease Tracts U-a and U-b (VTN, 1977). The same principle species are found on the Paraho site but in somewhat different fequencies than in the previous study. Within the sagebrush community are several associations: dwarf rabbitbrush, pure cheatgrass and badland scrub as shown on the vegetation map, Figure 4.6-1.

The shadscale community covers about 125 acres or 20% of Section 32, mainly in slight depressions with relatively deep, well-drained soils. Big sagebrush, shadscale, greasewood, several species of rabbitbrush and spring hopsage are the dominant shrubs, with some winterfat, horsebrush, and snakeweed. Important understory grasses and forbs include halogeton, cheatgrass, Indian ricegrass, and bottlebrush squirreltail. The shadscale community also exists in the transmission line corridors in the low-lying areas where ephemeral stream courses coalesce.

In contrast, the sagebrush community is dominated much more by big sage and black sagebrush. It is found on the shallower and more skeletal soils on ridgetops and upper slopes and covers roughly 50% of the parcel or over 300 acres. Cheatgrass, rabbitbrush, shadscale, Russian thistle, and Indian ricegrass are other important species in this


LEGEND
500' WIDE PROPOSED POWERLINE CORRIDOR
200' WIDE EXISTING POWERLINE CORRIDOR
200' WIDE EXISTING ACCESS ROAD
LEASE BOUNDARY
BS SAGEBRUSH
D DWARF RABBITBRUSH
CH CHEATGRASS
BD BADLAND SCRUB
HP SALT DESERT SCRUB
VEGETATION MAP
SCALE: 1" = 2000'
FIGURE 4.6-1
JUNIPERS
Pumping Station
WHITE
N

community. Associations within this type which account for another 180 acres are: dwarf rabbitbrush, which occurs only on the shallowest soils, nearly pure cheatgrass with some big sagebrush and rabbitbrush which occurs on disturbed sites (30 acres), and badland scrub which is mostly composed of black sagebrush and salina wildrye. The badland scrub is found on very steep slopes with shallow soils (90 acres). The sagebrush type and its variants dominate the whole Bonanza region which includes most of Section 32, and the transmission line and access road corridors.

The riparian community is only found adjacent to the White River on the primary floodplain in a swath about 500-750 feet wide. It includes approximately 60 acres of Section 32 (which are not included in the oil shale lease); however, the riparian community is sufficiently important to warrant discussion. This type is the most diverse and has an overstory of big sagebrush, greasewood, rabbitbrush and saltcedar and occasional Fremont cottonwoods. The understory includes cheatgrass, saltgrass, rushes, wildrye, Indian ricegrass and many others. The riparian community is important not only from the standpoint of species diversity, but also water supply, erosion control and its interactions with aquatic biology and wildlife.

4.6.1.3 Domestic Animal Use of the Project Area

The Paraho lease area is owned and administered by the State of Utah which presently leases the grazing rights of Section 32 to Mr. Thomas Woodward as a part of a larger Federal allotment. Sheep are grazed between November and March and are allowed 90 animal unit months (AUMs*) of forage consumption. Since five sheep are equivalent to one AUM, 450 head of sheep are allowed for one month in Section 32 and then herded to other parts of the allotment. Most years there is an ample snow cover during the grazing season for water supply, but some years deep snow precludes grazing altogether.

*An AUM is the amount of forage a cow (with calf) will consume in one month; approximately 1,000 pounds in this area (Broadbent, 1980).

The species composition of the subject area is almost completely dominated by shrubs with a distinctive lack of perennial bunchgrasses in all but the lowest frequencies. Annual grasses and forbs are available in this area as forage only in the spring for six to eight weeks or less (Vallentine). The shrub layer in these community types therefore assumes a very important role in supplying usable forage for livestock as well as wildlife. Sheep are generally more adept at utilizing browse and forbs, having a higher preference for them than do cattle or horses (Stoddart, Smith and Box, 1975). They are grazed in the area almost exclusively except for the White River riparian zone, which is used as summer range for cattle (Tolman, 1980). Shadscale, winterfat, spring hopsage and black sage have the highest palatability; however, big sage is also utilized by sheep. Greasewood and rabbitbrush have low palatibility; ricegrass and squirreltail (except in summer) are desirable forage plants; while ryegrass and dried cheatgrass receive little use (Vallentine, n.d.). Plants found on the subject site which may be poisonous include greasewood, horsebrush, Astragalus, and halogeton which were all found in relative abundance. Halogeton may not be available in winter due to snow cover.

4.6.1.4 Past and Present Mangement Practices in the Project Area

The Paraho project area has been used traditionally as sheep winter range for 50 years or more (Wall, 1980). It may have been used at stocking rates (50-60% of usable forage) higher than prudent management practices would suggest.

The present range condition can be described as fair to poor based on the presence of poisonous plants (such as Astragalus and halogeton), invaders such as cheatgrass, and a low frequency of decreasers such as ricegrass. Surface erosion, large areas of bare ground and low levels of organic matter accumulation also indicate fair to poor condition. Few changes in species composition are apparent, suggesting a static range trend. Site limitations such as shallow, coarse-textured soils with low nutrient status, low precipitation and temperature extremes limit the ability of these ranges to withstand misuse during dry years. Their ability to recover from stress is also limited. The site now produces an estimated 250-450 pounds of growth per acre per year or 75-135 pounds of forage based on a proper use factor of 30% (Broadbent, 1980). This is somewhat less production than required to support the stocking rates presently allowed by the State of Utah (90 AUMs).

4.6.1.5 Prime and Unique Farmland in the Project Area

Central Uintah County has an arid climate with less than ten inches of precipitation on the project site. Coarse soil texture, low nutrient status, and shallow soil development eliminates much of the area as potential irrigation sites. The oil shale lease area can be described as Class VII_s for farmland and contains no prime or unique farmland.

4.6.1.6 Wildlife Resources of the Project Area

The project site supports or is utilized by wildlife species typical of the Uinta Basin. Species diversity on the site is not expected to be high as a result of the generally uniform habitat, relatively small area and historical disturbance in the area by sheep grazing. The project area is located within the northern third of the Utah Division of Wildlife Resources' (DWR) wildlife unit 28A.

Mammals

The principle mammal species found on or near the project site are typical of those found throughout the salt desert shrub type. Big game species consist of mule deer and antelope. Mule deer are found infrequently on the project site. During spring, occasional individuals can be seen in the area; during the winter individuals can be observed on warm southern slopes; during the remainder of the year the few deer in the region are confined to the river bottom habitat (Crannie, 1980).

Pronghorn antelope is the principle big game species found on the project site and associated corridors. The project site (Section 32) is on the edge of the Bonanza pronghorn herd area boundary and is generally covered with sagebrush, a favored forage plant (Smith, Beale and Doell, 1965). The project section is utilized by approximately 20-30 pronghorn. The powerline corridor is estimated to be utilized by 35-50 animals (Jenson, 1980; Crannie, 1980). The total antelope population in the Bonanza area is probably slightly greater than 175 individuals (Crannie, 1980). Since 1974, forty pronghorn buck hunting permits per year have been allowed for the Bonanza herd with an average take of 31 bucks (Utah DWR, 1979b).

Coyote, bobcat and mustelids (skunks and weasels) are expected to be the major carnivores on the project area. The numbers of these animals utilizing the project area and associated corridors fluctuates with the availability of prey species and is believed to be similar to comparable habitat throughout the region.

Rodent populations utilizing the project area include whitetail antelope squirrel, whitetail prairie dog and deer mouse. Rodent populations, which form the prey base of many local predators, have recently undergone a rapid decline in the general region and a similar decline in carnivore numbers is expected to follow (Crannie, 1980).

Birds

A variety of raptors occur throughout the project region and may utilize the project site to some extent. Red-tailed hawk, American kestrel and turkey vulture are seen frequently in the region and forage over the site (Jenson, 1980). During the summer months, prairie falcon and golden eagle nest in the region (and possibly on the site) and forage near or on the site. During the winter, goshawk are occasionally sighted along the White River in the vicinity of the project site (VTN, 1977). Bald eagle are relatively common along the White River (Crannie, 1980) (see section 4.6.1.7 for further discussion).

Gamebirds in the region are limited to mourning doves, Canada geese, sage grouse and migrating watefowl. Little use of the project site (except along the White River) is expected by waterfowl due to the lack of free water. Limited numbers of Canada geese nest and forage along the White River. Mourning dove forage and nest in the project area and associated corridors in numbers that are expected to be normal for the Bonanza region. Sage grouse are expected to utilize the project area and associated corridors; however, the extent of utilization is unknown.

Song birds and other nongame species typical of the Uinta Basin are expected to utilize the project area and associated corridor at population levels assumed to be typical for the region.

Reptiles and Amphibians

Reptiles occur in all four vegetation communities in the White River region. Six species of lizards and five species of snakes have been observed on Tracts U-a/U-b (VTN, 1977). Amphibians (frogs and salamanders) are found in the project area immediately adjacent to the White River.

4.6.1.7 Sensitive Species of the Project Area

Two recently discovered plant species (an undescribed Penstemon and Astragalus) have been located near the project site by biologists from the BLM, Vernal, Utah office. These species are currently under investigation by the BLM and may be recommended for threatened or endangered status if studies indicate that such status is appropriate. It is not currently known if these species actually occur on the lease area since 1980 vegetation investigations at the Paraho site were conducted too late in the season (August) to positively identify specimens.

Four wildlife species considered endangered by the USFWS and the State of Utah have been observed in the Uinta Basin. These are the black-footed ferret (Mustela nigripes), the American peregrine falcon (Falco peregrinus anatum), the bald eagle (Haliaeetus leucocephalus), and the whooping crane (Grus americanus). In addition, the golden eagle (Aquila chrysaetos), which is protected by Federal Law; the bobcat (Lynx rufus) which is currently protected by State Law; the sandhill crane (Grus canadensis) and the silverspot butterfly (Speyeria nokomis nokomis) which are considered limited by the State of Utah (Utah DWR, 1979a); are known to occur or have been sighted in the Uinta Basin.

Utah is on the western margin of the historic range of the black-footed ferret. There have been several reliable, but unverified sightings reported during 1972 to 1975 within the Uinta Basin (Utah DWR, 1979a). It is extremely unlikely that any individuals utilize the project site. However, the possibility exists since evidence of prairie dog (an important prey species) was found on the site during field observations conducted in August 1980.

Peregrine falcon are known to nest in the Uinta Basin (Crannie, 1980) and several confirmed peregrine falcon sightings were made in 1975 within several miles of the project site (VTN, 1977). Bald eagle winter along the White River in the general vicinity of the project in numbers of about 15 to 20 individuals per 10 miles of river. These eagles may occasionally forage in the project area; however, none have been observed nesting in the area.

Both whooping and sandhill cranes have been sighted passing over the project region during migration. It is unlikely that either species would utilize the project site during migration.

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The bobcat population levels in Utah have experienced a state-wide decline as a result of excessive harvest. However, Utah has provided total protection, and the state-wide population level seems to have stabilized. Bobcat probably utilize the project site to some extent dependent on prey availability.

4.6.2 Aquatic Ecology

4.6.2.1 Aquatic Habitat

The project site is located adjacent to the White River, which is the only permanent aquatic habitat in the area. The White River originates in Colorado and flows approximately 250 km (150 miles) before joining the Green River about 90 km (55 miles) west of the project area. The White River drainage includes about 10,000 km^2 (4,000 sq. mi.) and is one of the few areas in the region which does not have a major impoundment. The river has a base flow of about 10 m^3/s (350 cfs) from August through March. When snowmelt occurs, discharge may exceed 57 m^3/s (2,000 cfs) (VTN, 1977).

Cooperative studies between the Utah DWR, the BLM, the USFWS and VTN have resulted in investigation of the 59 mile reach of the White River from the Utah-Colorado border to the Green River confluence. Information from eight sampling stations in this reach indicates that the gradient ranges from 0.50 and 1.80 percent with an average of 1.08 percent. Pool-riffle ratios are nearly optimum, ranging from 7 to 82 with an average of 47.4 for all eight stations. Many of these pools were considered good to excellent for fisheries use due to their size and depth (Utah DWR, 1980).

The terrain along the White River from the Utah-Colorado boundary to the Green River is characterized by deep canyons and rolling hills. Riparian vegetation includes Fremont cottonwood, saltcedar, and an understory including big sagebrush, rabbitbrush, and greasewood. Riparian areas are generally overgrazed by cattle and sheep (Utah DWR, 1980).

The reach of the White River from the project site to its confluence with the Green River is a slow flowing, relatively warm river and is considered by the DWR as a Class IV stream; one that is poor in water quality, primarily due to high turbidity, and of limited game fishery value (Utah DWR, 1980).

4.6.2.2 Major Species

Macroinvertebrates

The White River near the project area supports a benthic macroinvertebrate fauna which is generally typical of medium-sized rivers of the intermountain area. In general, macroinvertebrate populations are more dense in autumn than in spring. A variety of species are highly specialized for this particular area and habitat. These populations are probably geographically isolated (Bauman, Gaufin and Wing, 1975).

In general, the distribution and abundance of most of the species appears directly related to the availability of hard, stable substrates. Similarly, productivity appears related to habitat diversity and the presence of stable rock substrates and generally decreases from the upper portion of the river to that near the confluence with the Green River, which is mostly sand and silt substrate (Bauman, Gaufin and Wing, 1975). The dominant groups of invertebrates - mayflies, caddisflies, black flies - are all detritivous and/or herbivores; no dominant organisms are predatory. This suggests that the system is largely heterotrophic (food for aquatic organisms comes from vegetation outside the stream).

Fishes

The White River from the Utah-Colorado boundary to the Green River is currently considered by DWR to be of minor importance to the game fishery resource of Utah (Utah DWR, 1980).

The results of collections along the Utah portion of the White River conducted by the DWR and others (VTN, 1977; Utah DWR, 1980) indicate that the White River from the project site to the Green River currently provides marginal habitat for many species which are known to inhabit the Upper Colorado River system.

Sampling conducted by the DWR in 1974 and 1975 at eight stations between the Utah-Colorado border and the Green River, produced a total of 11 species. The most abundant species captured were red shiner, speckled dace, flannelmouth sucker, and fathead minnow.

4.6.2.3 Species of Concern

The Colorado squawfish (Ptychocheilus lucius), which is listed as endangered by the USFWS, is known to occur in the White River upstream and downstream from the project area (Utah DWR, 1980). The White River from upstream of Meeker, Colorado to the Green River is considered potentially important habitat for squawfish (Joseph et. al., 1977). Several squawfish have recently been collected from the White River in Colorado near the confluence with Piceance Creek (Seethaler, 1978). During a fisheries study in 1978, six squawfish were captured from the lower 12.2 miles of the White River. During 1979 an adult squawfish was captured about six miles below the proposed White River Dam site and another adult squawfish was captured about one mile below the Bitter Creek confluence downstream from the project site (Utah DWR, 1980). No young fish have been reported in the White River during recent studies, which may indicate that the White River is not an important spawning area.

The White River from the Colorado border to the Green River is considered important habitat for the humpback chub (Gila cypha). This endangered chub has been collected near Bonanza, Utah (Sigler and Miller, 1963) and is the only documented specimen of this species collected from other than a large river environment (Joseph et. al., 1977).

Another endangered species, the bonytail chub (Gila elegans), has been identified as occuring in the Green River only. However, the White River in the immediate vicinity of its confluence with the Green River could provide important habitat for the bonytail chub (Joseph et. al., 1977).

The humpback (razorback) sucker (Xyrauchen taxanus), a candidate for listing as a threatened species by the USFWS, and protected by the State of Utah, may also occur in the lower portion of the White River (U.S. Fish and Wildlife Service, 1979).

4.7 Ambient Noise

There has been no noise data collected at the Paraho project site. However, data have been collected (White River Shale Project, 1976) on the nearby Federal Prototye Oil Shale Lease Tracts U-a and U-b. The characteristics of the two sites are virtually the same and since the tracts are less than 2 miles apart at their closest borders, use of U-a/U-b data for the Paraho site can be justified.

The site is located in a remote portion of northeastern Utah. The nearest town to the project is Bonanza, approximately 2.5 miles northwest. The area is expected to be relatively quiet due to the absence of major noise sources, except for jeep trails that have extremely low usage.

Sound level surveys were conducted on Tracts U-a/U-b three times between April, 1975, and January, 1976, using hand-held precision sound level meters. Meters were set on a filter to simulate human aural responses.

The survey concluded that during periods of calm, noise levels were 24-26 dBA. The major noise sources during these wind-free periods were insects. Measurements of sound in areas adjacent to the White River gave slightly higher values of 30 dBA.

Under windy conditions (wind speeds of 5 m/s [11 mph]) sound levels reached a maximum of 60 dBA. Measurements were conducted during April, August and January to obtain data on the variability of sound with season. No seasonal change greater than 2 dBA was recorded. Changes that did occur can be attributed to the lack of insects during January, the quietest month.

For reference, the threshold of hearing is 0 dBA, a quiet residential bedroom may be 25 to 30 dBA, and a quiet office may be 40 dBA.

Forested or grassy regions typically show 40 to 50 dBA in no-wind conditions. Thus, the sound environment on the project site is very quiet because of the limited water, vegetation, and human and animal activities there.

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